Antecedents and consequences of retirement:

The role of health, work-related stress, and education.

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Antecedents and consequences of retirement:
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Contents

Chapter 1: Introduction

1.1. Background and aim of this dissertation

All over the world populations are aging. The number of persons aged 65 and older in the world almost doubled from 383 million in 1990 to 703 million in 2019, and it is expected to reach 1.5 billion persons in 2050 (United Nations 2019). Because of population aging, the old-age to working age ratio [1] has increased by more than 50% in OECD countries from 1980 to 2020, and it is expected to double by 2060 (OECD 2019). The projected working-age population (aged 20–64) will decrease on average by 10% in OECD countries by 2060, which will have a significant impact on the financing of pay-as-you-go pension systems. At the same time, increases in life expectancy put additional pressure on social security and health systems as more people spend more years in retirement. Life expectancy after labor market exit at age 65 increased from 15.9 years in 1990 to 19.8 years on average in 2020 in OECD countries.

These trends pose new challenges to the financial sustainability of social security systems, as an aging and increasingly scarce workforce faces rising costs in statutory pension and health care systems. Thus, policymakers throughout Europe are implementing pension and labor market reforms aimed at delaying retirement and extending working lives and, consequently, securing public pensions and healthcare systems. These reforms include raising statutory retirement ages and reducing the options for early retirement (Hofäcker et al. 2015). Hence, it seems that these reforms are taking effect as effective retirement ages and older workers' employment rates are rising all over Europe, but the reforms have different starting points and different extents (Ebbinghaus and Hofäcker 2013). Nevertheless, in most European countries, the average effective retirement age is still below the statutory age. It ranges from a positive ratio in Sweden to less than a year in Finland, almost two years in Germany and Austria, and

[1] The number of people older than 65 years per 100 people of working age (20–64 years old).

more than four years in Italy and Belgium in 2018 (OECD 2018). Considering labor market exit, which also includes phases of unemployment or homemaking before retiring, this gap might be even larger.

Against this background, this dissertation examines the antecedents and consequences of retirement on three levels. Previous research has shown that on the individual, micro-level, a primary reason for early retirement is poor health (van den Berg, Elders, and Burdorf 2010; Fisher, Chaffee, and Sonnega 2016; van Rijn et al. 2014). Health, in turn, is influenced by exposure to the job environment, in which most persons spend a high proportion of their lives (Nyberg et al. 2013). However, the specific mechanisms by which work-related stress and health influence retirement are not known. Hence, on the micro-level, we find Research Question (1): How are work-related stress and health associated with retirement age in Germany? (see Figure 1). This question is answered in Chapter 2.

Retirement can also have serious consequences for individuals' health after work exit because work exit itself can be seen as a stressful life event which likely influences declines in memory (de Breij et al. 2019; Denier et al. 2017). Research has provided a mixed picture of this association without considering contextual country differences, although retirement opportunities and population health varies among European countries (Bianchini and Borella 2016; Bonsang, Adam, and Perelman 2012; Starke et al. 2019). Thus, Chapter 3 focuses on Research Question (2): How does retirement affect memory decline and does this association vary across 17 European countries? On the meso-level, the healthcare sector is of high societal relevance as the need for healthcare and long-term care will rise, but this rising demand is contrasted by a lack of skilled professionals due to hard physical and mental working conditions, especially in Germany (Leinonen et al. 2011). These conditions make it more difficult to achieve the new goal of extending working lives within the healthcare sector

compared to other sectors. Therefore, Chapter 4 answers Research Question (3): What influence does the healthcare sector have on retirement preferences in Germany?

On the institutional macro-level, policymakers all over Europe have implemented pension and labor market reforms aimed at delaying retirement. These measures risk exacerbating social inequality, as low- and higher-educated workers leave the labor market at different ages and for different reasons, potentially widening pension gaps (Radl 2013; Robroek et al. 2015). Little is known about the association between institutional characteristics and the social gradient in labor market exit (Carr et al. 2018; Schuring et al. 2019). This leads to Research Question (4): How are institutional factors associated with the social gradient in retirement? This question is answered in Chapter 5.

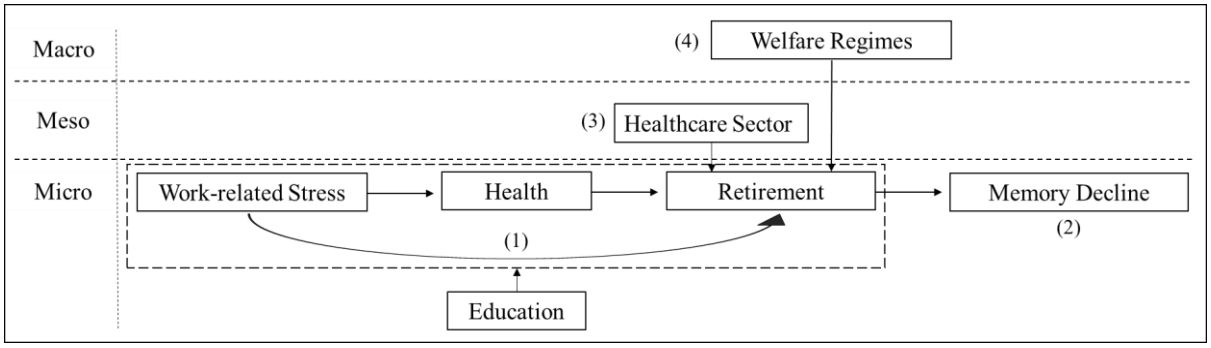

Figure 1: Relationship among the four research questions.

These questions are investigated using the longitudinal Survey of Health, Aging, and Retirement in Europe (SHARE) and the Transitions and Old Age Potential (TOP) study. Identifying the antecedents and consequences of retirement gives insights into possible modifications, and they are relevant for several reasons. First, concerning individuals, the findings can help to identify pathogenic job characteristics so they can be mitigated by developing protective measures. This benefits employees by reducing exposure to pathogenic influences so they can retire later and forestall memory decline. Second, the findings can help

companies and society at large. From an economic point of view, individual work-related health hazards result in workers' absenteeism and higher production failures of employers, leading to higher burdens for social security systems that cover medical expenses, rehabilitation, and earlier retirement. Hence, identifying the antecedents and consequences of retirement ideally leads to better individual health both before and after retirement, relief for social security systems, and greater economic growth.

Chapter 1 provides an overview of the studies in Chapters 2 to 5, addressing potential antecedents and consequences of retirement. First, current trends in retirement over the last decades and the current situation in Europe and Germany will be considered. Second, core assumptions and theories about the individual and the institutional levels are discussed, along with the interplay of the two levels. Finally, there is a summary of the four studies and an overall conclusion.

1.2. Setting the scene: Current retirement trends in Europe and Germany

Retirement can be seen as a complex, dynamic, and evolving process that varies across individuals and contexts (Fisher et al. 2016; Wang and Shultz 2010). Hence, various definitions of retirement take account of three dimensions: i) the timing of retirement, e.g. the age of retirement or "early" retirement (before the eligible pension age), ii) the voluntariness, and iii) the completeness i.e., complete vs. partial retirement (Beehr 1986).

The timing of retirement has changed considerably during the last decades. Between the 1970s and 1990s, most Western societies supported an early exit from the labor market, as this period was characterized by low economic growth and high and persistent unemployment in Europe (Hofäcker et al. 2015). Allowing older workers to exit the labor market early reduced the pressure on strained labor markets and was an effective measure to reduce unemployment

(Hofäcker and Radl 2016). Moreover, early retirement was socially accepted and a financially attractive arrangement because of generous public pension payments. As a result, most retirement transitions have been voluntary as many retirement options have been available.

During the 1990s, policymakers became aware of the trend toward demographic aging and the economic and social pressure it puts on public pension systems. Since then, policies to retain older workers in employment have gained importance. These reforms aimed at extending work lives by delaying retirement, so the number of contributors to public pensions systems remained high, social expenditures were controlled, and companies facing labor shortages were provided with skilled workers. All over Europe, reforms have been implemented that closed the options for early retirement or made them less attractive (Ebbinghaus 2006). Many countries raised their statutory retirement age, which made early retirement more expensive in actuarial pension systems, and elements of privatization and marketization were introduced (Ebbinghaus 2015; Hofäcker and Unt 2013). Besides punishing early retirement monetarily, measures under the umbrella of "active aging" have been implemented to increase the employability of older workers by providing programs for lifelong learning and health improvement (Walker 2002).

Germany implemented reforms such as raising the statutory retirement age stepwise from 65 to 67. Cohorts born in 1964 will be the first to retire at age 67 in 2031. The *Rentenreform* in 1992 reduced pensions by 0.3 percentage points for every month a person retires before the statutory pension age (Ebbinghaus 2015). In addition, the minimum age for early retirement for the long-term insured was increased, and the *Hartz Reform* made early retirement using unemployment insurance financially unattractive. In 2009, subsidies for partial-retirement were eliminated (Wanger 2009). Policymakers tried to increase private pension coverage with the *Riester* pension, aiming for the marketization of pensions (Ebbinghaus 2015). Moreover,

active labor market programs to increase the retention of older workers in the labor market have been introduced.

Considering the employment rates of older workers, it seems that these reforms have been effective in most European countries. In the European Union between 2005 and 2018, the employment rate of workers aged 55–64 rose by more than 25 percentage points to almost 59%. The share of employed older workers was especially in Germany high at more than 70% in 2018 (Eurostat 2020). Furthermore, more older workers took part in measures of lifelong learning (König, Hess, and Hofäcker 2016).

Overall, the reforms seem to have been effective in delaying retirement. However, it is likely that they increased the odds of involuntary retirement by minimizing options for retirement and closing multiple pathways to it. Voluntariness depends on freedom of choice, which, in turn, depends on opportunities for exiting the labor market and the circumstances in which the choice is made (Wang and Shultz 2010). Thus, antecedents of retirement at the individual micro-level, such as health status, work-related factors, and the family situation, along with macro-level indicators like labor market opportunities, influence the voluntariness of retirement decisions (Fisher et al. 2016). Previous research showed that 20–30% of retirees in Europe perceived their retirement as involuntary or forced (Dorn and Sousa-Poza 2010; Fisher et al. 2016).

The third dimension of retirement, completeness, involves shorter work schedules and partial retirement. This is less common in Europe, where less than 15% of older workers retiring partly compared to 60% in the United States in 2009 (Brunello and Langella 2013; Kantarci and Van Soest 2008). Therefore, this dissertation focuses on the timing and voluntariness of retirement.

1.3. Core assumptions and theories

Older workers' decision when to leave the labor market can be conceptualized as a process in which individuals weigh the benefits and costs of early and later retirement (Hofäcker et al. 2015). Hence, the decision to retire is not spontaneous; it starts with planning some time before the actual end of one's working life (Beehr 1986). Assuming that individuals try to maximize their utility, they decide to retire when expected benefits like income and leisure time after labor market exit outweigh the costs of staying at work. Within this maximization, individuals have to consider individual options as well as institutional opportunities and constraints, because the retirement decision process is embedded in a contextual framework (Van Solinge and Henkens 2014). Rational decision-making within an institutional framework entails the risk of bounded rationality. Bounded rationality occurs if a decision is based on imperfect information or a lack of skills. In particular, financial literacy, e.g. if individuals can understand their pension plans, plays a major role (van Erp, Vermeer, and van Vuuren 2014). Besides literacy, understanding depends on the information provided by the institutional context (Altman 2012). Thus, both individual and institutional factors should be considered in the retirement decision process. These opportunities and constraints within the process can be conceptualized as *push* and *pull* factors or *need* and *maintain* factors depending on the way they influence the retirement decision.

1.3.1. Individual *push* and *pull* factors

Individual *push* and *pull* factors are part of maximizing utility within the retirement decision process. Individuals choose to retire by considering either *push* or *pull* factors, or a combination of both (McGonagle et al. 2015). *Push* factors are defined as determinants that urge older workers to leave work and force them into retirement (Barnes-Farrell 2003). They are negative

considerations like poor health, stressful work, or dislike of one's job, that are taken into account within the retirement decision process (Shultz, Morton, and Weckerle 1998). *Pull* factors, on the other hand, refer to positive aspects of retirement, such as pursuing leisure interests or spending time with the family. These positive factors increase the desire to retire (Barnes-Farrell 2003). As these factors are part of the retirement decision process, they produce preferences and intentions regarding continuing to work or exiting. However, individuals might weigh these factors differently based on their perceptions and their own context. If the *pull* factor to pursue leisure interests is stronger, then the possible *push* factor health status does not matter in the decision process. Furthermore, some individuals might decide to keep on working as they weigh the financial necessity or enjoy work higher than *push* and *pull* factors. Therefore, the *push* and *pull* approach must be extended by *stay,* which can be further distinguished into *need* and *maintain* factors. *Need* factors are defined as determinants that force older workers to stay in employment, even if they desire to retire, like their financial situation. Whereas *maintain* factors are positive job attributes, increasing the wish to keep on working and delay retirement, such as enjoying work or just maintaining their daily routine (Atchley 1999).

Push, pull, need, and *maintain* factors influence the timing and voluntariness of retirement in different ways (Fisher et al. 2016). *Push* and *pull* factors should lead to early retirement, while *need* and *maintain* factors are likely to delay retirement. Concerning voluntariness, *pull* factors might contribute to retiring voluntarily, *push* factors, conversely, to involuntary retirement. *Need* factors likely increase the odds of involuntarily staying employed, even if individuals want to retire, and *maintain* factors should increase the odds of staying employed voluntarily.

Considering the consequences of retirement, retirement might have a beneficial effect when a person exits work because of *push* factors, such as work-related stress or poor health status. The person is no longer exposed to those factors, and they have more time to rehabilitate (Wang

and Shultz 2010). In addition, family-related *pull* factors, like being happily married, are positively associated with post-retirement satisfaction (Pinquart and Schindler 2007). However, retirement might also have negative effects. The *use-it-or-lose-it* hypothesis states that retiring from mentally challenging work and entering a more sedentary retirement lifestyle may lead to cognitive decline (Clouston and Denier 2017). Moreover, for most older people, retiring from their jobs is a milestone that marks the transition into later stages of life including major social role changes (Kim and Moen 2002). Retiring and losing the work role along with changes in everyday activities might be associated with feelings of role loss leading to psychological distress. Stress may lead to dysregulation of homeostatic processes and weaken neuronal structures, especially in the hippocampal brain region, which leads to health impairments (Andel et al. 2015).

To sum up, *push*, *pull*, *need*, and *maintain* factors are important determinants in the retirement decision on the individual level, and they might also affect post-retirement outcomes. However, these individual factors are embedded in an institutional context that involves more opportunities and constraints. These, too, should be considered in the retirement decision.

1.3.2. Institutional *push* and *pull* factors

An individual's retirement decision depends on more than individual-level factors. Contextual opportunities and constraints of welfare state regulations are influential determinants of retirement too, as they shape the costs and benefits of exiting work. Institutional factors driving retirement also can be described as *push* and *pull* factors. Incentives related to social protection and the availability of multiple pathways to early work exit are summarized as *pull* factors. *Pull* factors provide financially attractive opportunities for workers to retire early with little or no reduction in pension. The age at which pension benefits become available is a key feature

of pension systems in this respect (Ebbinghaus and Hofäcker, 2013; Hofäcker and Unt, 2013). Assuming that older workers compare the benefits and costs of continuing to work or exiting the labor force, they will choose the financially more attractive option. If early exit programs compensate for forgone wages and future pension benefits, individuals will opt for an early exit rather than keep on working until formal retirement age. As a result, older workers voluntarily decide to retire early instead of continuing to work (Hofäcker and Radl, 2016).

In contrast, *push* factors can be seen as structural labor market constraints that drive older workers involuntarily into early retirement (Ebbinghaus and Hofäcker 2013). Economic downturns or labor demand shocks, with the associated increase in the unemployment rate, reduce older workers' employment chances and raise the likelihood of retirement. Also, economic restructuring due to technological changes may crowd older workers out of the labor market. As a result, *push* factors lead to an early and involuntary retirement decision (see Figure 2). During the last decade, a paradigmatic shift from supporting early labor market exit to policies to retain older workers in employment have gained importance. Therefore, the *push* and *pull* approach, which aimed for an early work exit, has been extended by *stay* factors (Ebbinghaus and Hofäcker 2013). *Stay* factors target a late labor market exit and were further differentiated into *need* and *maintain* factors (Hofäcker and Radl, 2016). Policies supporting older workers' retention in employment are defined as *maintain* factors. *Maintain* factors include lifelong learning and active labor market policies aiming at increasing older workers' employability. They also encompass anti-ageism campaigns and incentives to hire or retain older workers. While *maintain* factors improve the opportunities for older workers to stay in employment, the purpose of *need* factors is explicitly to increase the financial necessity to do so. *Need* factors comprise recent upward shifts in retirement ages and the monetary punishment of early work exits through pension deductions. Other measures to increase the financial need to remain employed are restricting or closing early exit pathways, such as disability retirement

and unemployment insurance, and cuts in pension levels either by delaying access to them or reducing replacement rates (Hofäcker and Radl, 2016). Hence, *need* and *maintain* factors are associated with later retirement, but *maintain* factors try to achieve this on a voluntary base, in contrast to *need* factors, which aim at delaying retirement involuntarily.

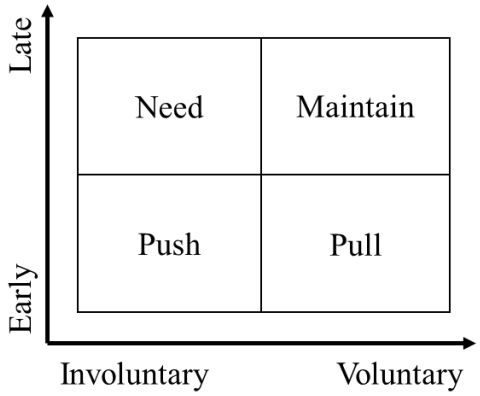

Figure 2: Association between *push*/*pull* and *need*/*maintain* factors and the timing and voluntariness of retirement.

In terms of policy, it is desirable to be in the upper right corner of the graph (Figure 2) and to support late and voluntary retirement transitions. Early and involuntary retirement might be associated with additional costs for social security systems, and they can have serious negative consequences for individual workers well-being, such as less life satisfaction, lower self-rated health, higher risk of depression, and lower income in old-age (Ebbinghaus and Radl, 2015; Heisig, 2017; Hyde et al., 2015).

1.3.3. The interplay of levels: The institutionalism approach

A theoretical concept that links the institutional macro-level to the individual micro-level and explains how institutions affect individual behavior is *institutionalism* (Hall and Taylor 1996).

Individuals are embedded in an institutional context, which influences their retirement decisions. The *calculus institutional approach* assumes utility maximizing individuals, who behave strategically. Individuals have a fixed set of preferences regarding retirement. Also, changes in the institutional framework alter incentives and constraints and therefore, behavior, but they do not change an individual's preferences. In this approach, institutions build a framework in which individuals make decisions according to their needs and desires (De Tavernier and Roots 2015). Consequently, individuals decide to retire based first on their preferences at the individual level and then by considering the opportunities and constraints at the institutional level. If the decision at the individual level is in line with the opportunities and constraints at the macro level, the decision to retire can be realized. If this is not the case, a decision conflict arises, whereby the voluntariness of the institutional-level factors is most important and the involuntary institutional-level *push* and *need* factors are dominant over the individual-level factors. Even if a person wishes to retire, it would not be possible if the institutional context does not provide opportunities. The same applies in the other direction: if a person wants to continue working but *push* factors are dominant at the macro-level, then the person is more likely to retire.

If, on the other hand, individuals decide to stay employed based on *need* or *maintain* factors, then voluntary *pull* and *maintain* factors on the institutional level might not affect the retirement decision. Thus, involuntary macro-level constraints are stronger than individual-level factors.

Following the *institutionalism approach*, system change, such as increasing the retirement age, is driven by exogenous factors like ensuring the sustainability of social security systems, because individual preferences are independent of the institutional framework.

1.4. Summarizing the four studies

In this dissertation, different dimensions of retirement are used to focus on the timing and voluntariness of retirement. The first study emphasizes the timing of retirement in Germany. Hence, retirement age is identified as the first time the person receives a state pension. By deriving the pension age from register data, survey reporting bias can be omitted. The second study defines retirement based on the individual's self-assessment of the current employment situation. The third study focuses on retirement timing by analyzing differences in the preferred and expected retirement ages, so it also takes voluntariness into account. The fourth study explicitly targets the voluntariness of retirement by classifying the reasons for exiting work into voluntary and involuntary.

Considering the antecedents of retirement on the micro-level, this dissertation focuses on *push* factors, controlling for *need* factors. To be specific, work-related stress, low education, and individuals' health are of special interest as drivers of retirement (Fisher et al. 2016; Wang and Shultz 2010). Furthermore, the consequences of retirement on memory are analyzed. On the macro-level, all four factors—*push*, *pull*, *need*, and *maintain*—are taken into account.

Each of the following chapters contains one study which has been published, or has been submitted to a scientific journal. Table 1 provides an overview of all four chapters and their main aspects. Each chapter considers a research question at one of three levels. Two studies are conducted at the individual micro-level. One analyzes the antecedents of retirement; the other, the consequences. These questions are investigated using the longitudinal Survey of Health, Aging, and Retirement in Europe (SHARE) and the Transitions and Old Age Potential (TOP) study. SHARE is an ongoing multidisciplinary and cross-national panel on health, socio-economic status, and the employment situation of 140,000 individuals aged 50 years and older (Börsch-Supan et al. 2013). The first wave began in 2004 and 2005 in 11 European countries and Israel, and follow-ups were conducted biennially until 2017.

Table 1: Overview of the studies included in this dissertation.

	Study I (Chapter 2)	**Study II (Chapter 3)**	**Study III (Chapter 4)**	**Study IV (Chapter 5)**
Title	Work stress among older employees in Germany: Effects on health and retirement age.	Cross-national differences in the association between retirement and memory decline	Transition to retirement in the healthcare sector. Working conditions and attitudes of older workers.	Educational inequalities in labor market exit of older workers in 15 European countries
Research Question(s)	Does work stress has a direct effect on retirement age or is health mediating this relationship?	Is retirement associated with a memory decline and vary this relationship among countries?	Do the expected and preferred retirement age differ between the healthcare sector and other sectors?	Are there country differences in the association between education and voluntary or involuntary labor market exit? Are these differences associated with institutional characteristics of the countries?
Dependent Variables	Retirement age	Immediate and delayed word recall	Expected and preferred retirement age	Involuntary/voluntary/ no work exit
Core Independent Variables	Work-related stress, self-rated health, depressive symptoms, high risk cardiovascular diseases	Retirement	Healthcare sector	Education
Data	SHARE 2004-2014 SHARE-RV	SHARE 2004-2017	TOP survey Wave 1 23 case studies	SHARE 2004-2017 OECD/Eurostat indicators
Statistical Units	Person-year observations Time-points nested within persons	Person-year observations, Time-points nested within persons, nested within countries	Persons	Person-year observations, Time-points nested within persons, nested within countries
Statistical Method	Time-lagged multi-group structural equation model	Linear-mixed model with random slopes	Mixed method approach: Propensity score matching, OLS and logistic regressions	Time-discrete multinomial event history combined with a meta-analysis
Current Status	Published in PLOS ONE	Under Review at Journals of Gerontology: Series B.	Published in German Journal of Gerontology and Geriatrics	Under Review at Journal of Social Policy.

Up to now, 28 countries[2] have participated. It was carried out using computer-assisted personal interviews and sampling strategies varied by country. Furthermore, the German SHARE offers the possibility of linking survey information with administrative records from the German pension scheme (SHARE-RV), including information on exact retirement dates. Respondents had to give consent for record linkage, which had a rate of 47.5%. In addition, SHARE provides the option to link country-specific macro indicators to the survey.

The German TOP survey focuses on retirement transitions and the potential of older adults in the labor market. In the first wave, conducted in 2013, 5,002 individuals born between 1942 and 1958 were interviewed. In a second wave, in 2015/2016 2,501 persons from the first wave were re-interviewed. The study used telephone interviews and was based on simple random sampling. Hence, both surveys are perfectly suited for analyzing the antecedents and consequences of retirement.

The second chapter, *Work stress among older employees in Germany: Effects on health and retirement age,* examines antecedents of retirement focusing on work-related stress and health as *push* factors. In particular, I investigate whether work-related stress has a direct effect on retirement age or if health is mediating this relationship. Furthermore, educational differences are taken into account. Previous research showed that poor health is one of the main reasons for early retirement at the individual level (Fisher et al. 2016; van Rijn et al. 2014). But health, in turn, is influenced by exposure to the job environment, in which most persons spend a comparatively high proportion of their lifetime. The influence of work stress on retirement have mostly been measured directly, controlling for health status. This closes the indirect pathway using health. Work stress can be best explained by two internationally established

[2] Austria, Germany, Sweden, Israel, The Netherlands, Spain, Italy, France, Denmark, Switzerland, Belgium, Czech Republic, Poland, Slovenia, Estonia, Greece, Ireland, Hungary, Portugal, Luxembourg, Croatia, Bulgaria, Cyprus, Finland, Latvia, Lithuania, Malta, Romania, and Slovakia

theoretical models: the demand–control model and the effort–reward imbalance model (ERI). The first model identifies stressful work in terms of high demands combined with low control (Karasek and Theorell 1990). The second model claims that an imbalance between high effort and low reward affects health and retirement decisions (Siegrist et al. 2004). Rewards can be financial, such as prospects for promotion and job security, or emotional, through recognition and appreciation. In addition, educational qualification is a major determinant as it provides resources and capabilities that employees need for successful integration into the labor market. Less-educated employees are more likely to have poor health and retire early since they often have less influence over their effort and therefore less motivation to stay at work. This is in contrast to higher-educated employees who are likely to have more challenging work and a greater level of influence.

In Chapter 2, I, therefore, examine the relationship between work stress and retirement age and if this relationship is mediated by health and moderated by education. Three dimensions of health are taken into account: self-rated health (SRH), depressive symptoms, and high cardiovascular risk diseases (HCVR). A German subsample of the longitudinal Survey of Health, Aging and Retirement in Europe (SHARE) was linked with register data of the German Public Pension Scheme (SHARE-RV). The sample followed 302 individuals aged 50 to 65 years at baseline from 2004 to 2014. Multi-group structural equation modeling was applied to analyze the direct and indirect effects of work stress on retirement age via health. Work stress was lagged so that it temporally preceded health and retirement age.

Results show that lower job-control and poorer SRH lead to a lower retirement age. Health does not operate as a mediator in the relationship between work stress and retirement age. However, education does moderate the relationship between work stress and health: high ERI leads to higher SRH and physical health of higher-educated persons. Low job control increases

the risk of depressive symptoms for persons with less education. Hence, work stress and self-rated health are both antecedents of retirement, *pushing* older workers directly out of work.

Chapter 3, *Cross-national differences in the association between retirement and memory decline*, focuses on the consequences of retirement. I analyze whether retirement is associated with a memory decline and if this relationship varies across countries. Preserving memory functioning represents a core element of healthy aging and independent living. The identification of factors associated with memory decline is of high importance at the individual and societal level to enable independent living at older ages and to ensure the sustainability of social security systems. From a life-course perspective, an individual's life contains different roles and events that take place throughout life. In this approach, retirement can be seen as a stressful life event (Elder 1994). For most older people, retiring from their jobs is a milestone, marking a transition into later stages of life. This includes major role transitions associated with feelings of role loss leading to psychological distress (Kim and Moen 2002). Stress may lead to dysregulation of homeostatic processes, which leads to cognitive impairment and decline (Andel et al. 2015). Also, the "use-it-or-lose-it" hypothesis states that retirees leave work life, which mostly required the regular "use" of cognitive capacities, and they enter a more sedentary retirement lifestyle, in which they "lose" cognitive abilities. Individuals from different European countries face diverse institutional opportunities and constraints of welfare state regulations, which provide retirement options and influence population health. Furthermore, social policies that protect against major risks, such as old-age poverty, by providing more generous pensions, should decrease stress. Thus, these policies help to mitigate memory decline. Hence, memory decline should be more prevalent in countries that offer fewer retirement options and invest less in social policies, as retirement is a more stressful event in these countries.

Thus, I analyze if retirement is associated with memory decline and if this association varies across 17 European countries. The empirical analyses are based on a sample of 8,646 respondents of the longitudinal Survey of Health, Aging, and Retirement in Europe, covering an observation period from 2004 to 2017. Respondents were aged between 50 and 78, and they had to be in paid work at baseline. The sample was restricted to individuals who retired during the observation period to assess within-person memory changes both before and after retirement. Memory was measured with a sum score of immediate and delayed 10-word recall. Three-level (time-points, individuals, countries) linear mixed models with random slopes for retirement at the country level were estimated.

Results show that, on average, memory declined faster after retirement, and between-country heterogeneity existed in this effect. The association between retirement and faster memory decline was stronger in Italy, Greece, Czech Republic, Poland, Portugal, and Estonia. Memory decline after retirement was modest in Northern and Central European countries. Rising retirement ages might postpone memory decline.

Chapter 4, *Transition to retirement in the healthcare sector. Working conditions and attitudes of older workers*, investigates if the expected and preferred retirement age differs between the healthcare sector (HCS) and other sectors. Thus, the fourth chapter focuses on *push* factors at the meso-level. In light of population aging, the HCS is of high societal relevance as the need for health and long-term care will rise. The rising demand for care is contrasted by a shortage of skilled healthcare employees, due to hard physical and mental working conditions which lead to higher absenteeism, burn out problems, and drop-outs. One way to counteract the shortage is to extend work years by increasing the retirement age and implementing human resource measures aimed at working longer. However, challenging working conditions in the HCS make extending work lives more difficult than in other sectors. Using a mixed-methods

approach, I analyze the differences in working conditions and the preferred and expected retirement age between employees in the HCS and other sectors. The quantitative data are derived from the German Transitions and Old Age Potential (TOP) study. Data were collected in 2013 on 5,000 individuals born between 1942 and 1958. Older employees and pensioners were asked about their actual and past working context and their past and future retirement intentions and transitions. The sample comprised older employees aged 55–65 who reported to be in paid employment. Using the International Standard Classification of Occupations (ISCO-88) coding, 124 older employees in the HCS were identified. Included were nurses, midwives, and others in caring professions, e.g. certified care employees. In the first step, coarsened exact matching including relevant demographics[3] was used to identify statistical twins for 114 HCS employees, identifying at least one non-HCS employee for each of them. This matching allows a quasi-experimental design with an experimental group (HCS employees) and a control group (non-HCS employees). In the second step, differences in the working conditions between HCS and non-HCS employees were analyzed using OLS and logistic regressions. Dependent variables were mental and physical working conditions and the importance and recognition of work, which were dichotomized into strenuous and effortless conditions. Also differences in the preferred and expected retirement age of HCS and non-HCS employees were analyzed using linear regressions. For more in-depth analysis of retirement expectations in the HCS, 23 case studies were carried out with employees and representatives of management[4].

Results show that HCS employees were more likely than non-HCS employees to report harder physical working conditions and to have the impression that their work did not receive the recognition it deserved. Moreover, HCS employees expected to retire at the same age as those

[3] Gender, age, education, marital status, taking care of grandchildren, and ethnicity.

[4] The qualitative data were collected and analyzed by Dr. Sebastian Merkel.

in other sectors, but they would prefer to retire significantly earlier than those outside the HCS. These findings are in line with the results of the case studies which show that HCS employees believe they would have to delay retirement to avoid pension cuts. However, most of them felt unable to work until the official retirement age due to hard working conditions, so changing to a managerial position was the preferred strategy for handling the situation. The results are in line with the theory, which stated that involuntary institutional *need* factors overpower individual-level *push* factors. Even if working conditions within the HCS *push* workers out of employment, *need* factors on the institutional level increase the financial necessity to remain employed. The *need* factors are stronger than the wish at the individual level to retire.

In chapter 5, *Educational inequalities in labor market exit of older workers in 15 European countries*, I examine country differences in the association between education and voluntary or involuntary labor market exit and whether these differences are associated with country-specific institutional characteristics. Hence, the fifth chapter focuses on the macro-level. Policymakers all over Europe are implementing pension and labor market reforms aimed at delaying retirement. These measures risk exacerbating social inequality, as less- and higher-educated workers leave the labor market at different ages and for different reasons, potentially widening pension gaps. Low educated workers leave the labor market earlier while higher-educated workers are more likely to work past the age of 65 and retire later. The less-educated leave the workforce early and often involuntarily because of ill health, hazardous working conditions, or unemployment, whereas those who are higher educated leave the labor market later and more often voluntarily because of better health and stronger attachment to work (Carr et al. 2018; van Solinge and Henkens 2007). Whether a work exit is voluntary or involuntary depends on institutional opportunities and constraints driving the decision to exit the labor market. The institutional factors can be categorized into *push* and *pull*, and *need* and *maintain*

factors, whereas the former factors support an early work exit, the latter ones promote a delayed exit. Furthermore, *push* and *maintain* factors force an involuntary exit, and *pull* and *need* a voluntary one.

The association between education and work exit was investigated with the longitudinal Survey of Health, Aging, and Retirement in Europe. The analysis uses data from six waves covering an observation period from 2004 to 2017 and the analytical sample includes 15 countries[5]. Respondents were aged between 50 and 69 and had to be in paid work during the first observation. The sample comprised 19,716 respondents. Country-specific case numbers range from *n*=268 in Portugal to *n*=2,179 in Belgium. Depending on the reasons for leaving the labor market, the exit was classified into voluntary, involuntary or no exit. Educational differences were identified by comparing the difference between the average probability that the low-educated (ISCED 1,2) exit work involuntary or voluntary or stay employed, compared to high educated workers (ISCED 5,6). Time discrete event history models with a categorical outcome are estimated for each country separately. Afterwards, macro-level indicators were added and a meta-analysis conducted to analyze country differences.

Results show that in almost all countries a social gradient in involuntary work exit exists but not in voluntary exit. Lower educated workers are more likely to exit the labor market involuntarily. Institutional factors, especially *maintain* factors supporting older workers' retention in employment are associated with a smaller social gradient in work exit. The findings suggest that investments in active labor market expenditures, especially in lifelong learning and rehabilitation for lower educated workers, may help to reduce the social gradient in involuntary work exit.

[5] Austria, Germany, Sweden, The Netherlands, Spain, Italy, France, Denmark, Switzerland, Belgium, Czech Republic, Poland, Slovenia, and Estonia

1.5. Conclusions

Against the background of population aging, extending working lives and delaying retirement has been an important goal for policymakers to ensure the sustainability of social security systems. Overall, most factors were associated with retirement. On the individual level, work-related stress and individuals' health status are antecedents of retirement *pushing* older workers out of work. Looking at the consequences, memory decline became faster afterwards over all countries, but there was significant between-country heterogeneity in this effect. Results also showed that raising retirement ages might postpone the decline.

Also, the healthcare sector on the meso-level, which is of special importance in the light of population aging, has an impact on retirement preferences. Employees within the healthcare sector would prefer to retire earlier than employees in other sectors but do not think this is feasible because of pension cuts when exiting early. Moreover, results show that in almost all European countries lower educated workers were more likely to exit the labor market involuntarily. The social gradient in involuntary work exit is associated with *push* and *maintain* factors on the institutional level.

From a theoretical perspective, the results are in line with the *push* and *pull* theory extended by *need* and *maintain* factors. On the individual-level, poor working conditions and ill health are factors *pushing* older workers into earlier retirement. Furthermore, low education was associated with a higher probability of involuntary retirement. As low education is related to less attractive and lower-income occupations and poorer working conditions, low education can be considered as a *need* factor on the individual level (Fisher et al. 2016). However, if institutional *push* factors are dominant on the macro level, they are increasing the risk of an involuntary work exit, especially for lower educated workers, who need to work longer but institutional *push* factors limit their choices concerning retirement. Also, the healthcare sector can be seen as a *push* factor, as the characteristics of the sector increase the preference to retire.

But because of the dominance of *need* factors on the macro-level, HCS employees do not expect that they can realize their individual preferences regarding retirement. These results underpin the theoretical interplay of the two levels with respect to retirement transitions. Individuals' preferences regarding retirement are determined by individual-level factors. But whether the decision can be realized depends on the opportunities and constraints at the institutional level.

1.5.1. Strengths and Limitations

The results of this dissertation contribute to previous research by analyzing antecedents and consequences of retirement on different levels. They shed light on the underlying mechanisms by which these factors influence retirement, and they reveal the interactions among the different levels. At the individual level, the complex relationship between work stress, health, and retirement age in Germany has been disentangled by considering a possible mediation of work stress via health on retirement age, as most prior studies did not consider the indirect effects of work stress on retirement (van den Berg et al. 2010; Pietiläinen et al. 2011; Wahrendorf, Dragano, and Siegrist 2013) Next, the results show that not only individual factors but also the institutional context plays a major role in the association between retirement and memory decline. Prior inconsistent findings about the association between retirement and memory decline might be due to country differences, which were overlooked in previous research (Bianchini and Borella 2016; Bonsang et al. 2012; Mazzonna and Peracchi 2017). Furthermore, it advances previous research by considering the meso-level and showing how older employees in the healthcare sector adapt to higher retirement ages and last, by empirically testing how institutional *push, pull,* and *need,* and *maintain* factors influence the voluntariness of retirement differently depending on educational attainment.

Moreover, this dissertation contributes to prior research by applying several advanced statistical methods in a longitudinal perspective. Starting with multi-group structural equation modeling, the direct and indirect effects of work stress in a longitudinal perspective were disentangled. In addition, a mixed-methods approach was applied to analyze how retirement preferences in the healthcare sector helped to shed light on employees' strategies to delay retirement. As multilevel analysis tends to overestimate country effects, a meta-analytical approach was used for analyzing the association between the social gradient in work exit and institutional factors. This can be seen as a more conservative method to test country differences (Bryan and Jenkins 2016). To avoid the heathy worker effect in memory decline, a within-person change design, which enabled the possibility of comparing memory trajectories before and after retirement within persons and not comparing retirees with workers, was applied.

Furthermore, different definitions of retirement have been used to analyze the timing and voluntariness of retirement and to draw a comprehensive picture of retirement. The first article, which focuses on the timing of retirement, the retirement age was derived out of register data and thus, minimized reporting bias. A study by Korbmacher (2014) showed that 40% of the German SHARE respondents misreported their retirement year with a deviation of three years on average. Moreover, from a social policy perspective, it is important to consider work exit and not only retirement entry. Work exit also includes becoming unemployed or a homemaker before retiring, which is not covered by observing retirement entries. Since social security systems must already intervene when a work exit occurs much earlier than retirement entries, this leads to higher costs such as unemployment benefits. Thus, retirement was operationalized as work exit in the second and fourth study. Moreover, this dissertation is one of the first to consider the policy shift to extending working lives and to empirically test institutional factors that include measures aimed at delaying retirement and hence, extended the *push* and *pull* approach by *need* and *maintain* factors.

However, some theoretical and methodological limitations restrict the conclusions. This dissertation focused on the timing and voluntariness of retirement without taking the third dimension, completeness, into account. Even if partial retirement is more common in the American context, in Europe the number of workers engaged in bridge employment is rising (Dingemans, Henkens, and van Solinge 2017). Bridge employment occurs when individuals continue to work for pay after retiring (Beehr and Bennett 2015). This rise might be due to policy shifts which increased the financial need to continue working but it can also be attributed to active aging and staying socially engaged (Dingemans et al. 2017). Further research analyzing the determinants of the new European phenomenon of bridge employment is needed. Another theoretical limitation is possible bounded rationality within the rational retirement decision process. In this respect, an individual's education also plays a major role in the retirement decision. More education is associated with higher financial literacy, and this might lead to more rational retirement decisions (Altman 2012). Holman et al. (2020) showed that 15% of British women, especially those who are less educated, were not aware that a pension reform raised the statutory pension ages for females (Holman, Foster, and Hess 2020). The interplay of the individual level and institutional level, the *calculus approach of institutionalism*, assumes that individual level preferences are independent of the opportunities and constraints at the macro-level and exogenous factors cause system change. Even if the change was started by external, financial factors, pension reforms might have an impact on social norms. Higher retirement ages might become more socially acceptable over time, as individuals adapt their preferences. Although this dissertation analyzed retirement on the macro-, meso-, and micro-levels, future research is needed, particularly at the meso-level. Additional company-level data are required to further investigate how the working context, occupational pensions, and human resource measures aimed at extending work lives, are shaping retirement transitions. Furthermore, this dissertation focuses on individual level *push*

factors controlling for *need* factors, like the person's financial situation, influence retirement decisions. Although *pull* and *maintain* factors, such as spending more time with the family or enjoying work, are associated with retirement. These factors are measured only indirectly as they are part of voluntary labor market exits.

Moreover, only educational differences could be taken into account. A measure for social class besides education would have been desirable, as the opportunity structure for older workers depends on their level of employability, which is determined by more than education (Radl 2013). Nevertheless, ISCO codes for occupations have been collected only during the first wave of SHARE, not in subsequent waves. Furthermore, work-related stress might not be captured adequately by the measures used. As SHARE is carried out biennially, the time lag may be too long as work stress can occur punctually. In addition, the questions about work stress were asked broadly and not specific to a time frame. As a result, high scores captured only long-lasting, extreme stress. Besides, effort–reward imbalance (ERI) is a measure of work stress for the whole workforce; it is not explicitly designed for older workers. Some factors, such as the prospects of promotion, might be less important for older workers or they might even have the reverse effect. Receiving a promotion and new tasks shortly before retiring can cause even more stress. Additionally, both work stress measures, ERI and job-control, should be adjusted to changing working conditions because of digitalization, which might be, particularly for older workers, challenging and stress-inducing. Designing these measures especially for older workers could be a task for future research.

Likewise, the sample of the first study was restricted to employees because civil servants and self-employed individuals were not part of SHARE-RV. The results of analyzing the mechanism between work stress, health, and retirement, therefore, might not be generalizable to other occupational groups. This restriction is generally reasonable, as self-employed individuals have a greater degree of job autonomy and are likely to retire later. Moreover, their

lack of access to the public retirement scheme may postpone retirement. The results of this dissertation might also not be generalizable to countries outside Europe, as labor market and retirement schemes are much more privatized and not comparable to the European context.

1.5.2. Practical Implications

The results of this dissertation allow for multiple implications and recommendations for action, particularly for employers, trade unions, and policymakers. First, reducing individual-level *push* factors and improving psychosocial working conditions can help to reduce early retirement beyond workers' health status. Policymakers, employers, and trade unions should closely monitor people's work stress if they wish to prolong work lives and tackle the shortage of skilled professionals, especially in the healthcare sector, in times of demographic change. Reducing work stress and increasing workers' satisfaction might even increase workers' productivity (Baruch-Feldman et al. 2002).

Second, extending work lives can not only ensure the sustainability of social security systems, it also has a positive impact on healthy aging as delaying retirement is beneficial for preventing memory decline, especially in Southern and Eastern European countries. Nevertheless, work-related stress should be minimized, as it reduces the effect of retire later on memory decline. Taking this into account, raising retirement ages is positively associated with hindering memory decline.

Third, for lower educated workers in almost all European countries, it is more difficult to reach the new goal of extending work lives. This may lead to rising social inequality between lower and higher educated workers. Investments in active labor market policies, especially in lifelong learning and rehabilitation for lower educated workers might increase their employability and help to reduce the social gradient in involuntary work exit.

Overall, the results of this dissertation contribute to the current debate about retirement in Europe and Germany by showing, that increasing retirement ages might not only ensure the financial sustainability of social security systems, it also can be beneficial against memory decline. However, policymakers should improve psychosocial working conditions and address subgroups, especially lower educated and healthcare workers, differently to avoid increasing social inequalities.

1.6. Status of the studies and contributions of co-authors

Chapter 2: ***Work stress among older employees in Germany: Effects on health and retirement age.*** Published in PLOS ONE, *14*(2), e0211487.

As a single author, I developed the research question and theoretical framework, prepared the data for analyses, conducted the analyses and prepared the manuscript.

Chapter 3: ***Country differences in the association between retirement and memory decline.*** Under review at Journals of Gerontology: Series B.

As the lead author, I developed the research question and theoretical framework, prepared the data for analyses, conducted the analyses and prepared the manuscript. Co-authors Prof. Dr. Maria M. Glymour, University of California San Francisco, and Dr. Alicia Riley, University of California San Francisco, commented on the manuscript. Maria M. Glymour also assisted in developing the data analytical approach and Alicia Riley has done the code checking.

Chapter 4: ***Transition to retirement in the healthcare sector. Working conditions and attitudes of older workers.*** Published in *Zeitschrift für Gerontologie und Geriatrie*, *52*(1), 25–31.

As the lead author, I developed the research question and theoretical framework, prepared the quantitative data for analyses, conducted the quantitative analyses and prepared the manuscript. Co-authors Dr. Sebastian Merkel, Institute for Work and Technology, conducted and analyzed the qualitative data, Dr. Moritz Hess, Bremen University, assisted in developing the theoretical framework, Prof. Dr. Josef Hilbert, Institute for Work and Technology, and Prof. Dr. Gerhard Naegele, Institute of Gerontology, commented on the manuscript.

Chapter 5: ***Educational inequalities in labor market exit of older workers in 15 European countries.*** Under review at Journal of Social Policy.

As the lead author, I developed the research question and theoretical framework, prepared the data for analyses, conducted the analyses and prepared the manuscript. Co-authors Dr. Patrick Präg, Oxford University, Dr. Moritz Hess, Bremen University, and Prof. Dr. Lea Ellwardt commented on the manuscript. Patrick Präg also assisted in developing the data analytical approach.

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Chapter 2: Work stress among older employees in Germany: Effects on health and retirement age.

Abstract

*Objective***:** This study examines the relationship between work-related stress and retirement age. It investigates whether this relationship is mediated by health and moderated by education. Three dimensions of health are taken into account: self-rated health (SRH), depressive symptoms, and high cardiovascular risk diseases (HCVR).

*Methods***:** A German subsample of the longitudinal Survey of Health, Aging and Retirement in Europe (SHARE) was linked with register data of the German Public Pension Scheme (SHARE-RV). The sample followed 302 individuals aged 50 to 65 years at baseline from 2004 to 2014. The data contains information on work stress, measured by job control and effort–reward–imbalance (ERI), health, and age of retirement. Multi-group structural equation modeling was applied to analyze the direct and indirect effects of work stress on retirement age via health. Work stress was lagged so that it temporally preceded health and retirement age.

*Results***:** Lower job control and poorer SRH lead to a lower retirement age. Health does not operate as a mediator in the relationship between work stress and retirement age. Education moderates the relationship between work stress and health: high ERI leads to better SRH and better physical health of higher educated persons. Low job control increases the risk of depressive symptoms for persons with less education.

Conclusions: Improving stressful working conditions, particularly improving job control, can prolong the working lives of employees and postpone retirement.

2.1. Introduction

Europe's workforce is aging rapidly, especially in Germany. This demographic change requires policies that seek to extend working lives, for example, by increasing the statutory pension age and closing early retirement pathways. The aim of these reforms is to increase the labor participation of older workers to secure the long-term sustainability of the social security systems. However, the actual retirement age in Germany in 2016 was 63.2 years and thus below the statutory age of 65 years (OECD 2016). Moreover, the premature exit from paid work has also been a serious concern for individuals and companies. For individuals, leaving paid work might increase the risk of financial and social problems, while companies face a skill shortage. This highlights the importance of understanding risk factors contributing to early retirement. Previous research has shown that one primary reason for early retirement is poor health (van den Berg, Elders, and Burdorf 2010; Fisher, Chaffee, and Sonnega 2016; van Rijn et al. 2014). Health in turn is influenced by exposure to the job environment, in which most persons spend a comparatively high proportion of their lifetime (Kivimäki et al. 2015; Nyberg et al. 2013; Smith and Bielecky 2012).

This longitudinal study investigates the complex relationship between work stress, health, and retirement age in Germany by asking whether work stress has a direct effect on retirement age or if health partially mediates this relationship. In addition, it examines whether effects vary, depending on the education levels of the employees, as health is affected by educational attainment.

Most studies analyzing the influence of work stress on retirement have measured the direct effects of work stress on retirement and controlled for health status. However, some studies have shown that work stress can influence an employee's health status as well (Bonde 2008; Kivimäki et al. 2012; Nieuwenhuijsen, Bruinvels, and Frings-Dresen 2010; Nyberg et al. 2013). Only a few studies have analyzed how the effects of work stress via health have subsequently

influenced retirement. These studies show that working conditions explain about 20% of the association between health and disability retirement in the Finnish context (Juvani et al. 2014; Pietiläinen et al. 2011).

By doing so, this study advances previous research in several ways. First, the use of structural equation modeling (SEM) creates the opportunity to estimate effect sizes for direct and indirect effects (mediation). Second, three different health measures are taken into account: self-rated health (SRH), depressive symptoms, and high cardiovascular risk diseases (HCVR). Third, the dependent variable, retirement age, is drawn out of register data, which reduces reporting bias (Korbmacher 2014). Furthermore, reversed causality between work stress and health can be ruled out due to the use of longitudinal data in the SEM framework. Finally, this study gains insights into the mechanism in the German context, as previous research has been mostly carried out in Scandinavia (van Rijn et al. 2014). The German case is particularly interesting as the labor market and pension reforms aiming to delay retirement have been effective and the employment of older workers has increased steeply (König, Hess, and Hofäcker 2016). Early retirement is possible at the age of 63 for persons with an insurance record of at least 35 years. However, the pension benefit will be reduced by a permanent deduction. Disability retirement is possible at the age of 63 without pension cuts and at the age of 60 with a deduction of 10.8%. On the other hand, it is possible to postpone retirement and to increase the pension benefit by 0.5% per every additional month worked.

Work-realted stress can be best explained by the two internationally established theoretical models: the demand–control model (Karasek and Theorell 1990) and the effort–reward–imbalance model (ERI) (Siegrist et al. 2004). The first model, also known as the job strain model, identifies stressful work in terms of high demands in combination with low control. Different studies have shown that the control dimension seems to be more important than occupational demands for retirement intentions and disability retirement (Lahelma et al. 2012;

Wahrendorf, Dragano, and Siegrist 2013). The second model claims that an imbalance between high efforts and low rewards affects health and retirement decisions. Rewards can be financial, e.g. promotion prospects, including job security, or emotional through recognition and appreciation (Siegrist and Dragano 2006). The two models complement each other, with the first one focusing on work content, and the second highlighting violations of reciprocity exchanges. The latter implies that high efforts are perceived as not being adequately rewarded and a gratification crisis arising. Both models predict higher risks of several stress-related health outcomes and retirement intentions, e.g. early retirement and disability pension (Bonde 2008; Hintsa et al. 2015; Hoven, Wahrendorf, and Siegrist 2015; Juvani et al. 2014; Steptoe and Kivimäki 2012; Topa, Depolo, and Alcover 2018).

A strong predictor of retirement is *self-rated health* (van den Berg et al. 2010; Fisher et al. 2016). SRH is a commonly used generic health indicator, which is not necessarily related to a certain medical condition, but broadly reflects the different dimensions of health not covered by specific measures of illness or disease (Jylhä 2009; Pietiläinen et al. 2011). Self-rated health predicts many health outcomes, such as functional limitations (Idler, Russell, and Davis 2000), mortality (DeSalvo et al. 2006), and disability retirement (Pietiläinen et al. 2011). Another predictor is *depression*. Depression is the leading cause of disability worldwide and contributes significantly to the global burden of disease and costs (WHO 2017). Work stress can trigger depression, especially among older employees, given the significance of exposure time and lower adaptability of older workers to changing working conditions (Bonde 2008; Siegrist et al. 2012). Several studies have shown that depressive symptoms lead to earlier retirement (Karpansalo et al. 2005; Olesen, Butterworth, and Rodgers 2012; van Rijn et al. 2014). Finally, work stress not only affects mental health, but also harms physical health. In particular, *cardiovascular diseases* (CVDs) can be caused by work stress, as long-lasting stress increases the risk of hypertension, stroke, and heart attacks (Kivimäki et al. 2012; World Health

Organization 2017). All three health outcomes—SRH, depression, and CVD—can be caused by work stress and thus may lead to a lower retirement age. A meta-analysis by van Rijn et al. (2014) compared the associations between these health outcomes and retirement. Because no studies for the effects of depression on early retirement existed, van Rijn et al. analyzed their effects on disability retirement. Their results showed that SRH was the strongest predictor of disability retirement, followed by chronic diseases and mental health, respectively. This is because SRH globally reflects the health-related quality of life instead of merely covering the physical or mental dimension (van Rijn et al. 2014).

In addition, the influence of work stress and health on retirement age likely varies between individuals. Less educated employees have a higher risk of poor health and early retirement (Radl 2013; Wahrendorf et al. 2013). Educational qualification is a main determinant as it provides resources and capabilities for employees that are required for successful labor market integration. Less-educated employees often have less influence over their effort and therefore lower motivation to stay at work compared with higher-educated employees with more challenging work and a higher influence level (Schreurs et al. 2010). However, the lower-educated employees might not have the financial resources to retire early (Radl 2013). It can be expected that work stress leads to a lower retirement age and that health mediates this relationship at least partially. Furthermore, work stress in less-educated groups leads to a lower retirement age than in higher-educated groups.

2.2. Methods

2.2.1. Data and sample

The associations between work stress, health, and retirement age in Germany were investigated with the longitudinal Survey of Health, Aging and Retirement in Europe (SHARE). The survey

collected data on health as well as the social and economic circumstances of participants aged 50+ years (Börsch-Supan et al. 2013). Starting with the first wave in 2004 and 2005 in 11 European countries[1] and Israel, follow-ups were conducted biennially until 2015. In Germany, random sampling was based on regional registers, and a multi-stage design was applied. The first German sample in 2004 consisted of 3,008 respondents, and the longitudinal response rate across all waves was 77.6%, including respondents who recovered after missing a wave. In addition, SHARE-Germany offers the unique opportunity to link survey information with administrative records from the German pension scheme (SHARE-RV), including information on exact retirement dates on a monthly base (Forschungsdatenzentrum der Rentenversicherung; Max-Planck-Institut für Sozialrecht und Sozialpolitik 2017). This is restricted data, which can be retrieved through a separate application procedure[2]. The last wave of the SHARE used was in 2013. Because SHARE-RV was only available until 2014, it was not possible to use any later waves of the SHARE. In addition, respondents had to give consent for record linkage, and the linkage was 47.5% (S1 Appendix).

Permissions to use and store SHARE and SHARE-RV data were obtained from the European Research Infrastructure Consortium (SHARE-ERIC) and the Research Data Center of the German Pension Insurance (FDZ-RV). Data was anonymized before they were accessed and combined using social security numbers (SSN) as a unique identifier. Respondents were asked for written consent during the regular SHARE interview to collect respondents' SSN. Subsequently, FDZ-RV converted SSN into an anonymized code, which allows the researcher to combine data, but not to access the unique SSN. Ethical approval for the SHARE study and SHARE-RV was given by the Ethics Committee of the University of Mannheim and the Ethics council of the Max Planck Society.

[1] Sweden, Denmark, The Netherlands, Belgium, Germany, Austria, Switzerland, France, Italy, Spain and Greece
[2] http://forschung.deutsche-rentenversicherung.de/FdzPortalWeb/antragAction.do

The final sample of the present study consisted of respondents between 50 and 65 years at their first observation. To be included in the analysis, respondents had to be in paid work at the start of the observation and needed a minimum of two follow-ups. Self-employed persons and civil servants were excluded as they differed from employees and were not eligible for the German pension scheme and by that not part of the SHARE-RV. After data preparation, 302 respondents fulfilled these criteria (S1 Appendix). Robustness checks showed that demographics between the original sample and the final sample did not differ.

2.2.2. Variables

Retirement Age

The dependent variable, retirement age, drawn from the register data was calculated on a monthly base. Respondents were asked for consent to record linkage, and only respondents with insured activities were part of the administrative records. Record linkage was possible since the third wave, which had a linkage rate of 61%. Only nine respondents retired before 59 years and were treated as outliers and recoded to 59 years.

Work Stress

The independent variable, work stress, was measured with shortened versions of the original scales of the demand–control model (Karasek et al. 1998) and the effort–reward–imbalance model (Siegrist et al. 2004). Given the constraints of a multidisciplinary approach, the inclusion of the full questionnaire was not possible in SHARE (Hoven et al. 2015). Job strain was restricted to the control dimension because the predictive power of control by far exceeded the power of demand (Wahrendorf et al. 2013). Based on the questions “I have little freedom to

decide how I make my work" and "I have an opportunity to develop new skills" with answers ranging from 1- strongly agree to 4- strongly disagree, a sum index for low control was built (Hoven et al. 2015). The second question was reversed, so that both items were negative. The index ranges from 2-8 and a higher score indicates lower job control.

The effort–reward imbalance model was constructed as recommended by the developers (Siegrist et al. 2014) and was used in different studies based on previous SHARE data (Hoven et al. 2015; Lunau et al. 2015; Wahrendorf et al. 2013). The effort–reward imbalance model was restricted to two items measuring effort and five items measuring reward. The ERI was defined by the ratio of the sum score of effort items (nominator) divided by the sum score of reward items (denominator) adjusted for the number of items (Siegrist et al. 2014). A higher score showed an effort–reward–imbalance. Both models have been found to be valid (Karasek et al. 2007; Siegrist et al. 2014) and have been associated with health and retirement in previous studies (Hoven et al. 2015; Lunau et al. 2015; Wahrendorf et al. 2013).

Health

As health can be seen as a multidimensional concept, three different health measures were included as mediators. SRH was measured using the question, "Would you say your health is… 1- excellent, 2- very good, 3- good, 4- fair, or 5- poor."

Depressive symptoms were measured using the EURO-D depression scale (Prince et al. 1999). The scale consisted of 12 items measuring the number of depressive symptoms in general population surveys (Hoven et al. 2015). The scale ranged from 0 to12, whereby a higher value indicated more depressive symptoms. The EURO-D scale has been tested as a valid and consistent indicator of elevated levels of depressive symptoms in cross-European studies (Prince et al. 1999).

Based on the WHO criteria, high cardiovascular risk diseases (HCVRs) were considered to be a group of high risk factors, such as hypertension, diabetes, and high blood cholesterol, which increase the risk of disorders of the heart and blood vessels, including coronary heart disease and stroke (Torquati et al. 2017; World Health Organization 2017). SHARE respondents were asked if a doctor had told them that they had any of the named 14 conditions. HCVR was coded as a dummy into 1 if a respondent named one of the following four answers: 1. A heart attack, including myocardial infarction or coronary thrombosis or any other heart problem, including congestive heart failure; 2. High blood pressure or hypertension; 3. High blood cholesterol; and 4. A stroke or cerebral vascular disease.

Moderator

Education was measured with the International Standard Classification of Education (ISCED-97) using ISCED-97 as a dummy, which is 1 when respondents have tertiary education, e.g. a university degree (5-6), and 0 otherwise (0-4).

2.2.3. Statistical analysis

Multi-group structural equation modeling (SEM) was applied to analyze the direct and indirect effects of work stress on retirement age via health. The advantage of multi-group structural equation models is that they enable the possibility to estimate direct and indirect effects for less-educated people as well as higher-educated people. They also test whether differences between these two groups are significant. Estimation was done with maximum likelihood with missing values (mlmv). Additionally, a correlation between the two work stress indicators was assumed. Longitudinal data enabled the analysis of a causal path. Of five waves, the last two time points for each respondent before retirement were used. Retirement age was measured at

t, the health measures on t-1 and work stress at t-2. The design was chosen for causality reasons, as the cause must temporarily proceed the outcome. Three different models for each health measure were estimated: Cross-lagged panel models for health and work stress were chosen first to rule out reversed causality. Second, a longitudinal SEM of work stress, health, and retirement age were chosen to analyze the mediating effect of health. Third, the model was stratified by education using the multi-group option in SEM. Robust standard errors were estimated. All analyses were carried out with STATA 14.0.

2.3. Results

The mean retirement age of the respondents was 63 years. Less-educated employees retired earliest (Table 1). Low job control was the highest for less-educated individuals. ERI was higher among highly educated individuals. Respondents with less education reported poor SRH, depressive symptoms, and HCVR more often than people with higher education. P-values based on a t-test showed that differences in retirement age between less-educated people and highly educated people were significant.

Table 2.1: Sample characteristics at baseline. Means, standard deviations in parentheses. P-values based on t-test.

				Low Education		High Education		
	Range	Mean	SD	Mean	SD	Mean	SD	P-Value
		N=302		N=203		N=99		
Retirement Age	59-65	62.96	2.03	62.83	2.05	63.22	1.98	0.06
Low Control	2-8	4.16	1.52	4.29	1.54	3.92	1.46	0.07
ERI	0.25-3.5	1.16	0.58	1.11	0.59	1.24	0.54	0.08
SRH	1-5	3.21	1.00	3.34	1.04	2.95	0.86	0.00
Depressive Symptoms	0-11	2.07	2.00	2.38	2.13	1.43	1.51	0.00
HCVR	0-1	0.59	0.49	0.71	0.46	0.29	0.46	0.06
Female	0-1	0.45	0.50	0.71	0.45	0.29	0.45	0.09

Results of the cross-lagged panel models showed that no reversed causality existed between work stress and the three health measures (S2 Appendix). The results of the structural equation model, which was adjusted for gender and education, showed no significant effects of low control and ERI on SRH (Fig 2.1.). However, low control had a significant direct effect on retirement age. Respondents with low control had a significantly lower retirement age (B=-0.21, 95% CI-0.40;-0.02). In addition, poor SRH led to a significantly lower retirement age (B=-0.25 95% CI -0.49;-0.005). No indirect effects of work stress on retirement age were found. SRH did not mediate the association between work stress and retirement age. Fit indices showed a good model fit.

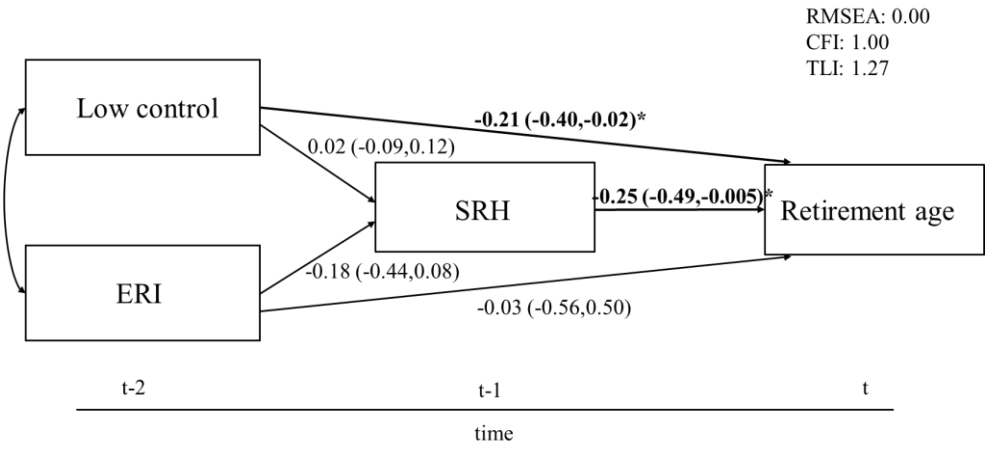

Figure 2.1. Structural equation model of the association between work stress, SRH and retirement age. 95% CIs in parentheses, adjusted for gender and education, N=302. Levels of significance: *** p≤0.001; ** p≤0.01; * p≤0.05

Also, depressive symptoms (Fig 2.2.) and HCVR (Fig 2.3.) did not mediate the relationship between work stress and retirement age. Only low control had a significant direct effect on retirement age in both models (depressive symptoms: B=-0.22 95% CI -0.41;-0.03; HCVR: B=-0.21 95% CI -0.40;-0.02).

Multi-group models were estimated to examine whether effects differed based on educational level (Table 2). Educational differences were only significant in the association between work

stress and health, but not in the retirement context. Higher ERI led to a significantly better SRH (B=-0.34, 95% CI -0.66;-0.01) for highly educated employees. For depression, low control

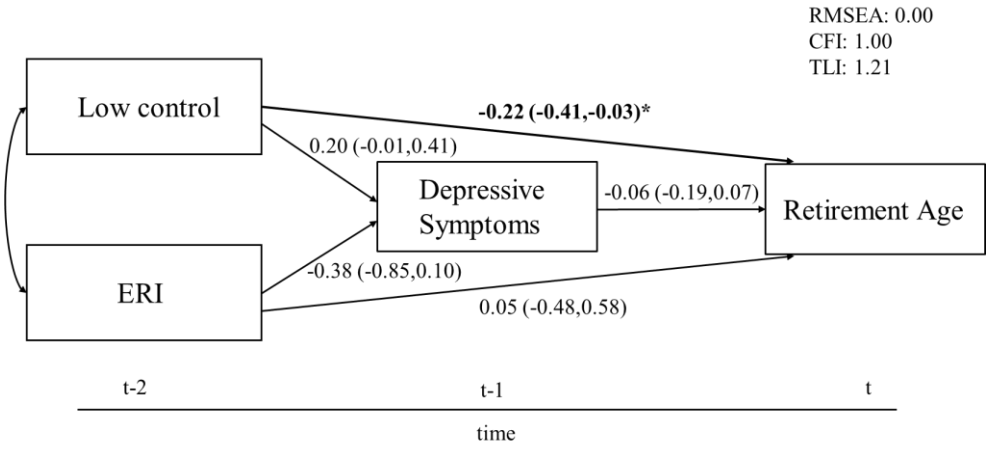

Figure 2.2. Structural equation model of the association between work stress, depressive symptoms and retirement age. 95% CIs in parentheses, adjusted for gender and education, N=302. Levels of significance: *** p≤0.001; ** p≤0.01; * p≤0.05

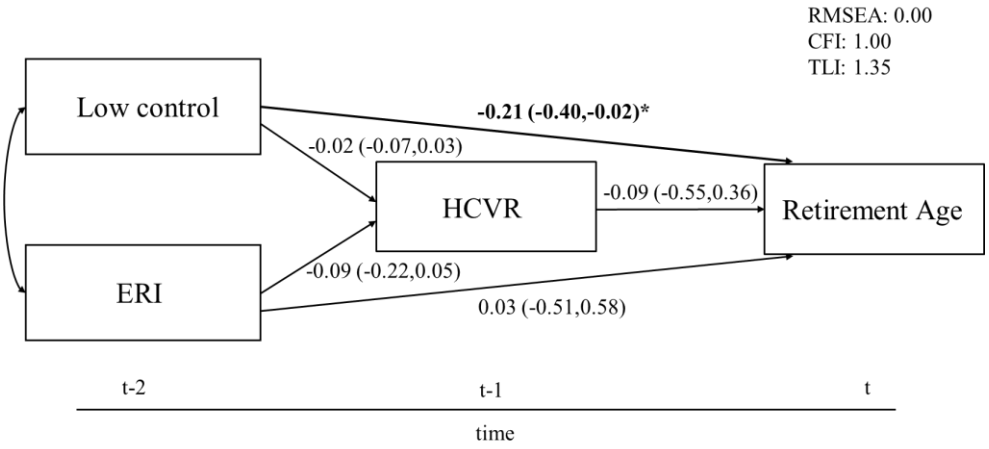

Figure 2.3. Structural equation model of the association between work stress, HCVR and retirement age. 95% CIs in parentheses, adjusted for gender and education, N=302. Levels of significance: *** p≤0.001; ** p≤0.01; * p≤0.05

increased depressive symptoms only for less-educated employees significantly (B=0.32, 95% CI 0.02;0.62). In the event of HCVR, a higher ERI reduced the risk of an HCVR for highly educated employees (B=-0.22, 95% CI -0.39;-0.05).

Table 2.2: Direct effects of education on work stress, health, and retirement age, adjusted for sex, N=302.

		Moderator: Education			
		Low Education		High Education	
		Coef.	95% CI	Coef.	95% CI
On SRH	Low control	0.02	-0.13,0.17	0.03	-0.11,0.16
	ERI	-0.10	-0.45,0.25	**-0.34***	**-0.66,-0.01**
On Retirement Age	Low control	-0.19	-0.44,0.05	-0.27	-0.61,-0.07
	ERI	-0.20	-0.88,0.47	0.48	-0.41,1.37
	SRH	-0.26	-0.53,0.02	-0.15	-0.64,0.34
On Depression	Low control	**0.32***	**0.02,0.62**	0.01	-0.20,0.21
	ERI	-0.37	-1.02,0.28	-0.15	-0.74,0.43
On Retirement Age	Low control	-0.19	-0.44,0.05	-0.27	-0.61,-0.07
	ERI	-0.17	-0.83,0.50	0.48	-0.36,1.32
	Depression	-0.05	-0.19,0.10	0.15	-0.43,0.13
On HCVR	Low control	-0.01	-0.07,0.06	-0.01	-0.09,0.07
	ERI	-0.01	-0.18,0.15	**-0.22***	**-0.39,-0.05**
On Retirement Age	Low control	-0.20	-0.44,0.03	-0.27	-0.61,-0.08
	ERI	-0.17	-0.83,0.50	0.56	-0.32,1.44
	HCVR	-0.12	-0.70,0.45	0.01	-0.77,0.79

2.4. Discussion

The aim of this study was to examine the relationship between work stress, health, and retirement age, based on educational level. The results show that health does not mediate the association between work stress and retirement age. Work stress in terms of low control has a direct effect on retirement age, showing that lower job control is associated with a lower retirement age. In contrast to previous research, effort–reward–imbalance has no effect on

health and retirement age in Germany (Lunau et al. 2015; Wahrendorf et al. 2013). Additionally, poor SRH reduces retirement age, whereas depressive symptoms and HCVR do not. In line with previous research, this study shows that SRH seems to be a stronger predictor for early retirement than other conditions (Pietiläinen et al. 2011; van Rijn et al. 2014). The results differ by education: Work stress affected health differently, depending on the level of education of the employee and the health measure. In the case of SRH, a higher ERI led to a better SRH for highly educated employees. Employees with a high level of education with a high ERI also had a lower probability of HCVR. In contrast, less-educated people with low job control had more depressive symptoms. No differences between educational level and retirement age were found.

This study contributes to previous research by showing that German employees tend to retire early when they perceive their job as stressful. Even though effect sizes in this study were small, among other factors, low job control and SRH can be assumed to play a role in the decision-making process on retirement (Topa et al. 2018). Within this process, employees' subjective assessment of their health status (SRH) matters more than the presence of depressive symptoms and high risk cardiovascular diseases. In line with previous research (van Rijn et al. 2014), this study shows that that self-rated health reflects a multidimensional concept of health and well-being, which goes beyond the absence of disease. Other important factors when considering retirement may be a higher preference for leisure time or family-related reasons, such as a retired spouse or grandchildren (Fisher et al. 2016). Further research, especially on the partner dyad, is needed on social determinants on retirement. Furthermore, in the present study, retirement age was calculated based on reliable register data, which has been rarely done in Germany. Labor market exits might occur before the actual retirement age, for example, when respondents become unemployed before they retire. This is not the case in the present study in which only employed respondents were considered who did not experience

unemployment until retirement. As a result, the estimated work exit in the present study is a conservative estimation, and the gap between the statutory retirement age and work exit might be even larger when also considering episodes of unemployment. However, given the possibility of deriving the actual retirement age from register data, reporting bias has been minimized. Korbmacher (2014) showed that 40% of the German SHARE respondents misreported their retirement year with a deviation of three years on average (Korbmacher 2014). The usage of register data is, hence, one contribution of this study. Additionally, reversed causality of work stress and health can be excluded based on the results of the cross-lagged panel models. Finally, this study closes a gap in previous research on retirement, health, and work stress by investigating the relationship in the German context, as most studies were carried out in Scandinavia (van Rijn et al. 2014). Compared with the Scandinavian literature, no indirect effect of work stress on retirement was found in Germany (Juvani et al. 2014; Pietiläinen et al. 2011). In the Scandinavian context, depression and musculoskeletal diseases, determined by a physician, mediated the relationship between work stress and retirement and not a self-evaluation as in SHARE.

A limitation of the current study is the small sample size, which yields to low statistical power. Some effects might have been significant in a larger sample, for example the borderline-significant effects of low control on depression and SRH on retirement age for less-educated employees. Due to the small sample size, it was only possible to measure education binary. Respondents with tertiary education were put into the “highly educated group” and all other respondents became a part of the “less-educated” group. This led to subsuming a diverse group, including respondents with post-secondary education as well as primary education. The current sample cannot capture potential differences in work stress within the less-educated group. In addition, distinguishing old age pension from disability pension was not possible with the small sample, as only 5% of the respondents received a disability pension. Robustness checks were

conducted by excluding respondents with disability pension, and the results did not change substantially. Moreover, stratifying instead of adjusting for gender showed no significant effects for women. This result may be mostly due to the smaller group size for women than for men. Nevertheless, it indicates that the associations between work stress and retirement age are stronger for men than for women. A replication of the study with a larger sample size could be a task for future research.

Germany is a special case regarding retirement, as the institutional background has changed much in the last 20 years. Specifically, manifold reforms aiming to delay retirement and active labor market measures helped to increase older workers' employment (Ebbinghaus and Hofäcker 2013; König et al. 2016). In the current sample, 95% of the respondents were born before 1952 and thus had not been affected by these contextual changes. Additional analysis controlling for cohort showed no significant differences in the results.

The longitudinal design of this study covered five waves in total. A respondent's retirement was modelled based on the respondent's latest two waves before retirement, so that the independent variables temporarily preceded the dependent variable. Despite its advantages, this retrospective design yields the risk of a selection bias: Health and work stress were measured at older ages among those who retired later than among those who retired earlier, while risk of both poor health and retirement increase with age. Robustness checks controlling for age cohort did not reveal significantly different results, suggesting that such bias was limited. Furthermore, the sample was restricted to employees because civil servants and self-employed individuals were not part of the SHARE-RV. Results may, thus not be generalized to all occupational groups. This restriction is generally reasonable, as self-employed individuals have a greater degree of job autonomy and thereby likely retire later. Additionally, their lack of access to the public retirement scheme may postpone retirement (Radl 2012).

The results of work stress on health differ from those of previous research, which showed that effort–reward–imbalance and low job control increase the risk of depression and cardiovascular diseases (Kivimäki et al. 2012; Nyberg et al. 2013; Smith and Bielecky 2012). A possible explanation is the time lag between work stress and the health measures due to the longitudinal study design. As the SHARE is carried out biennially, the time lag may be too long as work stress can occur punctually and therefore is not captured adequately. In addition, the questions about work stress were ask broadly and not specific to a time frame. As a result, high scores only captured long-lasting, extreme stress. Analyzing work stress and the health measures cross-sectionally showed associations between work stress and health. Another explanation could be that some of the employees were not heavily exposed to work stress as they were working part time. While distinguishing between full-time and part- time work would have been desirable, this was not possible in a limited SEM. Moreover, the assessment of the two work stress measures was incomplete, as job strain was measured with two control dimension items only without any of the demand items. This detail increased the risk of underestimating the effects of work stress (Hoven et al. 2015). In addition, ERI was measured with a shortened scale, for example, excluding over-commitment for detecting coping with job demands. Sensitivity analyses have been done with the single dimensions of the ERI. In HCVR, only the effort dimension had a significant effect and in terms of SRH, the reward dimension was more important than effort. Not receiving the deserved recognition only affected the SRH of highly educated employees. Highly educated employees may be more overcommitted as they identify more strongly with their jobs. Moreover, coping mechanisms differ between highly educated and less-educated employees because highly educated individuals are more likely to possess helpful resources and are more adaptive (Doherty 2009; Radl 2012). Similarly, work stress is a subjective assessment, and respondents can become accustomed to stress or selecting themselves out of stressful jobs. Furthermore, the ERI is a measure for work stress among the

whole workforce and not explicitly designed for older workers and specific educational groups. Some questions, e.g. job promotion prospects, may be less important for older workers or may even have the reverse effect. Receiving a promotion and new tasks shortly before retiring can even cause more stress. ERI might not be equally valid among special groups. Designing an ERI measure especially for older workers could be a task for future research. This idea may explain the effects of ERI on SRH and HCVR of highly educated people. Aside from these effects, less-educated employees may be more exposed to physical working conditions, such as noise or lifting heavy items, which are not captured in the present study. Instead, the ERI scale included a subjective assessment of the physical demands of the respondents' jobs (e.g., "My job is physically demanding" is part of the ERI effort dimension). Data on objective conditions would have been desirable, and future research should include observational variables, for example, by linkage to a job-exposure matrix. However, SHARE did not offer this option.

Improving psychosocial working conditions can help to reduce early retirement beyond workers' health status. In particular, improving job control potentially extends people's work life, as it directly contributes to explaining low retirement ages in the present study. Policy makers and stakeholders, such as employers and trade unions, should closely monitor people's work stress if they wish to prolong working lives and tackle the shortage of skilled professionals in times of demographic change.

2.5. Acknowledgements

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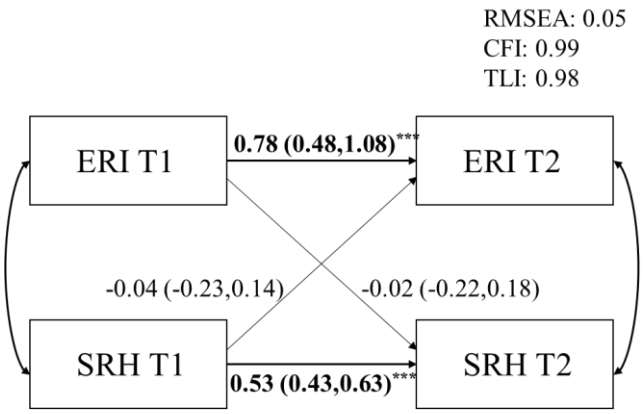
2.7. Appendix

Table 2.3: Attrition in SHARE.

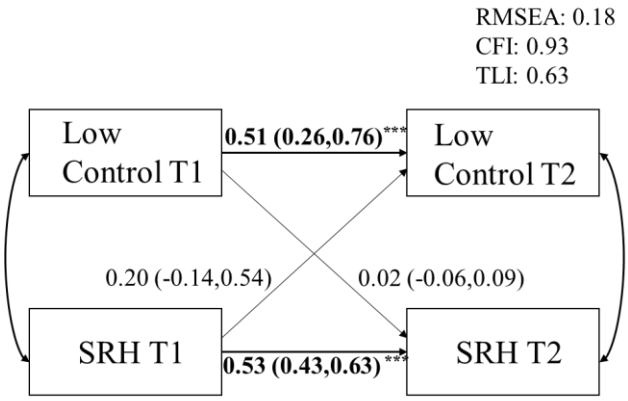
Attrition in SHARE	N	%
SHARE-RV sample	4148	100
Remove respondents which participated only once	3449	83,1
Remove respondents which retired before first wave	2606	62,8
Remove respondents, which are not aged between 50 and 65	2440	58,8
Remove respondents which had a transition to retirement but only one observation left	1808	43,6
Remove respondents if unemployed or homemaker at first observation	1416	34,1
Remove respondents without event (retire) during observation period	302	7,3

Cross-lagged-panel models.



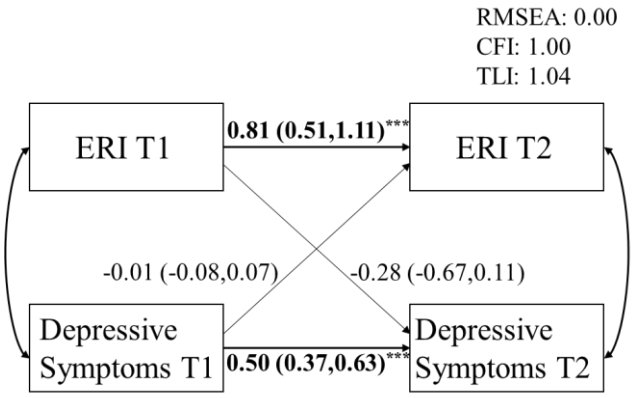
Levels of significance: *** p≤0.001; ** p≤0.01; * p≤0.05

Figure 2.4: Cross-lagged-panel model ERI and SRH.



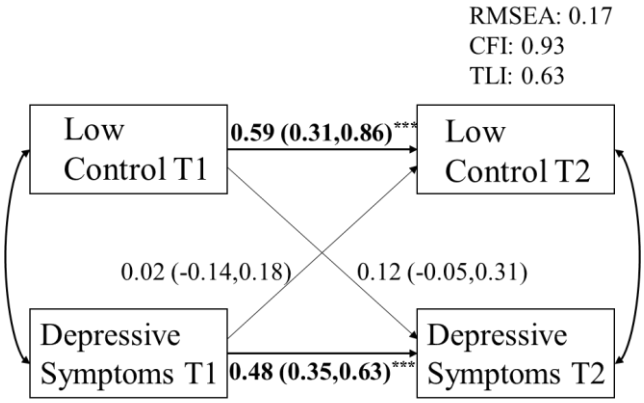
Levels of significance: *** p≤0.001; ** p≤0.01; * p≤0.05

Figure 2.5: Cross-lagged-panel model low control and SRH.



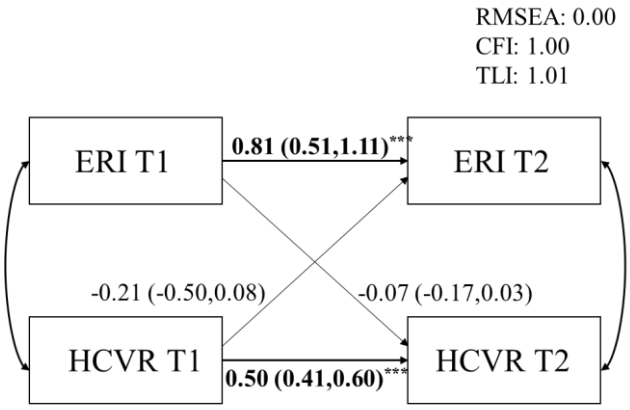
Levels of significance: *** p≤0.001; ** p≤0.01; * p≤0.05

Figure 2.6: Cross-lagged-panel model ERI and depressive symptoms.



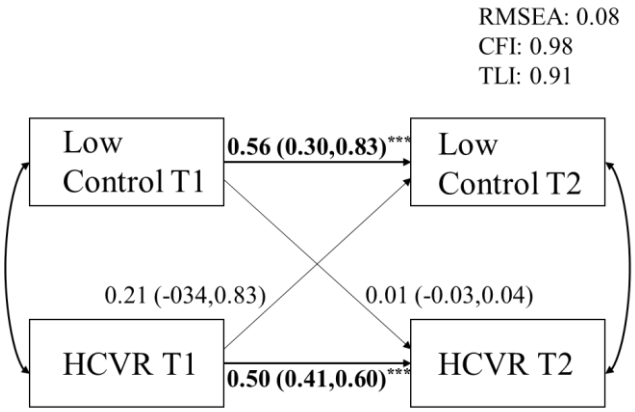
Levels of significance: *** p≤0.001; ** p≤0.01; * p≤0.05

Figure 2.7: Cross-lagged-panel model low control and depressive symptoms.



Levels of significance: *** p≤0.001; ** p≤0.01; * p≤0.05

Figure 2.8: Cross-lagged-panel model ERI and HCVR.



Levels of significance: *** p≤0.001; ** p≤0.01; * p≤0.05

Figure 2.9: Cross-lagged-panel model low control and HCVR.

Chapter 3: Cross-national differences in the association between retirement and memory decline

Co-authored by: Alicia Riley and Maria M. Glymour

Abstract

Objective: Thus, this study examines to identify how retirement affects memory decline and if this association varies among 17 European countries.

Methods: Respondents of the longitudinal Survey of Health, Aging, and Retirement in Europe (SHARE; N=8,646) aged 50+ who were in paid work at baseline and retired during the observation period completed up to 6 memory assessments (immediate and delayed word recall) over 13 years. Three-level (time-points, individuals, countries) linear mixed models with random slopes for retirement at the country level were estimated to evaluate whether memory decline accelerated after retirement and if this association differed between countries.

Results: On average, retirement was associated with a moderate decrement in word recall (b= -0.273, 95% CI -0.441, -0.104) and memory decline accelerated after retirement (b= -0.044, 95% CI -0.070, -0.018). Significant between-country heterogeneity in memory decline after retirement existed (var= 0.0474,95% CI (0.013,0.168). Memory decline after retirement was more rapid in Italy, Greece, Czech Republic, Poland, Portugal, and Estonia compared to Northern and Central European countries.

Conclusions: Rising retirement ages might postpone memory decline, especially in Southern and Eastern European countries. Evaluation of resources that could protect retirees from memory decline not only on the individual level would be valuable.

3.1. Introduction

Preserving memory functioning represents a core element of healthy aging and independent living as cognitive decline is associated with multiple health domains including depression, physical health, and dementia (Celidoni, Bianco, and Weber 2017; Fisher et al. 2014; González, Bowen, and Fisher 2008; Salthouse 2012; Xue et al. 2018). The identification of factors associated with memory decline is of high importance at the individual and societal level to enable independent living at older ages and to ensure the sustainability of social security systems. Retirement has been repeatedly reported to be a potential trigger for cognitive aging as it can be seen as a stressful life event accompanied by changes in everyday life (Bonsang, Adam, and Perelman 2012; Clouston and Denier 2017; Hessel 2016; Mazzonna and Peracchi 2017). Recent increases in statutory retirement ages in most European countries raises the question of whether delayed retirement may influence later life memory trajectories (Bianchini and Borella 2016). However, the institutional context which provides retirement options and influences population health, differs among countries and hence, it is likely that not only individual factors, but also institutional factors, are associated with retirement and memory decline. Comparing memory trajectories before and after retirement in 17 European countries, this study aims to identify cross-national differences in the association between retirement and memory decline.

From a life course perspective, retirement is a major life transition associated with changes in everyday activities and the turnover of social roles, which might create stress and, in turn, influence memory decline (Atchley 1989; Elder 1994). The “use-it-or-lose-it” hypothesis suggests that when retirees leave the labor force--which frequently requires regular “use” of cognitive capacities--and adopt a more sedentary lifestyle in retirement, they will “lose” cognitive abilities (Clouston and Denier 2017; Rohwedder and Willis 2010). However, retirement may be a relief from stressful work and hazardous working conditions and thus,

could improve memory functioning (Hessel 2016). Based on previous research, the overall effect of retirement on memory is unclear. Many prior studies have suggested that retirement is associated with a cognitive decline (Atalay, Barrett, and Staneva 2019; Bonsang et al. 2012; Clouston and Denier 2017; Coe and Zamarro 2011; Mazzonna and Peracchi 2012, 2017; Xue et al. 2018), but other studies found no or inconsistent effects (Denier et al. 2017; Starke et al. 2019) or even a positive relationship between retirement and memory (Bianchini and Borella 2016). These inconsistencies may reflect the challenges inherent to observational research on retirement and memory. Some studies compared retirees with workers, which provides a potentially biased estimate of the effect of retirement on memory because people who continue to work at higher ages are likely to differ systematically from those who retire early, e.g. in their health status (Xue et al. 2018). This healthy-worker selection effect results in more negative findings for the retiring group (Bonsang et al. 2012; Coe and Zamarro 2011; Mazzonna and Peracchi 2012). Furthermore, the a few studies which included occupational characteristics showed smaller negative effects of retirement on memory decline (Mazzonna and Peracchi 2017; Zulka, Hansson, and Hassing 2019).

Although some work has adopted an instrumental variable (IV) design to clarify the causality between retirement and cognition using statutory pension ages as an IV (Bianchini and Borella 2016; Celidoni et al. 2017; Coe and Zamarro 2011; Mazzonna and Peracchi 2012, 2017), the validity of this method depends on the chosen instrument. Especially in cross-national studies, it is likely that statutory pension ages are correlated with other national differences that affect health, and therefore do not provide valid IVs for the effects of retirement *per se* (Xue et al. 2018).

While previous research on the association between retirement and memory decline has not considered country differences as the variable of interest, the retirement-memory association appears to differ across institutional contexts (Bergqvist, Yngwe, and Lundberg 2013). This

variation is likely due to diverse institutional opportunities and constraints of welfare state regulations which provide different retirement options and influence population health among countries (Bergqvist et al. 2013). To the extent that more generous social policies and pensions systems provide protection against major risks such as old-age poverty, we hypothesize that they may decrease stress and, in turn, protect against memory decline.

Thus, this study examines (1) how retirement affects memory decline and (2) if this association varies among 17 European countries. The focus is on episodic memory which belongs to the fluid cognitive abilities as they are more sensitive, also with regard to stress, and start to decline earlier than crystallized cognitive abilities (Salthouse 2012; Starke et al. 2019; Zulka et al. 2019). By doing so, this study advances previous research in several ways. So far, it is the first study investigating country differences in the association between retirement and memory decline. The study is based on longitudinal data from the survey of health, aging, and retirement in Europe (SHARE) covering a long observation period of 13 years before and after retirement, which enables the possibility to analyze short as well as long-term decline after retirement. Moreover, the use of a linear mixed model and additionally considering occupational characteristics allows for analyzing within-person change before and after retirement and increases the likelihood of capturing changes that are truly related to retirement itself (Zulka et al. 2019).

3.2. Why retirement might be associated with memory decline

From a life course perspective, an individual's life contains different roles and events that take place throughout life at various ages and stages of development (Elder 1994). Within this approach, retirement can be seen as a stressful life event (Elder 1994). Employment is central to an individual's identity as they spent a comparatively high proportion of their lifetime in

employment. For most older people, retiring from one's job is a milestone, marking a transition into later stages of life (Kim and Moen 2002). *Continuity theory* emphasizes that individuals try to maintain consistency in life patterns over time and hence, retirement can be seen as a disruptive and stressful life-event (Atchley 1989). Moreover, from a *role theory* perspective, retirement can be seen as a major role transition not only on the personal level, but also within the society in that individuals shift from contributing to social security systems to a receiver role. Therefore, retiring and losing the work role as well as experiencing changes in everyday activities might be associated with feelings of role loss leading to psychological distress. Stress may lead to dysregulation of homeostatic processes and a weakening of neuronal structures, especially in the hippocampal brain region which leads to cognitive impairments and decline (Andel et al. 2015).

Also, according to the "use-it-or-lose-it" hypothesis, intellectual activity and mental challenges are needed to maintain memory functioning (Salthouse 2012). When retirees leave the labor force--which frequently requires regular "use" of cognitive capacities--and adopt a sedentary retirement lifestyle, they will "lose" cognitive abilities (Denier et al. 2017; Hultsch et al. 1999). This interpretation assumes that the workplace is a more challenging environment which stimulates cognition, such that retiring implies losing stimulation and is therefore a potential trigger for memory decline (Rohwedder and Willis 2010).

According to these theories, retirement should accelerate memory decline. However, even if retirement is a stressful life event, individuals' may adjust to retirement and the resulting change in social roles after a certain period of time. A life course approach is therefore especially suitable for explaining short-term memory declines. In contrast, the "use-it-or-lose-it" hypothesis might explain more constant, long-term effects in memory decline.

Previous research on the association between retirement and memory decline has shown mixed results. Starke et al. (2019) analyzed the decline in episodic memory before and after retirement

in England and found no differences in decline before and after retiring. Xue et al. (2018) found that the decline in episodic memory became faster after retirement but not in other cognitive domains among English civil servants. Other studies found that retirement was associated with a more rapid decline in episodic memory in the United States and Australia (Atalay et al. 2019; Clouston and Denier 2017). In contrast, Denier et al. (2017) found no association between retirement and episodic memory but a positive association with abstract reasoning which increased after retirement in the United States. Another vast body of literature from the economic stream tried to analyze the causal impact of retirement on cognition by using an instrumental-variable approach. Bonsang et al. (2012) used social security eligibility ages as instrument for retirement within the American HRS sample and showed that retirement was associated with a 9% reduction in episodic memory and the effect occurs shortly after retirement. Likewise, Mazzonna and Peracchi (2017) found a negative effect of retirement in Europe using early and statutory retirement ages as IV, and the effects became larger as the number of years spent in retirement increased. In contrast, two other studies using SHARE with four years additional follow-up and using eligible retirement ages as an instrument found a positive effect of retirement on episodic memory (Bianchini and Borella 2016; Celidoni et al. 2017). Overall, the results revealed negative, null, or positive associations. These differences can be partly attributed to the adjustment of prior occupational characteristics, which slightly decreased the effect of retirement on memory decline (Zulka et al. 2019). Moreover, studies based on American data (HRS, WLS) reported more frequently negative results than studies based on the European SHARE. A meta-analysis adjusting for different study designs, e.g. diverse analytical approaches or operationalizations of retirement, showed that differences in the results are not due to dissimilarities in study characteristics (Zulka et al. 2019). However, none of these studies considered variations between countries in the relationship of retirement and memory decline which might explain the diverse results.

3.3. Country differences in retirement and memory functioning

Individuals from different European countries face diverse institutional opportunities as well as constraints from welfare state regulations, which shape retirement options and influence population health. Thus, it is likely that besides individual factors, institutional factors also play a major role in the association between retirement and memory decline. For instance, in 2006, the statutory retirement age ranged from 60 years in France to 65 years in most other European countries and has increased steadily in all countries since then. In addition to the statutory retirement age, options for early retirement differ between countries: whereas early retirement is possible at age 57 in France and Italy, less generous options exist in the Netherlands or Portugal, and no options for early retirement are available in Israel (OECD 2009). Furthermore, social policies that protect against major vulnerabilities, such as old-age poverty, by providing more generous pensions should make the retirement transition a less stressful event and hence, might be protective against memory decline. In particular, Northern European countries, followed by Central Europeans, offer more benefits and generous policies, including higher social spending and coverages rates, protecting against old-age poverty compared to Southern or Eastern European countries (de Breij, Huisman, and Deeg 2020; König, Hess, and Hofäcker 2016). Thus, it is reasonable to suspect that retirement is a more stressful event in countries with less generous pensions and inflexible retirement options, which might accelerate memory decline.

Previous research has shown that more generous policies and benefits are associated with better population health (Bergqvist et al. 2013). Other studies found that higher coverage rates and higher social spending are associated with better self-rated health (Álvarez-Gálvez and Jaime-Castillo 2018; Ferrarini, Nelson, and Sjöberg 2014). Yet, to our knowledge, none of these studies analyzed memory decline as an outcome. While other research has shown that country differences in memory decline exist, scholars have yet to investigate how retirement is

associated with country differences (Cadar et al. 2017; Formanek et al. 2019). The cross-country comparative design we employ in this study is a promising approach for clarifying the effect of retirement on memory decline. We test the hypothesis that memory decline varies across countries because retirement options and social policies differ among countries, making retirement a more stressful event in countries offering fewer options and less support.

3.4. Data & Method

3.4.1. Data and sample

This study used longitudinal data from the Survey of Health, Aging, and Retirement in Europe (SHARE). The survey followed participants aged 50+ (Börsch-Supan et al. 2013). Starting with the first wave in 2004 and 2005 in 11 European countries and Israel, follow-ups were conducted biennially through 2017. Data collection based on computer-assisted personal interviews and sampling strategies varied by country. Refreshment samples were added constantly to increase sample size and compensate for attrition. The wave specific response rates of the longitudinal sample differed by country, ranging from 79% in Italy to 91% in Estonia (Bergmann et al. 2019). We used data from six waves (1,2,4,5,6,7), covering an observation period from 2004-2017. Although SHARE has included 28 countries to date, our analytical sample includes 17 countries[1] who were part of the longitudinal SHARE sample and had a sufficient number of retirement transitions. Respondents in the analytic sample were aged between 50 and 78, had to be in paid work at the first observation, and had to have retired during the observation period (see Figure 1) so we could assess within-person memory changes both before and after

[1] Austria, Germany, Sweden, The Netherlands, Spain, Italy, France, Denmark, Greece, Switzerland, Belgium, Israel, Czech Republic, Poland, Portugal, Slovenia and Estonia.

retirement. The analytic sample consisted of 8,646 respondents, 49% female and 51% male, and 35,285 observations with on average 4.1 observations per respondent.

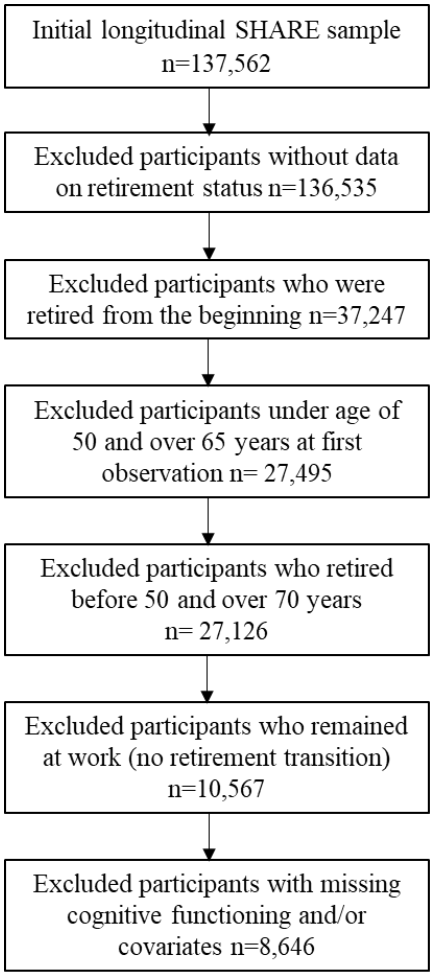


Figure 1: Flowchart of sample selection process.

3.4.2. Variables

Memory functioning

Episodic memory was measured with immediate and delayed 10-word recall (Harris and Dowson 1982). The test focused on episodic memory abilities and consisted of the verbal registration and recall of a list of 10 words. Respondents listened to the list of words once and

were tested twice: first immediately after the encoding phase, and second, after a delay time of about five minutes. In wave 1 and 2 all respondents got the same list of words and from wave 4 onwards, word lists were randomized into 4 different lists and assigned to respondents. A sum score over immediate and delayed word-recall was built ranging from 0-20 (Celidoni et al. 2017; Starke et al. 2019).

Retirement and retirement age

The respondent's current job situation was measured by self-report in every wave. Respondents were classified as retired if they exited work. Thus, they could change from paid work to retirement directly or they could report themselves to be unemployed, disabled, or a homemaker at one wave and retired at a subsequent wave. In case of retirement or unemployment, respondents reported the year of the event. For homemakers and permanently disabled persons, the interview year the employment transition was first reported was used. Retirement age was calculated based on the year of retirement. Retirement transitions were coded with a dummy variable changing from 0 to 1 once a respondent retired. Each respondent's age was centered around that person's individual retirement age (i.e., age at retirement was coded 0 years) and was included as a covariate. Possible period effects were considered by adjusting for the mean-centered birth year.

Covariates

Analysis were adjusted for education and gender which were measured at baseline. Educational categories were classified according to the International Standard Classification of Education (ISCED-97) and recoded into low (ISCED 1,2), medium (ISCED 3,4) and high (ISCED 5,6). Other possible confounders that we controlled for were respondents' marital status (married vs. not married) and having difficulty to make ends meet measured at baseline. Respondents'

health status was adjusted with time-varying assessments of: self-reported health status (SRH), the EURO-D depression scale, and comorbidities. SRH was captured on a five-point scale ranging from 1- excellent to 5- poor. The EURO-D scale consisted of 12 items measuring the number of depressive symptoms in general population surveys (Hoven, Wahrendorf, and Siegrist 2015). The scale ranged from 0 to 12, with higher values indicating more depressive symptoms. Based on the question "Has a doctor ever told you that you had any of the following conditions", respondents were shown a list of 17 chronic conditions ranging from a heart attack or stroke, to diabetes or hip fractures. Comorbidity was dichotomized as less or 2 and more chronic conditions.

We also adjusted for pre-retirement work-related stress, which was measured with the effort-reward-imbalance model (ERI) (Siegrist et al. 2004) and the low job control model (Karasek et al. 1998). ERI was assessed with seven items in total, two on effort and five on reward. The ERI was defined by the ratio of the sum score of effort items (numerator) divided by the sum score of reward items (denominator) adjusted for the number of items (Siegrist et al. 2014). A higher score indicated a greater effort-reward imbalance. Low job control was measured with an index of two questions about job autonomy and further training. The index ranges from 2–8, with higher scores indicating lower job control. A detailed description of the measures can be found elsewhere (Mäcken 2019). In case of missing values in the work-related stress questions due to changed filters in wave 5 of the questionnaire, data were imputed based on the values of a previous or later wave.

To minimize any influence from practice effects, a dummy was included, which was 0 for the wave when a respondent took the test for the first time and 1 for all subsequent assessments (Vivot et al. 2016).

3.4.3. Statistical analysis

To analyze the association between retirement and memory decline, we estimated a linear mixed model (LMM). Three different levels were considered: time points (level 1) were nested in respondents (level 2), who were nested within countries (level 3). Respondents' age was centered at the individual retirement age and thus measured the within-person change as the person approached retirement and in the years following retirement (range= -13 to 14). The between-person differences were measured by including the retirement age (not centered) in the model (Curran and Bauer 2011). An interaction between retirement status and respondents' centered age-at-retirement was included to measure the slope after retirement (i.e., this variable was zero for all years prior to retirement and represented the difference in rate of memory change after retirement compared to before retirement). Country differences were analyzed by specifying random slopes for: retirement status, centered age-at-retirement, and the slope after retirement (interaction between retire*centered age) at the country level. We visualized between-country differences using caterpillar plots for each country's predicted deviation from the overall average.

Sensitivity Analysis

We conducted several sensitivity analyses to assess the robustness of the results. To adjust for time-varying treatment (retirement) and confounding due to changes in health and work-related stress which may precede memory decline, a marginal structural model was used. In this approach, logistic regressions were estimated to predict the probability of retirement at *t* with time-lagged covariates at *t-1* for each individual (Robins, Hernan, and Brumback 2000). The predictive probabilities of these two models were used to generate inverse probability of treatment weights that were applied in the analysis so that the distribution of the confounders was independent of the exposure and allowed for an unbiased estimate of the association

between retirement and cognitive functioning (Cole and Hernán 2008; Pool et al. 2018). We also excluded 955 respondents from the analytic sample who retired for health reasons to assess potential bias to the results due to reverse causality (Xue et al. 2018). In addition, analyses were estimated separately by gender. Recent simulation studies on multilevel analysis suggested that random effects models based on few countries tend to overestimate country effects (Bryan and Jenkins 2016). To validate our findings, the model was estimated with country dummies and interactions between country and retirement.

3.5. Results

Participants' characteristics

At baseline, the average word recall over all countries was 10 words, with the lowest around eight words in Portugal and Spain, and the highest in Austria and Denmark with eleven words (see Table 1). Average retirement age was 61.6 years: lowest in Poland and highest in Sweden.

Table 1: Sample characteristics at baseline, by country.

Country	N	Word-Recall	Retirement age	Baseline age	Female	Married	Low education	Medium education	High education
		M (SD)	M (SD)	M (SD)	%	%	% (SD)	% (SD)	% (SD)
Austria	504	11.0 (3.6)	60.0 (3.1)	56.4 (3.5)	53.4 (-)	70.4 (-)	14.3 (35.0)	50.8 (50.0)	34.9 (47.7)
Belgium	885	10.3 (3.1)	60.4 (3.4)	55.8 (3.6)	45.2 (-)	76.8 (-)	31.1 (46.3)	31.6 (46.5)	37.3 (48.4)
Czech Republic	684	10.1 (3.1)	60.3 (2.8)	57.2 (3.1)	54.2 (-)	77.6 (-)	39.3 (48.9)	47.2 (50.0)	13.5 (34.1)
Denmark	637	11.0 (2.9)	62.4 (3.2)	57.3 (3.7)	53.4 (-)	77.4 (-)	8.8 (28.3)	38.3 (48.7)	55.4 (50.0)
Estonia	518	10.0 (3.2)	62.1 (3.4)	59.8 (3.4)	55.2 (-)	67.0 (-)	14.9 (35.6)	59.7 (49.1)	25.5 (43.6)
France	811	9.8 (3.1)	60.2 (3.0)	55.5 (3.3)	49.0 (-)	72.5 (-)	23.6 (42.6)	44.8 (49.8)	31.7 (46.6)
Germany	529	10.5 (2.8)	62.6 (3.0)	57.6 (3.7)	51.0 (-)	84.7 (-)	7.0 (25.5)	53.7 (49.9)	39.3 (48.9)
Greece	465	9.4 (2.9)	63.1 (3.7)	56.5 (3.8)	33.8 (-)	84.1 (-)	39.6 (49.0)	34.8 (47.7)	25.6 (43.7)
Israel	354	9.0 (3.0)	63.1 (4.0)	58.1 (3.6)	59.6 (-)	86.7 (-)	24.6 (43.1)	38.1 (48.6)	37.3 (48.4)
Italy	445	8.8 (3.0)	60.3 (3.7)	56.1 (3.7)	39.3 (-)	88.1 (-)	53.3 (49.9)	33.5 (47.2)	13.3 (34.0)
Netherlands	397	10.2 (3.2)	61.7 (3.0)	57.7 (3.3)	41.1 (-)	89.2 (-)	36.0 (48.1)	24.9 (43.3)	39.0 (48.8)
Poland	233	8.7 (3.2)	59.3 (3.5)	55.0 (3.2)	52.8 (-)	87.6 (-)	18.9 (39.2)	67.8 (46.8)	13.3 (34.0)
Portugal	85	8.0 (3.0)	60.9 (3.8)	58.8 (4.1)	61.2 (-)	82.4 (-)	78.8 (41.1)	9.4 (29.4)	11.8 (32.4)
Slovenia	185	9.9 (3.2)	59.1 (2.9)	56.2 (2.7)	47.6 (-)	80.0 (-)	16.2 (37.0)	61.6 (48.8)	22.2 (41.6)
Spain	505	8.0 (3.3)	62.1 (3.5)	57.5 (4.1)	37.2 (-)	87.5 (-)	66.3 (47.3)	16.8 (37.5)	16.8 (37.5)
Sweden	860	10.6 (2.8)	64.2 (2.4)	58.6 (3.5)	54.1 (-)	82.8 (-)	33.5 (47.2)	33.6 (48.1)	32.9 (47.0)
Switzerland	549	11.0 (3.0)	63.3 (2.9)	58.8 (3.7)	48.6 (-)	76.0 (-)	20.6 (40.5)	62.7 (48.4)	16.8 (37.4)
Total	8,646	10.0 (3.2)	61.6 (3.5)	57.2 (3.8)	48.9 (-)	79.5 (-)	29.0 (45.4)	41.7 (49.3)	29.4 (45.5)

Table 1(continued): Sample characteristics at baseline, by country.

Country	Self-rated Health	Depressive Symptoms	Comorbidity	ERI	Low Job-Control	Difficulty to make ends meet
	M (SD)	M (SD)	%	M (SD)	M (SD)	%
Austria	2.5 (.99)	1.7 (1.8)	28.0 (-)	0.99 (.44)	4.4 (1.5)	15.9 (-)
Belgium	2.6 (.94)	2.3 (2.1)	33.7 (-)	0.98 (.47)	4.3 (1.4)	21.9 (-)
Czech Republic	3.0 (.92)	1.7 (1.9)	33.0 (-)	1.07 (.43)	4.6 (1.2)	47.2 (-)
Denmark	2.2 (.98)	1.6 (1.8)	34.5 (-)	0.96 (.40)	3.8 (1.4)	10.0 (-)
Estonia	3.7 (.81)	2.6 (2.0)	40.0 (-)	1.02 (.40)	4.6 (1.3)	43.8 (-)
France	2.7 (.99)	2.4 (2.0)	27.9 (-)	0.97 (.46)	4.3 (1.6)	29.2 (-)
Germany	2.8 (.96)	1.7 (1.8)	28.9 (-)	1.02 (.47)	4.1 (1.4)	18.3 (-)
Greece	2.5 (.84)	1.5 (1.8)	22.4 (-)	1.11 (.46)	4.7 (1.4)	64.9 (-)
Israel	2.7 (1.1)	2.0 (1.9)	37.0 (-)	0.97 (.40)	4.5 (1.3)	53.7 (-)
Italy	2.7 (.96)	2.1 (2.0)	27.0 (-)	1.14 (.49)	4.7 (1.5)	53.9 (-)
Netherlands	2.6 (1.0)	1.6 (1.7)	22.9 (-)	0.87 (.31)	3.9 (1.1)	12.8 (-)
Poland	3.3 (.92)	2.9 (2.2)	32.6 (-)	1.11 (.44)	5.0 (1.3)	67.8 (-)
Portugal	3.6 (.76)	2.7 (2.5)	50.6 (-)	1.09 (.44)	4.5 (1.3)	64.7 (-)
Slovenia	2.9 (.91)	1.9 (1.6)	25.9 (-)	1.05 (.49)	4.5 (1.2)	51.9 (-)
Spain	2.8 (.91)	1.9 (2.1)	27.5 (-)	0.99 (0.39)	4.6 (1.3)	45.3 (-)
Sweden	2.3 (.96)	1.7 (1.7)	30.0 (-)	0.95 (.41)	3.8 (1.3)	10.3 (-)
Switzerland	2.4 (.93)	1.8 (1.7)	23.0 (-)	0.86 (.37)	4.0 (1.3)	10.0 (-)
Total	2.7 (1.0)	2.0 (1.9)	30.2 (-)	0.99 (.44)	4.3 (1.4)	31.1 (-)

Multivariate Findings

In linear mixed models adjusted for age, gender, education, health, work-related stress, and financial difficulties, retirement was associated with a moderate decline in word recall (b = -0.273, 95% CI -0.441, -0.104) (see Table 2). The centered age at retirement indicated that prior to retirement, the age-slope for memory was slightly positive but close to null (b = 0.033, 95% CI 0.004, 0.061) but after retirement the age-slope significantly declined (b= -0.044, 95% CI -0.070, -0.018). Individuals with a later retirement age averaged higher word recall with the estimated effect of delaying retirement by a year (b =.045, 95% CI 0.026, 0.063) almost equal and opposite the annual effect of being retired.

Table 2: Results of the linear mixed model on word recall.

	ß Coefficient	P-value	95% CI
Retired status (change in memory at the time of retirement)	-0.273	0.002	(-0.441,-0.104)
Years until retirement (age slope prior to retirement)	0.033	0.026	(0.004,0.061)
Difference in age slope following retirement vs prior to retirement	-0.044	0.001	(-0.070,-0.018)
Retirement Age	0.045	<0.001	(0.026,0.063)
Year of birth	0.086	<0.001	(0.071,0.102)
Practice effect	0.379	<0.001	(0.290,0.468)
Female	1.066	<0.001	(0.975,1.158)
Married	0.080	0.166	(-0.033,0.192)
Low Education	0.000	-	(0.000,0.000)
Medium Education	0.832	<0.001	(0.717,0.947)
High Education	1.811	<0.001	(1.686,1.937)
Self-rated health	-0.229	<0.001	(-0.265,-0.192)
Depressive symptoms	-0.099	<0.001	(-0.117,-0.081)
2+ chronic diseases	0.058	<0.099	(-0.011,0.127)
Effort-Reward-Imbalance	-0.008	0.881	(-0.117,0.101)
Low job-control	-0.048	0.004	(-0.081,-0.015)
Difficulty to make ends meet	-0.240	<0.001	(-0.348,-0.132)
Constant	6.812	<0.001	(5.623,8.001)
Observations	35285		

Random-effects Parameters	Variance in coefficients	Std. Err. of variance estimate	95% CI
Country-level variance			
Retired Status	.0474	0.031	(0.013,0.168)
Years until retirement	.0022	0.001	(0.001,0.006)
Difference in age slope following retirement vs prior to retirement	.0012	0.001	(0.0003,0.005)
Constant	0.496	0.183	(0.242,1.021)
Individual-level variance			
Constant	2.980	0.069	(2.849,3.118)
Residual	5.544	0.048	(5.451,5.639)

We found significant between-country variability in the random coefficients for retirement, the age-slope prior to retirement, and post-retirement age-slope. Caterpillar plots of the random effects (see Figure 2) showed country differences in words recalled. The lines indicate the average variance of the random effect parameters of the linear mixed model.

Retirement had a more negative association with memory in most Eastern and Southern European countries (with the exception of Poland, Slovenia, and Spain) compared to the overall average effect of retirement (see Figure 2a). No clear pattern in the pre-retirement age slope of memory existed over countries, although there was substantial heterogeneity (see Figure 2b) with the fastest decline in Greece and Estonia and the slowest decline in Czech Republic, Belgium, and France.

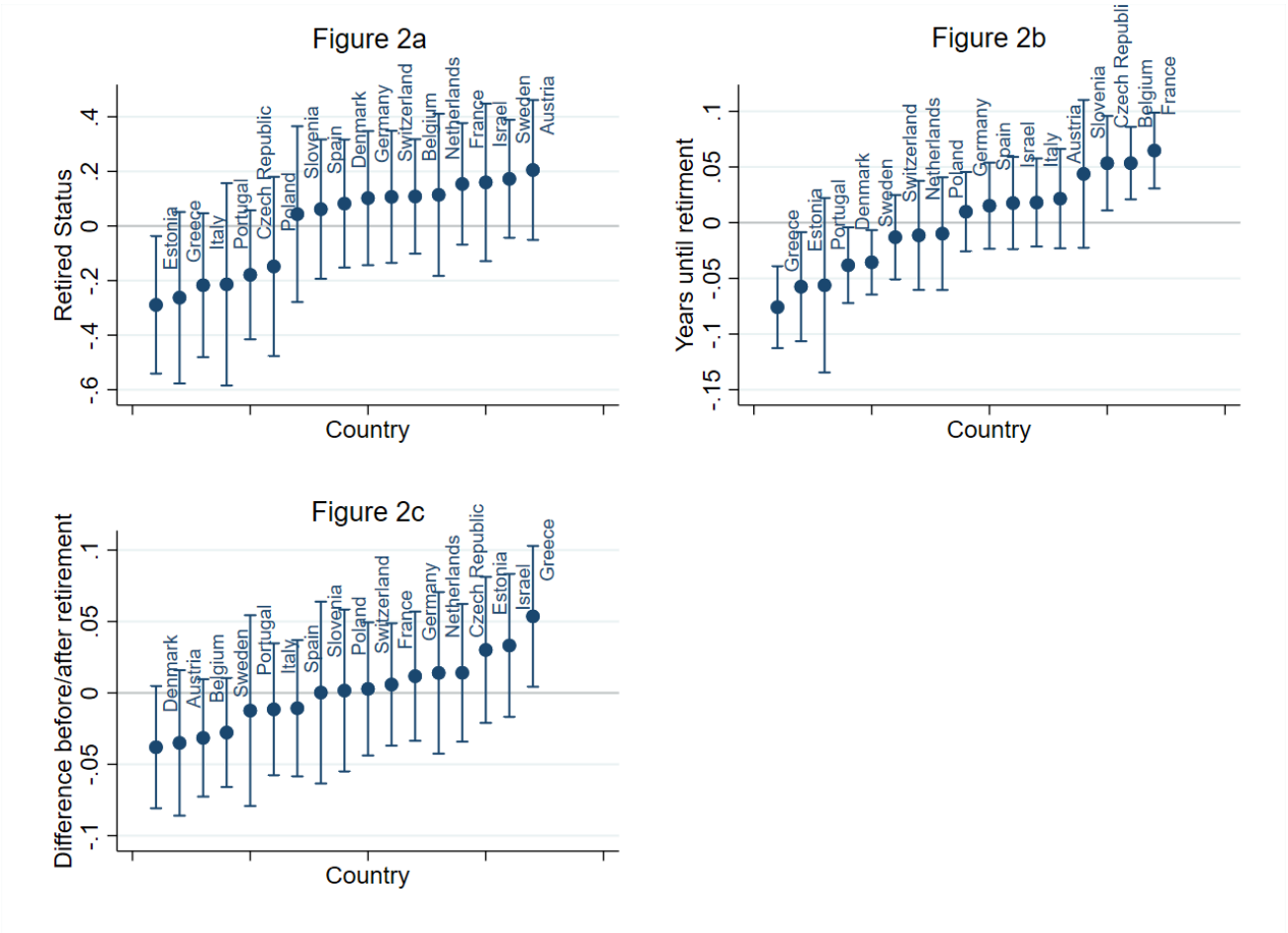


Figure 2: Caterpillar plots of random effect residuals with 95% CI.

The caterpillar plot representing the change in the slope before compared to after retirement (see Figure 2c) indicated significant between-country heterogeneity (var= .0012, 95% CI 0.0003,0.005), with the fastest increase in cognitive decline after retirement observed in

Denmark, Austria, Belgium, and Sweden but the slowest decline in Estonia, Israel, and Greece. Few of the country-specific estimates were significantly different from the overall average estimate however.

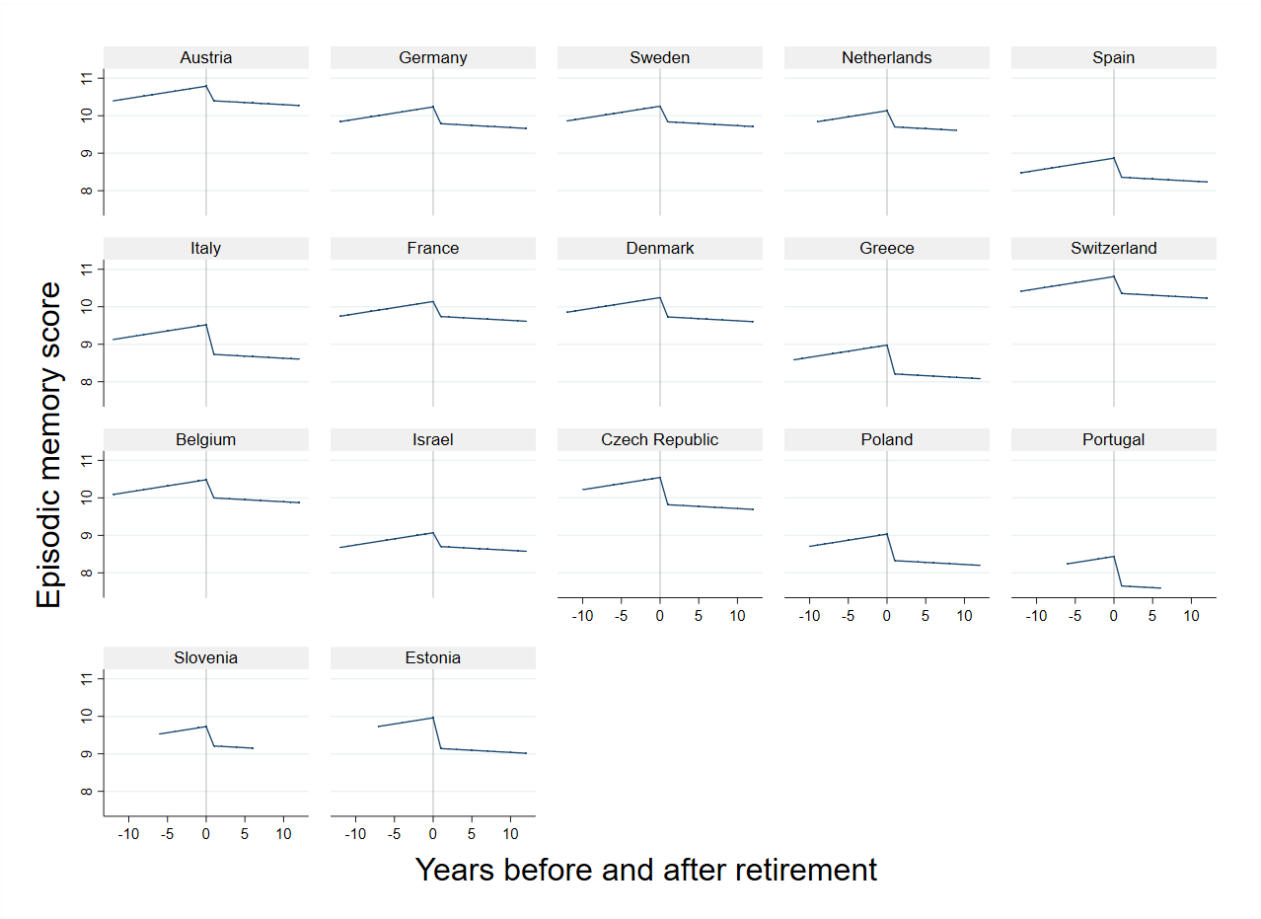


Figure 3: Country-specific predictions of episodic memory trajectories before and after retirement. Predictions for males with average values of all covariates.

Considering both the fixed and random effects predictions (see Figure 3), words recalled was associated with a deterioration in memory after retirement in all countries, but to different extents. The decline in memory after retirement was moderate in Northern and Central European countries and stronger in Southern and Eastern European countries. In Italy, Greece, Czech Republic, Poland, Portugal, and Estonia words recalled declined by almost one word

after retirement. The increase in words recalled before retirement was mostly due to practice effects.

Sensitivity analysis

The conducted sensitivity analysis did not change the estimated associations between retirement and episodic memory. The results of the marginal structural model revealed the same associations as the unweighted model but the confidence intervals increased. However, the slight increase in the slope prior to retirement lost significance, and the decline in the change in memory at the time of retirement increased. Excluding participants who retired due to ill health and estimating separate models for men and women did not change the results. Moreover, the linear mixed model with only two levels (time-points and individuals) and country dummies instead of a third level showed significant country differences in the association between words recalled and retirement between countries. Hence, the country effects of the linear mixed model did not appear to be overestimated. Results from these sensitive analyses are shown in the appendix tables 3-6.

3.6. Discussion

The aim of this longitudinal study was to clarify how retirement affects memory decline and to explore whether and how this association varies across 17 European countries. Overall, results indicate that memory declines slightly after retirement, whereby the short-term decline after retirement is more imminent than a long-term decline. Our results support prior findings which found of a negative association between retirement and episodic memory (Bonsang et al. 2012; Mazzonna and Peracchi 2017; Starke et al. 2019; Wickrama and O'Neal 2013). Additionally, we showed that this association varies depending on the country context. The effects of retirement differed between countries in interesting ways. In Italy, Greece, Czech Republic,

Poland, Portugal, and Estonia retirement was associated with a more rapid decline in episodic memory shortly after retirement compared to Northern and Central European countries. Memory decline was more rapid in Southern and Eastern European countries which are characterized by comparatively low social expenditures and pension replacement rates as well as low lifelong learning rates of older workers (de Breij et al. 2020; Eurostat 2019). Hence, results support the hypothesis that retirement seems to be a more stressful event in countries with less generous pensions, lower social spending, and inflexible retirement options, which accelerate memory decline after retirement. Our results are in line with previous research showing that more generous policies and benefits are associated with better pre- and post-retirement population health (Álvarez-Gálvez and Jaime-Castillo 2018; Bergqvist et al. 2013; de Breij et al. 2020).

On the individual level, results demonstrate that retirement triggers memory decline mainly in the short-term. Thus, the life course approach considering retirement as a stressful life event might be more applicable than the "use-it-or-lose-it" hypothesis. However, our results cannot fully disentangle which of these two theoretical assumptions might be more valid as neither stress measures during the retirement transition nor mentally challenging work measures were available.

The overall decline in memory after retirement was moderate, indicating that retirement can be a stressful life-event for some individuals it might be a relief from stressful work and hazardous working conditions for others (Hessel 2016). To attempt to account for this, we adjusted for pre-retirement work-related stress, measured as low job control, which was negatively associated with episodic memory. Moreover, giving up the role of work can be a relief if retirees have other competing social roles, e.g. within the family, they can fully focus on after retiring.

The slightly increase in episodic memory prior to retirement can mostly be attributed to practice effects. Further sensitivity checks showed that the positive age slope prior retirement is not significant which is in line with previous research (Starke et al. 2019). Furthermore, a higher

retirement age was positively associated with episodic memory. This result may reflect positive selection if individuals with worse memory are more likely to retire earlier, confirming a likely bias in studies on the effects of retirement based on comparing people with different ages of retirement.

This study contributes to previous research by showing that not only individual factors, but also the institutional context plays a major role in the association between retirement and memory decline. While the current study did not test specific mechanisms for these cross-national differences in the retirement coefficients, our interpretation of the results generates new hypotheses that should be explored further in future research. For example, we found that retirement appears to be more consequential for memory loss in countries with less generous social security systems, such as Portugal, Italy, Greece, Poland, or the Czech Republic. Countries offering more generous social protections, such as Sweden, Denmark, or the Netherlands, may provide older adults with a sense of security during the retirement transition which may, in turn, reduce stress and decelerate memory decline (Bambra 2011; de Breij et al. 2020). This suggests that larger societal and policy factors moderate the association between retirement as a stressful event in the life course and cognitive aging. Future research should investigate the potential for country-specific characteristics to moderate the association between retirement and memory decline, such as participation in lifelong learning among older workers or active labor market expenditures. Additionally, the long observation period of 13 years before and after retirement offered the possibility to analyze short as well as long-term effects of retirement showing that the long-term effect of retirement on memory decline is only marginal in most countries. Applying a within-person change design enabled the possibility of comparing memory trajectories before and after retirement within persons and not comparing retirees with workers and thus, avoiding the healthy worker effect. Several sensitivity analyses have been conducted to analyze possible reverse causality due to self-selection into retirement showing the robustness of the results.

This study has some limitations. A challenge, especially when analyzing cognition, is bias due to loss-to-follow-up that is differential for people with low cognitive functioning (Zulka et al. 2019). Within this study only retired participants with repeated observations before and after retirement were included. Some respondents dropped out earlier than others and had fewer measures of episodic memory which might not be randomly distributed. Furthermore, previous research showed differences in the association between different cognitive abilities and retirement, and episodic memory was among the first cognitive functions that declined with aging (Denier et al. 2017; Starke et al. 2019). However, this study focused on episodic memory and not on other cognitive measures of fluid cognitive abilities, such as numeracy or verbal fluency, which were not available in every wave of the SHARE. Also further information on occupational characteristics besides work-related stress, such as respondents' occupational class would have been desirable as retirement and episodic memory depend on other occupational characteristics besides work-related stress (Zulka et al. 2019). Another possible modifier of the association between retirement and memory are social activities or voluntary work if retirees substitute paid work with other activities. But occupational characteristics as well as social activities are not available in every wave of the SHARE (Radl 2013). Lastly, the current study is based on a small sample size in some countries, e.g. Portugal, which reduces precision of our effect estimates. A replication of this study with a larger sample size could be a task for future research.

In summary, our study is the first to test the association between retirement and memory decline across multiple country contexts. Our comparative, longitudinal research design enabled us to provide stronger evidence that was previously not available to explore variation between countries with different policy contexts. We found that retirement is associated with memory decline, but the association varies among countries. At the same time, later retirement ages are positively associated with memory functioning. Thus, raising retirement ages might have a positive impact on memory functioning in old age, especially in Southern and Eastern European

countries. Nevertheless, policy makers should consider improving psychosocial working conditions when raising retirement ages as work-related stress likely reduce this positive effect. Further evaluation of individual-level, as well as institutional-level, resources that could protect retirees from memory decline is warranted.

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3.9. Appendix

Table 3: Results adjusted for time-varying confounding with marginal structural model approach.

	ß Coefficient	P-value	95% CI
Retired status (change in memory at the time of retirement)	-0.365	0.003	(-0.605,-0.124)
Years until retirement (age slope prior to retirement)	0.032	0.094	(-0.005,0.070)
Difference in age slope following retirement vs prior to retirement	-0.042	0.007	(-0.073,-0.011)
Retirement Age	0.051	0.003	(0.017,0.084)
Effort-Reward-Imbalance	-0.085	0.212	(-0.219,0.048)
Low job-control	-0.061	0.001	(-0.098,-0.024)
Year of birth	0.084	<0.001	(0.049,0.120)
Practice effect	0.353	<0.001	(0.227,0.480)
Female	1.009	<0.001	(0.840,1.177)
Married	0.122	0.048	(0.001,0.243)
Low Education	0.000	-	(0.000,0.000)
Medium Education	0.878	<0.001	(0.704,1.053)
High Education	1.887	<0.001	(1.670,2.103)
Difficulty to make ends meet	-0.341	<0.001	(-0.448,-0.233)
Constant	5.745	<0.001	(3.591,7.899)
Observations	35285		

Table 4: LMM estimated without 955 participants who retired due to ill health.

	ß Coefficient	P-value	95% CI
Retired status (change in memory at the time of retirement)	-0.269	0.002	(-0.439,-0.100)
Years until retirement (age slope prior to retirement)	0.031	0.034	(0.002,0.060)
Difference in age slope following retirement vs prior to retirement	-0.041	0.002	(-0.067,-0.015)
Retirement Age	0.040	<0.001	(0.020,0.059)
Effort-Reward-Imbalance	-0.033	0.582	(-0.149,0.084)
Low job-control	-0.045	0.012	(-0.079,-0.010)
Year of birth	0.084	<0.001	(0.068,0.100)
Practice effect	0.400	<0.001	(0.307,0.494)
Female	1.043	<0.001	(0.946,1.139)
Married	0.089	0.146	(-0.031,0.209)
Low Education	0.000	-	(0.000,0.000)
Medium Education	0.828	<0.001	(0.706,0.949)
High Education	1.783	<0.001	(1.652,1.914)
Self-rated health	-0.232	<0.001	(-0.271,-0.193)
Depressive symptoms	-0.088	<0.001	(-0.108,-0.069)
2+ chronic diseases	0.063	0.091	(-0.010,0.136)
Difficulty to make ends meet	-0.242	<0.001	(-0.357,-0.127)
Constant	7.109	<0.001	(5.849,8.370)
Observations	31635		

Table 5: LMM estimated separately for female and male respondents.

	Female			Male		
	ß Coefficient	P-value	95% CI	ß Coefficient	P-value	95% CI
Retired status (change in memory at the time of retirement)	-0.309	0.012	(-0.551,-0.068)	-0.227	0.021	(-0.420,-0.034)
Years until retirement (age slope prior to retirement)	0.044	0.005	(0.013,0.074)	0.024	0.126	(-0.007,0.055)
Difference in age slope following retirement vs prior to retirement	-0.051	0.002	(-0.084,-0.019)	-0.044	0.001	(-0.069,-0.019)
Retirement Age	0.056	<0.001	(0.029,0.082)	0.031	0.016	(0.006,0.056)
Effort-Reward-Imbalance	0.056	0.482	(-0.099,0.210)	-0.072	0.357	(-0.225,0.081)
Low job-control	-0.071	0.003	(-0.118,-0.024)	-0.024	0.299	(-0.070,0.022)
Year of birth	0.091	<0.001	(0.069,0.113)	0.086	<0.001	(0.065,0.107)
Practice effect	0.374	<0.001	(0.246,0.502)	0.381	<0.001	(0.257,0.505)
Married	-0.059	0.447	(-0.209,0.092)	0.262	0.003	(0.090,0.433)
Low Education	0.000	-	(0.000,0.000)	0.000	-	(0.000,0.000)
Medium Education	0.869	<0.001	(0.703,1.034)	0.819	<0.001	(0.660,0.978)
High Education	1.854	<0.001	(1.674,2.035)	1.774	<0.001	(1.600,1.948)
Self-rated health	-0.218	<0.001	(-0.271,-0.165)	-0.237	<0.001	(-0.288,-0.186)
Depressive symptoms	-0.090	<0.001	(-0.114,-0.067)	-0.108	<0.001	(-0.136,-0.081)
2+ chronic diseases	0.059	0.237	(-0.039,0.158)	0.055	0.262	(-0.041,0.151)
Difficulty to make ends meet	-0.279	<0.001	(-0.434,-0.124)	-0.262	0.001	(-0.412,-0.111)
Constant	7.270	<0.001	(5.581,8.959)	7.554	<0.001	(5.960,9.148)
Observations	17354			17931		

Table 6: LMM with country dummies and interaction between country and retirement.

	ß Coefficient	P-value	95% CI
Retire	0.130	0.272	(-0.102, 0.363)
Centered Age	0.033	<0.001	(0.017, 0.049)
Retire*Centered Age	-0.045	<0.001	(-0.063, -0.027)
Retirement age	0.030	0.002	(0.012, 0.049)
Year of birth	0.098	<0.001	(0.082, 0.114)
Married	-0.064	0.274	-0.179, 0.051)
Low education	0.000	-	(0.000, 0.000)
Medium Education	0.775	<0.001	(0.657, 0.894)
High Education	1.770	<0.001	(1.640, 1.900)
Self-rated health	-0.244	<0.001	(-0.281, -0.207)
Depressive symptoms	-0.070	<0.001	(-0.088, -0.052)
2+ chronic diseases	0.061	0.083	(-0.008, 0.130)
Effort-Reward-Imbalance	-0.111	0.026	(-0.208, -0.013)
Low job-control	-0.067	<0.001	(-0.097, -0.037)
Difficulty to make ends meet	-0.202	<0.001	(-0.314, -0.090)
Practice effect	0.390	<0.001	(0.301, 0.480)
Austria	0.000	-	(0.000, 0.000)
Germany	-0.431	0.007	(-0.745, -0.116)
Sweden	-0.162	0.275	(-0.452, 0.129)
Netherlands	-0.570	0.002	(-0.925, -0.215)
Spain	-2.049	<0.001	(-2.374, -1.723)
Italy	-1.340	<0.001	(-1.674, -1.007)
France	-0.920	<0.001	(-1.205, -0.634)
Denmark	-0.211	0.171	(-0.512, 0.091)
Greece	-1.303	<0.001	(-1.641, -0.965)
Switzerland	0.186	0.241	(-0.125, 0.497)
Belgium	-0.543	<0.001	(-0.823, -0.263)
Israel	-1.610	<0.001	(-1.966, -1.253)
Czech Republic	-0.269	0.081	(-0.571, 0.033)
Poland	-1.617	<0.001	(-2.040, -1.195)
Portugal	-1.996	<0.001	(-2.666, -1.326)
Slovenia	-1.229	<0.001	(-1.672, -0.786)
Estonia	-0.477	0.004	(-0.801, -0.152)
Austria*Retire	0.000	-	(0.000, 0.000)
Germany*Retire	-0.090	0.566	(-0.396, 0.216)
Sweden*Retire	-0.483	0.001	(-0.759, -0.208)
Netherlands*Retire	-0.185	0.300	(-0.534, 0.165)
Spain*Retire	-0.112	0.483	(-0.423, 0.200)
Italy*Retire	-0.459	0.005	(-0.777, -0.141)
France*Retire	0.358	0.012	(0.078, 0.638)
Denmark*Retire	-0.611	<0.001	(-0.900, -0.321)
Greece*Retire	-1.118	<0.001	(-1.448, -0.788)
Switzerland*Retire	-0.238	0.121	(-0.540, 0.063)
Belgium*Retire	0.084	0.545	(-0.189, 0.358)
Israel*Retire	0.204	0.243	(-0.139, 0.548)
Czech Republic*Retire	-0.174	0.250	(-0.472, 0.123)
Poland*Retire	-0.519	0.014	(-0.931, -0.107)

Portugal*Retire	-1.131	0.001	(-1.827, -0.434)
Slovenia*Retire	-0.017	0.941	(-0.462, 0.428)
Estonia*Retire	-0.815	<0.001	(-1.134, -0.495)
Constant	9.395	<0.001	(8.226, 10.564)
Observations	35285		

Chapter 4: Working conditions and prospective retirement age of older employees in the health and care sector

Co-authored by: Sebastian Merkel, Moritz Hess, Josef Hilbert, Gerhard Naegele

Abstract

Objective: This paper investigates the working conditions and the preferred and expected retirement age of older employees in the healthcare sector (HCS) in comparison to other sectors and explores what companies are doing to address the needs of their employees.

Methods: A mixed methods approach was conducted. The quantitative part is based on data derived from the Transitions and Old Age Potential (TOP) study in which older German employees were asked about their working conditions and retirement transitions. Matching techniques (Coarsened Exact Matching) were used to investigate difference between sectors. The sample consisted of 114 employees aged between 55 and 65, working in the HCS and their statistical twins. The qualitative analysis is based on case studies in two inpatient care organisations and two hospitals in Germany. 23 semi-structured interviews with staff members and with representatives of the management were carried out and analysed thematically.

Results: Results show that older employees in the HCS do not expect to retire earlier but significantly more often preferred to do so. Furthermore, HCS employees are more likely to face physically burdensome working conditions than in other sectors of the economy. The case studies indicate that there are very diverse and unsystematic strategies in addressing and supporting older employees.

Conclusion: Older employees in the HCS sector are employed in much "harsher" working conditions than their peers in other sectors. This must be kept in mind when trying to extend their working lives.

4.1. Introduction

The health and care sector (HCS) is of high societal relevance for two main reasons: First, demographic ageing will increase the need for health and long-term care and, consequently, the HCS will grow and have a rising demand for employees (European Commission 2014). Second, the HCS is characterized by very distinct structural and working conditions. Its workforce is older than in other sectors (European Commission 2014; Schulz and Radvanský 2014) and predominantly female with women representing 78 % of all employees (European Commission 2014). In addition, the hard physical and mental working conditions are leading to higher absenteeism, burn out problems and drop-outs (Evans and Hilbert 2015; Leinonen et al. 2011; Manyisa and van Aswegen 2017). This, in combination with the rising demand of care, is causing a shortage of skilled health and care employees. One possible way of dealing with this shortage is the extension of working lives. However, recent concerns are that the pension and labour market reforms – like the rapid increase of the official retirement from 65 to 67 – as well as the human resource measures aimed at delaying retirement and extending working lives are accompanied by a (re)emergence of social inequalities in late career employment and retirement (Hofäcker, Hess, and König 2016; Naegele 2017). Retirement transitions are defined as the phase of retirement including the last years of employment, the actual retirement as well as the first years of pension receipt. In this context, social inequalities in the retirement transition can be seen mainly in the freedom of choice: High-skilled older employees with high incomes and pension claims have the resources to work longer and, due to a higher identification with their occupations are more likely to do so. Hence, high skilled older employees have the choice when to retire. In contrast, low skilled employees in manual occupations are struggling to meet the requirements of the new credo of extending working-lives and increasingly have to involuntarily delay their labour force exit and retirement (Schuring et al. 2013). Thus, inequalities might exist between different groups of older

employees within one sector or company, but also between sectors and companies. One can assume that in the HCS the working conditions are making an extension of working lives more difficult than in other sectors (Li et al. 2013).

The societal challenge, thus, is on the one hand to provide the HCS with skilled and experienced (older) employees and on the other hand, to offer exactly those (older) employees an institutional and workplace context that allows them to work longer and retire later. This challenge is at the core of the project "EXTEND: Social inequalities in extending working lives of an ageing workforce" funded in the framework of the Joint Programming Initiative (JPI) "More Years, Better Lives – The Potential and Challenges of Demographic Change" on which the work presented here is based.

In the paper at hand, we investigate the working conditions – for example the physical environment and the stress levels of the work– and retirement intensions of older employees in the HCS with a focus on potential social inequalities in comparison to other sectors. We hypothesize that working conditions in the HCS are harsher than in the non-HCS sector. Furthermore, based on the work of Hess (2016) which showed that older employees with low socio-economic status would like to retire earlier than their peers but expect that they have to work longer, we hypothesize no differences in the expected retirement age. However, we assume that older employees in the HCS wish to retire earlier than those not working in the HCS.

Methodologically we combine two empirical analyses to a mixed-methods approach: First, we use matching techniques to compare the working conditions and attitudes towards retirement of older employees in the HCS with those in other sectors. By using Coarsened Exact Matching, statistical twins are generated, which allows an almost experimental design on the treatment variable HCS. Due to the high level of control, the effect of the treatment HCS can be determined more clearly than in previous research. Second, for understanding the underlying

mechanisms of the effects of working conditions on older employees within the HCS, qualitative interviews were conducted. We analyse four case studies to further explore the situation of older employees from an individual and organisational perspective and to investigate what human resources measures employers offer to older employees. The combination of the employees' and organisations' view gives a holistic picture of the situation of older employees in the HCS and, thus, allows us going beyond previous research. Finally, we discuss the results from both analyses in the context of social inequalities in late career and retirement, and in the end derive first implications for policy makers and companies.

4.2. Data and Methods

4.2.1. Quantitative Analysis: Matching Technique

Data were derived from the Transitions and Old Age Potential (TOP) study. The TOP survey collected data in 2013 on about 5000 older employees' and pensioners' actual respectively past working context and their past and respectively future retirement intensions and transition (Sackreuther et al. 2016). It is perfectly suitable for the analysis at hand as it is most recent and includes over 2000 older employees aged 55 to 70. The final sample of the present study consisted of respondents aged between 55 and the statutory retirement age of 65. To be included in the analysis, respondents had to be in paid work. Using the International Standard Classification of Occupations (ISCO-88) coding we identify 124 older employees in the HCS. Included were nurses and midwives (code 323) and caring professions (code 513), e.g. certified care employees. Matching techniques (here we use Coarsened Exact Matching (CEM)) allows us to create statistical twins (Iacus, King, and Porro 2012) for each of the HCS employees with at least one non-HCS employee. By doing so we go beyond previous studies that either conducted no statistical analysis at all (BAuA 2012) or used regression analysis (Chang et al.

2006; Gelsema et al. 2005) when comparing the HCS to other sectors, as CEM allows an almost experimental design with an experimental group (here older employees in the HCS) and a control group (older employees outside the HCS). The matching process includes the following variables: gender, age, education (measured in years), marital status (having a partner vs. no partner), taking care of grandchildren (yes/no) and ethnicity (migrant vs. non migrant). By matching the covariates of the experimental group and control group, a better balance in the multidimensional distribution of the covariates can be reached which reduces the bias of the estimated outcome. Nevertheless, unmeasured confounders are still not balanced, which has to be acknowledged when interpreting the results. To compensate for strata with different numbers of experimental and control units after matching, CEM weights were used. Table 4.1. shows the results of the matching process. In the upper part of the table the distribution of socio-economic variables before the matching process are depicted: as expected, substantially more women and migrants work in the HCS, while the age, education, marital status, and caring for grandchildren differ less between the sectors. In the lower part of the table the results of the matching process are presented. For 114 older workers in the HCS statistical twins not working in the HCS were found that are almost equal on the variables used in the matching process.

In a second step, we conduct regression techniques including only the older employees from the HCS and their statistical twins using the group of sector as explanatory variables. To analyse if the working conditions significantly differ between the HCS and other sectors, we estimate regression analysis with the experience of hard physical work and mental work as dependent variables. Physical as well as mental work are measured on a four-point scale and dichotomized to strenuous work and effortless work.

Table 4.1: Results of Matching Process.

Before Matching				
	HCS	N=124	Unmatched (Non HCS)	N=2,676
	Mean	Std.dev	Mean	Std.dev
Age in years	58.38	3.09	58.89	3.12
Female %	91.92	0.27	53.29	0.50
Migrant %	12.10	0.33	6.10	0.24
Edu. in years	11.96	1.80	13.40	3.16
Has partner %	66.94	0.47	78.43	0.41
Caring grandchildren %	45.16	0.50	37.69	0.49
After Matching				
	HCS	N=114	Matched (Non HCS)	N=624
	Mean	Std.dev	Mean	Std.dev
Age in years	58.25	3.06	58.24	3.04
Female %	91.22	0.28	91.22	0.28
Migrant %	5.26	0.22	5.26	0.22
Edu. in years	11.90	1.76	11.80	1.82
Has partner %	69.30	0.46	69.29	0.46
Caring grandchildren %	45.16	0.50	43.86	0.49

Second, we explore if older employees in the HCS perceive their own work as important and receive enough recognition for their work compared to other sectors. Both are measured on a four-point scale and dichotomized afterwards (does apply/ does not apply). Further, the expected retirement age and preferred retirement age are the dependent variables. They capture when an older worker would like to retire and when he or she expects to do so (Hess 2016). In addition, we investigate if there are differences between older employees in the HCS and non-HCS regarding their intentions to work after retirement. Finally, the difference in the intension to do voluntary work after retirement was tested. For testing the hypothesis that older workers want to retire earlier than those not in the HCS, but expect to retire at the same time, we conduct linear regressions. For the binary outcomes intension to work beyond the retirement age, to do voluntary work as well as for the experience of hard work, and the perceived importance and

recognition of work, logistic regression analysis are conducted and thereby testing the hypothesis that working conditions in the HCS are likely to be harder than in the non-HCS.

4.2.3. Qualitative Analysis: Case studies

For a more in depth-analysis of retirement expectations within the HCS and to understand whether there are organizational measures (age-management) aiming at supporting (older) employees and how those are organized, we conducted case studies in care organizations in Germany (in-patient and hospitals). As part of these case studies, we carried out semi-structured interviews on-site with employees as well as representatives of the management. In contrast to the quantitative part, we did not make any age restrictions as we also wanted to analyze the perception of younger employees. The interview guidelines covered several themes (organizational background and structure; current challenges in the HCS from an organizational and individual perspective, such as potential consequences of prolonging working lives; implemented age-management measures including aims and impact). An information leaflet about the purpose and structure of the interview was given to potential participants. All interviews were audio recorded and transcribed verbatim; anonymity was ensured to participants and organizations. The cases were sampled purposefully. Data was analyzed thematically, following a deductive-inductive approach drawing on the results of comparable studies (Baldauf and Lindley 2013; Frerichs et al. 2012). All interviews were conducted in German. In addition to the case studies, expert interviews were carried out with different stakeholders from the HCS in Germany. In detail, we conducted four case studies, two in medium/large-sized in-patient care organizations with more than 200 care workers and two in hospitals (one in a small-sized specialized hospital with 100 care workers and one in a large-sized general hospital with more than 2.000 care workers). Organizations were recruited using contacts from previous research projects and by making use of contacts provided by the

experts. In total, we carried out 25 interviews (see Table 4.2.). In addition, five semi-structured interviews with experts in the HCS were conducted. The researcher, who approached all organizations, also conducted the interviews and analyzed the data.

Table 4.2: Overview of interviews.

Interview no. (Case no.)	Organization (employees)	Organization (type)	Age of interviewee	Position	Qualification
1 (1)	250	Inpatient care facility	33	Station management	Certified nurse
2 (1)	250	Inpatient care facility	24	Nurse	Certified nurse
3 (1)	250	Inpatient care facility	42	Assistant to center director	Nursing assistant
4 (1)	250	Inpatient care facility	27	Care manager representative	Certified nurse
5 (1)	250	Inpatient care facility	45	Nurse	Nursing assistant
6 (1)	250	Inpatient care facility	36	Nurse	Certified nurse
7 (1)	250	Inpatient care facility	50	Head of administration	Business Administration
8 (2)	600	Inpatient care facility	57	Station management	Certified nurse
9 (2)	600	Inpatient care facility	45	Station management	Certified nurse, master degree/diploma
10 (2)	600	Inpatient care facility	45	Controlling	Master degree/diploma
11 (2)	600	Inpatient care facility	59	HR Manager	Master degree/diploma
12 (2)	600	Inpatient care facility	61	CEO	Master degree/diploma
13 (3)	200	Hospital	44	Station management	Certified nurse
14 (3)	200	Hospital	44	Nurse	Certified nurse
15 (3)	200	Hospital	44	Nurse	Certified nurse
16 (3)	200	Hospital	39	Nurse	Certified nurse
17 (3)	200	Hospital	52	Nurse	Certified nurse
18 (3)	1.600	Hospital	29	Nurse	Certified nurse
19 (3)	200	Hospital	54	Care manager representative	Certified nurse, Master degree/diploma
20 (3)	200	Hospital	59	Care manager	Certified nurse
21 (4)	1.600	Hospital	44	Station management	Certified nurse
22 (4)	1.600	Hospital	44	Nurse	Certified nurse
23 (4)	1.600	Hospital	45	Care manager	Certified nurse
24 (4)	1.600	Hospital	39	Nurse	Certified nurse

4.3. Results

4.3.1. Quantitative Results

As shown in Table 4.3., the linear regressions after the coarsened exact matching show no significant differences in the expected retirement age between the older employees in the HCS and their statistical twins not working in the HCS. In other words, the average treatment effect is not significant different from their peers in other sectors and even after controlling for age, gender, education, marital status, caring for grandchildren, and ethnicity older employees in HCS do not expect to retire earlier or later. However, health and care professionals would prefer to retire earlier than their statistical twins in other sectors as indicated by the significant negative effect. The preferred retirement age of employees in the HCS is on average 0.87 years lower than those of their statistical twins not working in the HCS. Using logistic regression, no differences were found for the intension to work in addition to receiving a pension. However, older employees in the HCS significantly more often want to do voluntary work after retirement. Older employees in the HCS have on average a 1.90 times higher chance to do voluntary work compared to their statistical twins.

Table 4.3.: Average Treatment Effect of HCS

	Ex. Re. Age	Pref. Re. Age	Inten. Work Ref: No Inten.	Inten. Volun. Ref: No Inten.
HCS	-0.20 (0.20)	-0.87** (0.39)	1.07 (0.22)	1.90*** (0.40)
Constant	64.97	63.09	0.65	0.50
N	663	656	732	733
(Pseudo) R^2	0.002	0.007	0.0001	0.01

Levels of significance: * $p \leq 0.1$; ** $p \leq 0.05$; *** $p \leq 0.01$

Table 4.4. shows the average treatment effect of the matching techniques on four work related variables with logistic regressions. Older employees in the HCS report harder physically working conditions. The chance to report hard physical working conditions is 2.81 times higher when working in the HCS compared to the statistical twins not working in the HCS. No differences were found when asking the respondents for the importance of their work. Older employees in the HCS, however, compared to those not working in HCS have a 2.06 times higher chance to have the impression that their work does not receive the deserved recognition.

Table 4.4.: Average Treatment Effect of HCS in Odds-ratios

	Hard Men. Work *(Ref: No Hard)*	Hard Phy. Work *(Ref: No Hard)*	Impor. Work *(Ref: Low Impor.)*	Reco. Work *(Ref: High Reco.)*
HCS	1.48 (0.50)	2.81*** (0.64)	1.02 (0.65)	2.06*** (0.45)
Constant	6.32	0.99	36.39	0.26
N	738	738	738	738
(Pseudo) R^2	0.003	0.02	0.00	0.013

Levels of significance: * $p \leq 0.1$; ** $p \leq 0.05$; *** $p \leq 0.01$

In conclusion, the results of the quantitative analysis are in line with the hypotheses. As shown in previous studies, the working conditions in the HCS are physically much more demanding than in the non-HCS (Manyisa and van Aswegen 2017). The results also show that older workers in the HCS fell more mental pressure then, although here the differences are not significant. In addition, and in line with past research, employees in the HCS have the feeling that their occupation does not receive the deserved recognition; this is in particular the case for the long-term care sector (Gelsema et al. 2005). As assumed in the hypothesis, this hard working conditions result in a lower preferred retirement age; older employees in the HCS would like to exit the labour market and retire early. When realistically evaluating their options

on the decision when to retire they come to the conclusion that they will work as long as those outside the HCS indicated by the non-significant differences of the expected retirement age. In line with Hess (2016) we interpreted this as an involuntary delayed retirement and a loss of choice regarding the retirement timing. This interpretation supports the concerns of inequality between the HCS and other sectors. The intra-sector analysis will now be discussed in the following section on the results of the qualitative research.

4.3.2. Qualitative Results

As shown above, there is evidence that the working conditions in the HCS are more challenging for (older) employees compared to other sectors. This, arguably, leads to the wish to retire earlier, although persons working in the HCS expect not to be able to do so indicating inequalities between the sectors.

Therefore, the aim of the case studies was twofold: First, looking at differences within the HCS and, second, analyzing organizational approaches in dealing with the hard working conditions. The analysis of the case studies reveals that within all organizations studied, employees as well as employers described comparable challenges, which they are facing now. The most dominant challenge named was the shortage of skilled care workers, which, according to the interviewees, resulted from hard working conditions in physical and mental terms. Another aspect described frequently was the lack of acknowledgment of care work in general – reflecting the results from the quantitative analysis above – and, more specifically, in insufficient financial rewards. Moreover, the majority of the participants could not think of working until retirement age, which was reported by younger interviewees as well as older ones and regardless of the organizational background. Nevertheless, some of them felt that in order to avoid pension cuts they had to. This is in line with the finding from the matching

analysis that older employees in the HCS would like to retire earlier than they expect to do so. A common strategy in reducing the hard working conditions was found in further training, qualification, and professionalization to withdraw from "core" care work to administrative tasks such as shift management. This strategy was also followed by some of the younger employees in our sample that have been working in the HCS only for a couple of years. However, nearly all interviewees were aware that not everyone will be able to work in one of these job profiles as they are limited. Consequently, this could cause tension and inequalities between older and younger employees and even result in conflict, although this was not reported in our case studies. Another strategy reported by one of the interviewees was to reduce working time and to work for an external company in the HCS on a limited basis (450 EUR). The main motivation was to be more flexible and to have more leisure time with only minor financial drawbacks. That this could result in a lower pension after retirement was not seen as critical by the interviewees.

Considering implemented measures of age management and overall strategies, the analysis of the case studies indicates that there do not seem to be major differences between in-patient care organizations and hospitals. On the contrary, the studies show that there are multiple similarities. Most notably, this includes the generally low awareness regarding age management, which was also underlined by the experts. Other studies, which do specifically focus on the HCS come to comparable conclusions and summarize that only a "minority of the companies and among them primarily the larger ones offer special measures to promote […] older workers" (Naegele and Walker 2006:6). Most of the measures that could be identified were not age-specific. Although the analyzed organizations do not follow a strategical age-management approach, they have implemented several measures. The most common measures were found in the dimensions of recruitment (no age restrictions), qualification and competence development (also for those close to retirement), and transition into retirement (offering

employees to continue working past retirement), which have been implemented in all cases studied. Measures that have been implemented were not systematically evaluated.

4.4. Discussion

Against the background of ageing societies, it can be assumed that the number and importance of older employees in the HCS will increase rapidly as, first, the workforce is ageing in total and, second, with the growing need for health and long-term care the HCS is expected to expand significantly in near future. At the same time, the working conditions in the sector are comparably hard. Thus, investigating older employees´ attitudes towards retirement is of high importance. Its relevance will even increase given different pensions and labor reforms aimed at extending working lives in Germany, among which the increase of the statutory retirement age is the most prominent.

Combining quantitative with qualitative methods the study at hand investigates the situation of older employees in the HCS. The quantitative part compares the HCS with statistical twins outside the HCS showing that differences exist between sectors. The qualitative part reveals mechanisms within the HCS, which may cause these differences. Special focus is set on social inequalities regarding retirement decisions within the HCS as well as outside this sector. The quantitative analysis used matching techniques allowing an actual comparison of the situation of older employees in the HCS with those working in other sectors controlling for different confounding variables. Results show that although older employees in the HCS expect to retire at the same age as those in other sectors, they would like to retire earlier. This finding is in line with results from the case studies showing that older employees as well as their younger colleagues believe they would have to delay retirement to avoid pension cuts hinting at social inequalities also found in earlier work (Hess 2016). However, they felt unable to work until the

official retirement age due to the hard working conditions. In particular, the physically and mentally challenging working conditions make it much harder for older employees in the HCS than in other sectors and probably are also the main reason why older employees do not intend to work after retirement, unless they expect that they have to. One could conclude that social inequalities between sectors exist in the chances and possibilities to work until the retirement age and the HCS is one sector in which it is especially hard.

When interpreting the results, it has to be acknowledged that the quantitative analysis only compared older HCS employees with employees outside the HCS. By doing so, social inequalities may not be captured adequately as they can occur within the HCS as well. Also the small sample size limits the generalizability and lead to lower statistical power. However, considering the lack of data availability this study contributes to previous research by analysing the HCS quantitatively as well as qualitatively with the latter also exploring inequalities within the HCS. For the qualitative part, it has to be noted that the case studies did not include small sized organizations within the HCS such as the majority of out-patient care organizations.

Now the question arises what can be done to mitigate the problems older employees are facing in the HCS. A first starting point is that both the quantitative and qualitative analysis find that older employees in the HCS think their work is not receiving the recognition it deserves. Thus, actions that highlight the societal importance of the HCS would help giving recognition, although it would not alter the hard working conditions. At the company level, employers and trade unions must strive to improve the working conditions (Naegele 2017).

At the same time the organisations perspective is relevant as well. This raises the question whether the work environment can be organized in a supportive way, reducing these hard working conditions. Against the background of an ageing workforce, age management is seen as one strategy helping to reduce hard working conditions, supporting the workability and employability of (older) employees and decreasing the intention to retire early (Sackreuther et

al. 2016; Vuori, Toppinen-Tanner, and Mutanen 2012) In relation to Naegele and Walker (2006) Sporket (Sporket 2011), and Frerichs et al. (2012) age management encompasses several dimensions such as recruitment, training, career development, flexible working practices, health promotion, redeployment, employment exit, or comprehensive approaches. It has to be noted, that such measures should not be „age-exclusive“ but instead follow a (working) life course perspective. Changes accompanying the process of ageing cannot be neglected and ask for an „age-specific“ approach (Frerichs et al. 2011). As suggested in the qualitative analysis some (older) employees can switch to managerial jobs. Furthermore, technical advancements, such as assistive technologies, offer the potential to enhance hard physical working conditions, e.g. regularly shifting a patients' position in bed or lifting into a wheelchair. However, not all older employees benefit from such measures to the same extent and it can be argued that within the HCS differences can be found between types of care work (low skilled employees such as assistant nursing staff and qualified nurses) and between types of organizations with the HCS (e.g. in-patient care organizations and hospitals). Furthermore, it can be assumed that these efforts on the company and organisational level might not be enough for all employees. Hence, policy makers at the national and maybe even European level must also get involved. They should provide general alternatives within the HCS such as raising the ratios. Moreover, for employees for whom it is physically and mentally impossible to work until the official retirement age in the HCS alternatives need to be provided. Such alternatives might be retraining programs or even early retirement options such as disability pensions. These are examples that might help older employees in the HCS and decrease social inequalities in late career and retirement between the HCS and other sectors and also within the sector. The measures at the company and national level should be coordinated with each other and they should be implemented soon as the workforce in the HCS is ageing steadily and the need for health and long-term care service is increasing rapidly.

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Chapter 5: Educational inequalities in labor market exit of older workers in 15 European countries

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Abstract

Objective: This article examines country differences in the association between education and voluntary or involuntary labor market exit and whether these country differences map onto institutional characteristics of the countries. Work exit is defined as involuntary based on the reasons of exit. Four different types of institutional factors, *push* and *pull*, aiming for an earlier work exit and *need* and *maintain* factors to retain older workers in employment are considered.

Methods: Using data from 15 European countries from the longitudinal Survey of Health, Aging and Retirement in Europe (SHARE), time discrete event history analysis with a categorical outcome are estimated for each country separately. Afterwards, we add macro level indicators and conduct a meta-analysis to analyze country differences.

Results: Results show that in almost all countries a social gradient in involuntary work exit exists but not in voluntary exit. Lower educated workers are more likely to involuntarily exit the labor market. Institutional factors, especially those supporting older workers' retention in employment are associated with a smaller social gradient in work exit.

Conclusion: Our findings suggest that investments in active labor market expenditures, especially in lifelong learning and rehabilitation for lower educated, may help to reduce the social gradient in involuntary work exit.

5.1. Introduction

Demographic ageing is threatening the long-term financial sustainably of pay-as-you-go public pension systems as an increasing number of recipients is facing a shrinking number of contributors. Policy-makers all over Europe are implementing pension and labor market reforms aimed at delaying retirement and extending working lives and consequently securing public pensions. Examples for such reforms are an increase of statutory pension ages and the closing of early retirement options. Hence, it seems that these reforms are taking effect as actual retirement ages and older workers' employment rates are rising all over Europe, however from different starting points and to different extends (Ebbinghaus and Hofäcker 2013). These measures aiming to extend working lives run the risk of exacerbating social inequalities, as lower and higher educated workers leave the labor market at different ages and for different reasons, potentially widening pension gaps after the end of working lives. Comparing late careers of workers from 15 European countries, this study aims to identify educational differences in work exit and if these differences vary by institutional characteristics.

Most studies analyzing labor market exit found a social gradient. Lower educated workers leave the labor market earlier while higher educated are more likely to work past the age of 65 and retire later. For example, workers without a high school degree are five percentage points less likely to work beyond the age of 62 compared to high school graduates in the US and the lower occupational class has a 1.82 times higher probability of reporting retirement intensions compared to higher classes in European countries (Murphy, Mermin, and Johnson 2007; Wahrendorf, Dragano, and Siegrist 2013). Thus, pension and labor market reforms aimed at extending working lives may affect workers differently depending on their educational qualification. For lower educated workers, it is more difficult to reach the new goal of extended working lives. This may lead to rising social inequalities between lower and higher educated workers, as early work exit reduces old age pension claims.

The reasons for an early work exit differ between low and high educated workers. The lower educated exit the workforce more often involuntarily early due to ill health, hazardous working conditions, or unemployment (Robroek et al. 2015; van Solinge and Henkens 2007), whereas the higher educated leave the labor market later and more often voluntarily because of better health and stronger attachment to work (Carr et al. 2018).

Whether a work exit is voluntary or involuntary depends on institutional opportunities and constraints driving the decision to exit the labor market (Radl 2013). Institutional factors affecting an early work exit can be described as *push* and *pull* factors. As policies to retain older workers in employment have gained importance, the approach has been extended by *need* and *maintain* factors (Hofäcker and Radl, 2016). Previous research showed that involuntary work exit is more prevalent in countries where *push* factors are dominant, e.g. high levels of unemployment, whereas in countries supporting *pull* factors, for example with low statutory pension ages, older workers tend to exit the labor force more often voluntarily (Ebbinghaus and Radl 2015). Nevertheless, little is known about the effect of these institutional factors on different work exit routes of lower and higher educated workers, as previous research focused on single exit routes or was cross-sectional (Carr et al., 2018; Schuring, Schram, Robroek, and Burdorf, 2019; van Rijn et al., 2014). Furthermore, most countries implemented institutional factors supporting late work exit but until now the effect of such factors on the voluntariness of exit decisions has not been explored. Finally, most studies were single-country studies and the majority of these studies were conducted in Northern European countries making it difficult to explore differences in welfare regimes (Schuring, Robroek, Lingsma, and Burdorf, 2015; van Rijn et al., 2014). Studies analyzing country differences clustered countries according to welfare regimes which potentially hides important country variations and effects cannot be attributed to a specific institutional level factor. Previous multilevel studies have generated important findings but recent simulation studies suggested that random effects models based

on few countries tend to overestimate country effects, hence it is important to revisit findings from these seminal studies (Bryan and Jenkins, 2016; Engelhardt, 2012; Reeuwijk, van Klaveren, van Rijn, Burdorf, and Robroek, 2017; Schuring et al., 2019).

This study examines *(1)* country differences in the association between education and voluntary and involuntary labor market exit and *(2)* whether these country differences map onto institutional characteristics of the countries. We contribute to the existing literature in three ways. First, it is the first study which empirically test institutional factors that also include those aiming at delaying retirement and hence, extending the *push* and *pull* approach. Secondly, a meta-analysis is used which can be seen as a more conservative method for testing country differences (Brons, Liefbroer, and Ganzeboom 2017; Bryan and Jenkins 2016). Thirdly, using a longitudinal study-design across 15 European countries and considering different exit routes for higher and lower educated workers, this study may identify institutional measures which can help prolong working lives especially for workers with lower levels of education and reduce inequalities between lower and higher educated workers.

5.2. Education and labor market exit

Older workers' decision when to leave the labor market can be conceptualized as a process in which individuals weigh the benefits and costs of early respectively late labor market exit (Hofäcker et al., 2015). Assuming that individuals try to maximize their utility they decide to exit the labor market when the expected income and leisure time after work exit outweighs staying in work (Visser et al. 2016). Thus, work exit is largely driven by opportunities and constraints of socio-demographic, workplace and institutional factors.

Education is a main socio-demographic determinant in older workers' exit decisions as it is linked to several individual-level factors of work exit decisions, for instance, work place

characteristics, labor market changes, income, and health. Lower levels of education have been associated with poorer working conditions, earlier work exit, higher levels of morbidity and lower disability-free life expectancy (Carr et al. 2018; Wahrendorf et al. 2013). Especially older workers' health is a main reason for work exit but it is largely affected by education and thus part of the total effect of education which is of interest in the present study. Furthermore, education is a more suitable measure for social inequalities in work exit than social class or income because class and income vary over the life course, whereas education is determined early on in life and mostly remains stable. Thus, education is a valid key measure that summarizes several interrelated key individual-level determinants of work exit decisions (Hofäcker and Naumann, 2015).

High education provides individuals with opportunities to exit the labor market voluntarily as it is associated with more attractive and higher income jobs and healthier working conditions (Potočnik et al. 2009; Robroek et al. 2015). Only someone who is healthy and has a job can opt for working longer. Furthermore, higher education may be related with a delayed work exit because of later career onset due to time spent in formal schooling (Fisher, Chaffee, and Sonnega 2016). The lower educated, on the contrary, are facing more constraints as low education is linked to unfavorable working conditions, poorer health, and a higher risk of job loss (Ebbinghaus and Radl 2015; van Solinge and Henkens 2007). Thus, lower and higher educated differ by type of work exit as higher educated are able to exit work voluntary, lower educated, on the other hand, are at higher risk of leaving work involuntary, e.g. due to job loss or poor health. Previous research showed that lower educated are more likely to exit the labor market through involuntary exit routes, such as disability benefits, unemployment, and economic inactivity, but not to early retirement in The Netherlands (Robroek et al. 2015). Lower educated Swedish men have a higher risk of receiving a disability pension than those with higher education (Johansson et al. 2012). It can be hypothesized that *H1a*: The lower

educated are at higher risk of involuntary work exit, whereas *H1b*: The higher educated are at higher risk of voluntary work exit.

5.3. Country differences in labor market exit: The push and pull approach

Individuals' risk of type of work exit not only depends on individual factors. Contextual opportunities and constraints of welfare state regulations are influential determinants of individuals' decision to exit the labor market too, as they shape the cost and benefits of early respectively late work exit. Institutional factors driving work exit can be described as *push* and *pull* factors. Both factors are aiming for an early work exit but in different ways. Social protection related incentives and the availability of multiple pathways into early work exit are summarized as *pull* factors. *Pull* factors provide financially attractive opportunities for workers to leave work early without or only small pension reductions. The age at which pension benefits first become available is a key feature of pension systems in this respect (Ebbinghaus and Hofäcker, 2013; Hofäcker and Unt, 2013). Assuming that older workers compare the benefits and costs of continuing to work or exiting the labor force, they will choose the financially more attractive option. If early exit programs compensate forgone wages and future pension benefits, individuals will opt for an early exit rather than keep on working until formal retirement age. Labor market exit of older workers are thus regarded as being mostly voluntary because older workers decide to exit early instead of continuing to work (Hofäcker and Radl, 2016). Previous research showed that countries providing attractive early retirement options have the lowest employment ratios among older workers compared to other countries (Gruber and Wise, 2000; Hofäcker and Radl, 2016).

In contrast, *push* factors can be seen as structural labor market constraints that drive older workers involuntarily out of employment (Ebbinghaus and Hofäcker 2013). Economic

downturns or labor demand shocks and the associated increase in the unemployment rate reduce older workers' employment chances and raise the likelihood of an early work exit. Also economic restructuring due to technological changes may lead to a crowding out of older workers from the labor market. Evidence for *push* factors is mixed. Some studies showed that low levels of economic growth measured with the gross domestic product and high unemployment rates are associated with involuntary work exit (Ebbinghaus and Radl 2015; Hutchens 1999). Also employment protection regulations seem to have a weak positive effect on involuntary work exit. Other studies found no evidence of the influence of push factors on work exit (Ebbinghaus and Hofäcker 2013; De Preter, Van Looy, and Mortelmans 2013).

Yet, not all older workers benefit similarly from such policies, as economic incentives and structural constraints affect low and high educated workers differently (Blossfeld, Buchholz, and Kurz 2011). Higher educated workers face fewer constraints, healthier working conditions, and high private as well as occupational pension claims allow them a voluntary early work exit. In contrast, unfavorable working conditions, income and pension claims of lower educated workers make an early work exit much more difficult (Radl 2013). Also previous research showed a social gradient in work exit which varies by country context. Lower educated workers are at greater risk of any type of work exit in France, Finland, USA, the United Kingdom, and the Netherlands (Carr et al. 2018; Scharn et al. 2018). According to the *push* and *pull* approach, *pull* factors should have a stronger influence on low educated workers, as they provide financially attractive opportunities and especially enable low educated workers, who have smaller pension claims compared to higher educated, to retire voluntarily (Radl 2013). However, more low educated workers should retire voluntarily and hence, the social gradient in voluntary work exit should get smaller (see Figure 1). *Push* factors may affect low educated workers stronger as they are more vulnerable to economic restricting. This should increase the social gradient as low educated workers are at higher risk of exiting the labor market

involuntarily. To sum up, it can be hypothesized that *H2a*: *Pull* factors reduce the social gradient in voluntary and involuntary work exit and *H2b*: *Push* factors increase the social gradient in involuntary work exit.

5.4. Paradigmatic shift from early work exit to active aging: Need and maintain factors

During the last decade, policies to retain older workers in employment have gained importance. Thus, the *push* and *pull* approach, which aimed for an early work exit, has been extended by *stay* factors (Ebbinghaus and Hofäcker 2013). *Stay* factors target a late work exit and were further differentiated into *need* and *maintain* factors (Hofäcker and Radl, 2016). Policies supporting older workers' retention in employment are defined as *maintain* factors. *Maintain* factors include lifelong learning and active labor market policies aiming at increasing older workers' employability. Furthermore, they also encompass anti-ageism campaigns, and firm incentives to hire or retain older workers. The awareness of such policies has increased during the last years, as policies have undergone a paradigmatic shift from early work exit to active aging (Hofäcker and Radl, 2016). Whereas *maintain* factors intent to improve opportunities of older workers to stay in employment, the purpose of *need* factors is explicitly to increase the financial necessity to do so. *Need* factors comprise recent upward shifts in retirement ages and the monetary punishment of early work exits by pension deductions. Other measures to increase the financial need to remain employed are restricting or closing early exit pathways, such as disability retirement or unemployment insurance, or general pension level cuts either by delaying access to them, or reducing replacement rates (Hofäcker and Radl, 2016). Both, *need* as well as *maintain* factors should decrease the risk of voluntary early work exit, as both are aiming for longer working lives. *Need* factors should decrease the gap in the employment rate between high and low educated workers, as they are particularly strong for the low

educated, who have less financial resources to compensate financial pressures. Hence, *need* factors should increase the gap in involuntary exit. *Maintain* factors, in contrast, should decrease the gap in work exit between lower and higher educated workers if both have the same possibilities of lifelong learning. It can be hypothesized that *H2c*: *Need* factors increase the social gradient in involuntary work exit and in the employment rate and *H2d*: *Maintain* factors decrease the social gradient in voluntary, involuntary, and no work exit. The allocation of the indicators to the respective factor is based on Hofäcker and Unt (2013) and Hofäcker and Radl (2016).

Hypothesis	Factor	Indicators	Involuntary Work Exit	Voluntary Work Exit	No Work Exit
H2a	Pull	Passive labor market expenditures Formal retirement age	Smaller	Smaller	-
H2b	Push	Unemployment rate of older workers EPL-Index	Larger	-	-
H2c	Need	Net replacement rate Early retirement options Lifelong learning	Larger	-	Smaller
H2d	Maintain	Active labor market expenditures Rehabilitation expenditures	Smaller	Smaller	Smaller

Figure 1: Influence of institutional factors on the social gradient in work exit.

5.5. Data & Method

5.5.1. Data

The association between education and work exit was investigated with the longitudinal Survey of Health, Aging and Retirement in Europe (SHARE). The survey collected data of participants

aged 50+ (Börsch-Supan et al. 2013). Starting with the first wave in 2004 and 2005 in 11 European countries and Israel, follow-ups were conducted biennially until 2017. By now, 28 countries have participated. It was carried out using computer-assisted personal interviews and sampling strategies varied by country. The analysis uses data from seven waves and the analytical sample includes 15 countries[1]. Respondents were aged between 50 and 69 and had to be in paid work during the first observation. The sample consisted of 19,716 respondents and 131,669 spells in person-years. Country-specific case numbers range from *n*=268 in Portugal to *n*=2,179 in Belgium.

5.5.2. Variables

Outcome variable labor market exit

Respondents were asked each wave about their employment status and had several options to choose from. If they exited the labor market they were asked for the reasons. According to the Hofäcker et al. (2016) classification which we adopted, we consider the following responses to be voluntary or involuntary work exits (Figure 2). If respondents were still employed and no labor market exit occurred, they were treated as censored. Respondents with episodes of unemployment who reported to work again were treated as censored.

[1] Austria, Germany, Sweden, The Netherlands, Spain, Italy, France, Denmark, Switzerland, Belgium, Czech Republic, Poland, Slovenia and Estonia

Voluntary work exit	%	Involuntary work exit	%
• Became eligible for public, private, or private occupational pension	74.7	• Disability retirement	36.8
• Was offered an early retirement option/window	13.6	• Retired due to own ill health	15.9
• To enjoy life	3.9	• Became unemployed because you were laid off	13.9
• To spend more time with family	3.2	• Made redundant (for example pre-retirement)	11.6
• Became unemployed due to resigning or a mutual agreement	2.2	• Became unemployed because the place of work or office closed	9.7
• To retire at same time as spouse or partner	1.9	• Became unemployed because moved town or other reasons	5.9
• Became a homemaker because wanting to take care of grandchildren	0.2	• Became unemployed because a temporary contract had ended	5.0
• Became a homemaker because work was too tiring	0.2	• Retired due to ill health of relative or friend	1.2
• Became a homemaker because family income was sufficient	0.1		

Figure 2: Reasons for a voluntary and involuntary work exit.

Key predictor education

Education was measured at respondents' first wave. Country-specific educational categories were classified according to the International Standard Classification of Education (ISCED-97) and recoded into low (ISCED 1,2), medium (ISCED 3,4) and high (ISCED 5,6). The social gradient was identified by comparing the difference between the average probability of low educated (ISCED 1,2) of exiting work involuntary, voluntary, or staying employed, compared to high educated workers (ISCED 5,6). Thus, the social gradient is the contrast in the average probability between lower and higher educated workers of exiting work.

Country-level indicators

Hence, the independent variables should be observed before the outcome, all country level indicators were measured at the first wave for each country when all respondents were still in work. Respondents could exit the labor market thereafter at any time. Using the classification of measures by Hofäcker and Unt (2013) as a starting point, four different institutional factors were measured with at least two indicators each.

Pull factors: Passive labor market expenditures (PLMP) as percentage of GDP for each country were derived from the OECD database (OECD 2019b). PLMP aim at maintaining the living standard after work exit and encompass unemployment benefits and preretirement programs. Another *pull* factor is the formal retirement age. The formal retirement age was drawn from several *Pension at a Glance* OECD reports (OECD 2009, 2011, 2013, 2015).

Push factors: Unemployment rate of older workers aged 50-64 as percentage was derived from Eurostat (Eurostat 2019a). The OECD index of employment protection legislation (EPL) is a summary indicator measuring the general assessment of the strength of labor market regulation combining measures of job protection (OECD 2019a). The second version of the EPL index, which weighs the sum of individual and collective dismissals based on 12 items was used. The index ranges from 0-5 and higher scores indicating stricter regulations.

Need factors: The net replacement rate defined as the individual net pension entitlement divided by net pre-retirement earnings, taking into account personal income taxes and social security contributions paid by workers and pensioners. The average net replacement rate was drawn out of several OECD *Pension at a Glance* reports (2009, 2011, 2013, 2015). Also, the earliest age in which pension benefits can be claimed ("early retirement age") was derived from *Pension at a Glance* OECD reports. If gender differences existed, the joint early retirement age for men and women was calculated.

Maintain factors: Lifelong learning is firstly measured in 2007 with the participation rate in job-related non-formal education and training among workers aged 55-64 by Eurostat (Eurostat 2019b). Job-related non formal education is defined as learning activities outside the formal education system, such as courses, workshops, or guided on-the-job training to obtain knowledge and learn new skills needed for a current or future job. Furthermore, the active labor market expenditures (ALMP) as percentage of the GDP based on the OECD were considered (OECD 2019b). ALMPs intention is to help unemployed back to work by providing training or employment and recruitment incentives. Additionally, sheltered employment and rehabilitation expenditures as percentage of GDP by the OECD were taken into account (OECD 2019b). These expenditures cover typically relatively disadvantaged target groups (unemployed long-term, social assistance claimants, or people on disability benefit) and influence the probability and time interval of returning to work by increasing the health status.

5.5.3. Statistical analysis

Time-discrete event-history analyses with a categorical outcome (involuntary work exit/ voluntary work exit/ employed) were estimated for each country separately. To model a curvilinear shape of the hazard rate, age as well as age-squared were included in the models. For each possible outcome, namely involuntary work exit, voluntary work exit, and staying employed, the country-specific estimate and standard error (SE) was obtained. The country specific estimate was the social gradient in work exit gradient which is the contrast in the average probability between lower and higher educated workers of exiting work. For example, a social gradient of 0.02 says that lower educated workers are on average about 2% more likely to exit work than higher educated workers. On the contrary, a social gradient of -0.02 means that higher educated workers are more likely to exit work than lower educated workers.

To analyze (1) cross-national differences in the risk of labor market exit between high and low educated and if (2) country specific institutional factors can explain these differences, a two-step meta-analytic approach suggested by Bryan and Jenkins (2016) was used (Mills and Präg 2016). Due to the limited number of countries (N<30) and the design of the dependent variable, this approach instead of a multilevel analysis is preferred, as the standard errors of country-level effects are underestimated if the number of countries is small (Bryan and Jenkins 2016). The meta-analysis approach offers a more conservative test of hypotheses resulting in fewer incorrect rejections of a true null hypothesis (Brons et al. 2017).

First, a meta-analysis was performed in which all country-specific estimates and SEs of the time discrete event history model were included, to test whether there is a social gradient in type of work exit and if this gradient varies across countries. Meta-analysis provides a measure for between-country heterogeneity (I^2) ranging from 0-100. I^2 essentially indicates the percentage of observed total variation across countries that is due to real heterogeneity rather than chance. Higgins et al. (2003) set benchmarks for I^2 and considered 50% and 75% as moderate and high heterogeneity between countries (Higgins et al., 2003). Three meta-analyses, namely one for each type of work exit, are reported. Second, if significant between-country heterogeneity existed, a random-effects meta-regression was estimated. This regressed the country-specific social gradients in type of work exit on country-level indicators (Harbord and Higgins 2008). The sample size is the number of countries, *N*=15. Countries with a bigger sample size had more influence because countries are inversely weighted to the precision of their effect estimate as indicated by their SE and a random effect variance component, which is an estimate of the between-study variance (Brons et al. 2017).

5.6. Results

5.6.1. Descriptive Results

Across all countries, two third of respondents were employed, with the highest share in Estonia (82%) and the lowest in France (59%) (see Table 1). Most workers exited the labor market voluntarily and only 9% involuntarily, whereby the average age of involuntary work exit was 58.8 years and by that more than three years earlier than a voluntary work exit with 62.0 years. In Portugal and Spain, most older workers had low levels of education. In Denmark and Belgium, the majority of older workers were highly educated. Most respondents were married and half of the sample was female. Country differences existed on the macro level as well (see Table 2). PLMP spending was on average 1.35% of GDP, ranging from 0.19% in Czech Republic to 2.34% in Belgium. Formal retirement age was 65 years in most countries and early retirement age was on average 3 years before the formal one. Employment protection was the lowest in Estonia and the highest in Portugal in 2004. Also older workers' participation in lifelong learning varied greatly ranging from 6.9% in Italy to 48.7% in Sweden.

5.6.2. Social gradient in work exit

The results of the time-discrete event-history model showed that a social gradient in work exit existed in most countries. The average probability of an involuntary work exit overall countries was 2 percentage points (pp) higher for low educated compared to high educated workers (see Figure 3a). The social gradient was the smallest in Sweden, The Netherlands, and Denmark and greatest in the Czech Republic, Portugal and Germany. Between-country heterogeneity was moderate with 61%, and this is substantially relevant because almost two third of observed total variation across countries is due to real heterogeneity rather than chance and may be

Table 1: Characteristics of the sample. Mean in percentage and SD in parentheses.

Country	N	Involuntary work exit	Voluntary work exit	Employed	Low education	Medium education	High education	Female	Married	Age at last observation
Austria	948	9.1 (28.7)	30.1 (45.9)	60.9 (48.8)	14.0 (34.7)	49.3 (50.0)	36.7 (48.2)	48.1 (-)	71.3 (-)	58.4 (3.2)
Belgium	2,179	11.4 (31.8)	24.9 (43.2)	63.7 (48.1)	25.4 (43.5)	30.4 (46.0)	44.2 (49.7)	49.2 (-)	74.5 (-)	58.3 (3.6)
Czech Republic	1,238	11.3 (31.7)	28.9 (45.3)	59.8 (49.1)	32.2 (46.8)	50.0 (50.0)	17.8 (38.2)	50.5 (-)	77.8 (-)	58.8 (3.1)
Denmark	1,997	8.0 (27.1)	18.7 (39.0)	73.4 (44.2)	10.0 (30.0)	38.0 (48.6)	52.0 (50.0)	50.5 (-)	76.7 (-)	59.5 (4.1)
Estonia	1,974	8.5 (27.8)	9.8 (29.8)	81.7 (38.7)	10.0 (30.0)	58.7 (49.3)	31.3 (46.4)	56.3 (-)	69.4 (-)	59.6 (4.2)
France	1,627	9.8 (29.8)	31.5 (46.5)	58.6 (49.3)	19.8 (39.9)	47.1 (49.9)	33.1 (47.1)	53.3 (-)	72.3 (-)	58.6 (3.4)
Germany	1,873	7.6 (26.5)	19.4 (39.6)	73.0 (44.4)	5.0 (21.7)	57.9 (49.4)	37.1 (48.3)	51.9 (-)	80.2 (-)	59.4 (3.8)
Italy	1.186	8.2 (27.4)	17.8 (38.3)	74.0 (43.9)	41.0 (49.2)	40.7 (49.2)	18.3 (38.7)	43.1 (-)	84.9 (-)	59.1 (3.8)
Netherlands	1,016	9.3 (29.0)	24.6 (43.1)	66.1 (47.3)	30.8 (46.2)	30.5 (46.1)	38.7 (48.7)	46.4 (-)	85.5 (-)	59.3 (3.7)
Poland	409	13.7 (34.4)	27.6 (44.8)	58.7 (49.3)	13.7 (34.4)	69.9 (45.9)	16.4 (37.1)	46.0 (-)	86.1 (-)	59.0 (3.5)
Portugal	268	19.0 (39.3)	14.9 (35.7)	66.0 (47.4)	69.0 (46.3)	16.4 (37.1)	14.6 (35.4)	53.0 (-)	86.9 (-)	59.4 (3.3)
Slovenia	630	7.8 (26.8)	17.3 (37.9)	74.9 (43.4)	11.3 (31.6)	56.0 (49.7)	32.7 (47.0)	52.7 (-)	87.1 (-)	57.5 (3.0)
Spain	1,369	12.6 (33.2)	20.7 (40.6)	66.6 (47.2)	56.2 (49.6)	22.6 (41.9)	21.2 (40.9)	44.9 (-)	83.9 (-)	59.9 (3.8)
Sweden	1,699	5.9 (23.7)	32.8 (47.0)	61.3 (48.7)	25.4 (43.6)	36.8 (48.3)	37.7 (48.5)	54.6 (-)	78.9 (-)	61.8 (3.9)
Switzerland	1,303	4.6 (21.0)	24.8 (43.2)	68.8 (46.3)	14.3 (35.0)	64.9 (47.8)	20.9 (40.7)	50.8 (-)	73.5 (-)	60.8 (3.8)
Total	19,716	9.1 (28.7)	22.9 (42.0)	68.0 (46.6)	22.3 (41.6)	44.5 (49.7)	33.2 (47.1)	50.5 (-)	77.6 (-)	59.4 (3.9)

Table 2: Institutional characteristics of the sample.

	Pull factors		Push factors		Need factors		Maintain factors		
Country	PLMP	Formal retire-ment age	Unem-ploy-ment rate	EPL-index	Net replace-ment rate	Early retire-ment age	Life-long lear-ning	ALMP	Rehabili-tation expendi-tures
Austria	1.38	62.50	4.70	2.62	93.20	59.50	14.70	0.59	0.04
Belgium	2.34	64.50	3.80	2.82	63.10	60.00	12.00	0.63	0.11
Czech Republic	0.19	64.25	5.00	2.97	62.20	59.50	20.40	0.24	0.06
Denmark	2.59	65.00	5.40	2.56	54.10	60.00	23.50	1.64	0.49
Estonia	0.48	63.00	11.20	2.11	58.30	60.00	24.50	0.22	0.00
France	2.11	60.00	6.10	2.73	68.80	57.00	11.20	0.95	0.08
Germany	2.19	65.00	12.10	2.95	71.80	63.00	20.70	1.12	0.14
Italy	0.61	62.50	4.00	3.15	88.80	57.00	6.90	0.60	0.00
Netherlands	1.83	65.00	3.70	2.92	84.10	65.00	19.70	1.26	0.52
Poland	0.51	62.50	7.50	2.41	68.20	62.50	5.90	0.50	0.18
Portugal	1.37	65.00	11.00	3.49	69.20	65.00	7.50	0.58	0.04
Slovenia	0.91	64.00	7.00	2.82	85.40	58.00	11.00	0.35	0.03
Spain	1.47	65.00	7.40	2.76	88.30	60.00	8.90	0.73	0.03
Sweden	1.32	65.00	4.50	2.58	68.20	61.00	48.70	1.03	0.20
Switzerland	0.95	64.50	3.30	2.18	67.30	62.50	26.60	0.70	0.22
Mean	1.35	63.85	6.45	2.74	72.73	60.67	17.48	0.74	0.14
(SD)	(0.74)	(1.46)	(2.91)	(0.35)	(12.2)	(2.51)	(11.0)	(0.39)	(0.16)

explained by institutional factors. The hypothesis *H1a* that the lower educated have a higher risk of in involuntary work exit was supported in most countries, except Poland and Switzerland where no differences significantly different from 0 existed. Only small differences between educational level and voluntary work exit were found (see Figure 3b). On average, lower educated had a 1 pp higher probability of voluntarily exiting work than higher educated workers. The probability was the highest in Slovenia, Austria and Czech Republic. However, in most countries no significant differences in voluntary work exit between the low and high educated existed. The hypothesis *H1b* which stated that the higher educated have a higher risk of voluntary work exit was not supported. Moreover, the opposite was the case in seven countries or no differences in the risk of voluntary work exit existed. Overall, the average probability of staying employed was 3 pp lower for low educated workers compared to high educated workers (see Figure 3c). This gradient was the smallest in Denmark, Spain, and Germany and largest in Slovenia, Austria and Czech Republic. No significant differences

existed in The Netherlands, Poland and Portugal. Between-country heterogeneity was high, with an I^2 of 77.8%.

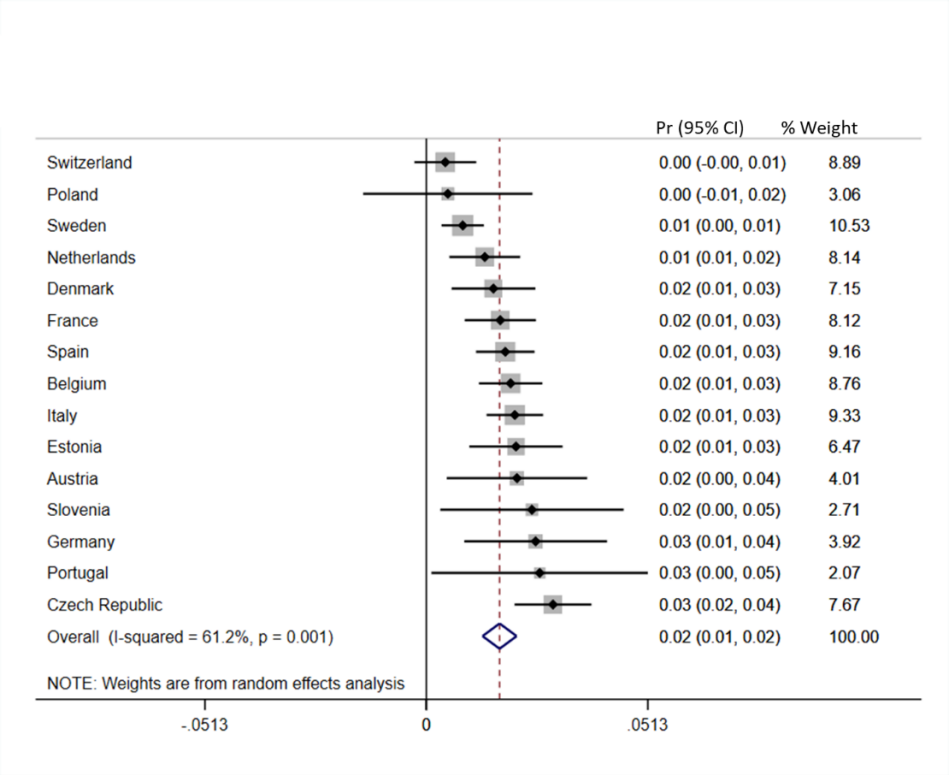

Figure 3a: Social gradient in involuntary work exit.

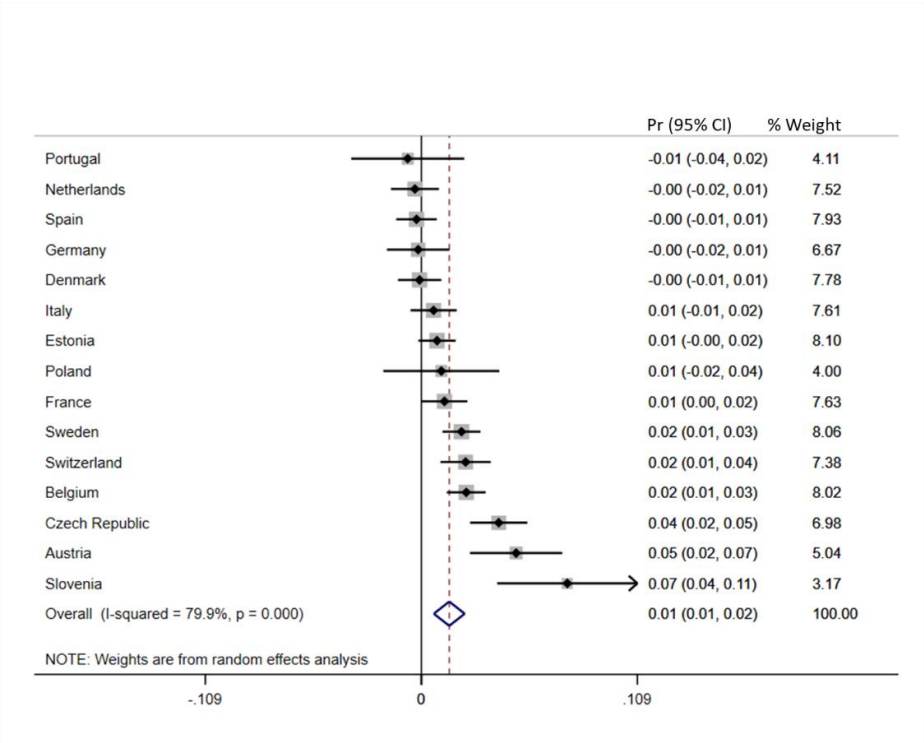

Figure 3b: Social gradient in voluntary work exit.

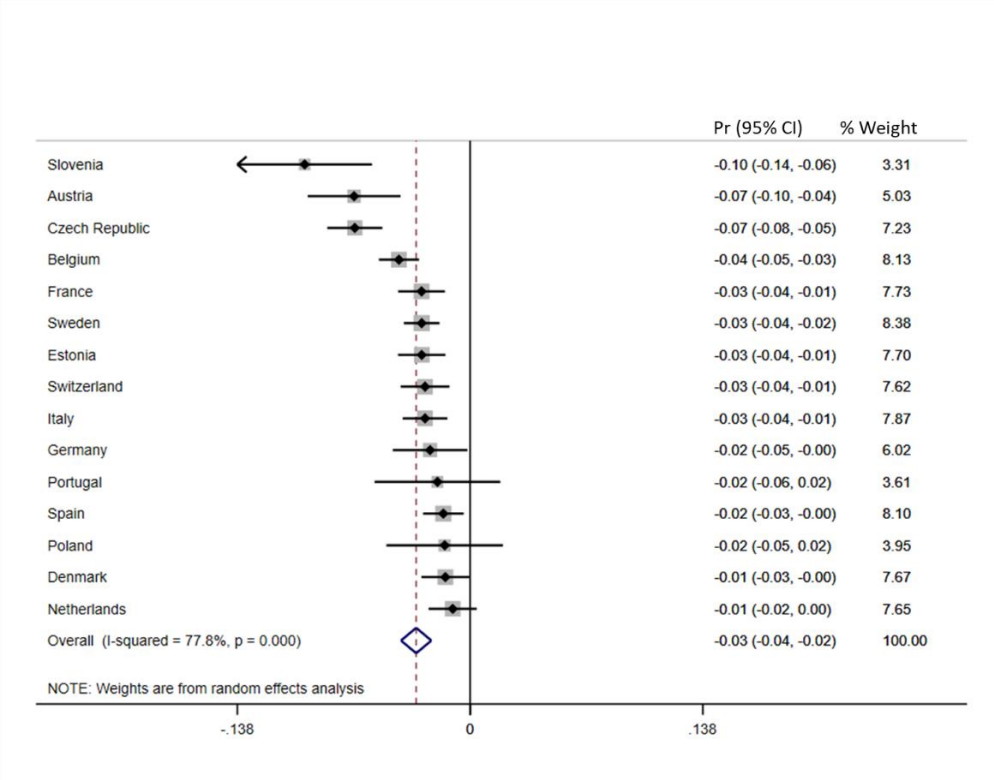

Figure 3c: Social gradient in staying employed.

5.6.3. Institutional factors and the social gradient in work exit

To test if the social gradient in work exit is associated with different types of institutional factors, meta-regressions were estimated in which the country-specific social gradients in type of work exit were regressed on country-level indicators (Harbord and Higgins 2008).

Pull factors did not explain any variance of the social gradient in employment, involuntary work exit or voluntary work exit (see appendix table 3). Passive labor market expenditures (PLMP) and the formal retirement age were not associated with the social gradient in type of work exit. The hypothesis *H2a* which stated that *pull* factors reduce the social gradient in voluntary work exit was not supported. Also *push* factors mostly failed to explain any of the between-country variance. Old age unemployment was not associated with the social gradient in work exit. Also the EPL-index was not associated with the social gradient in voluntary work

exit or staying employed, but with an involuntary work exit. Stricter employment protection was associated with a higher social gradient in involuntary work exit (see Figure 4a), which was against the assumption that lower protection should increase the risk. Hence, the hypothesis *H2b* that *push* factors increase the social gradient in involuntary work exit was rejected.

Likewise, *need* factors could not explain the social gradient in work exit. Early retirement age and the net replacement rate were not associated with the social gradient in work exit. Thus, the hypothesis *H2c* that *need* factors increase the social gradient in involuntary work exit was not supported. However, *maintain* factors, namely lifelong learning, active labor market expenditures (ALMP), and rehabilitation expenditures were associated with the social gradient in work exit. A higher participation of older workers in lifelong learning decreased the social gradient in involuntary work exit but the effect size was small (see Figure 4b). Also ALMP measured in percentage of GDP were associated with the social gradient in work exit. Higher spending on ALMP was associated with a smaller social gradient in voluntary work exit (see Figure 4c). Higher ALMPs were also positively associated with a lower social gradient in employment (see Figure 4d). Furthermore, higher expenditures in sheltered employment and rehabilitation as percentage of GDP were associated with a smaller gradient in staying employed (see Figure 4e). The hypothesis *H2d*, that *maintain* factors decrease the social gradient in work exit, was supported.

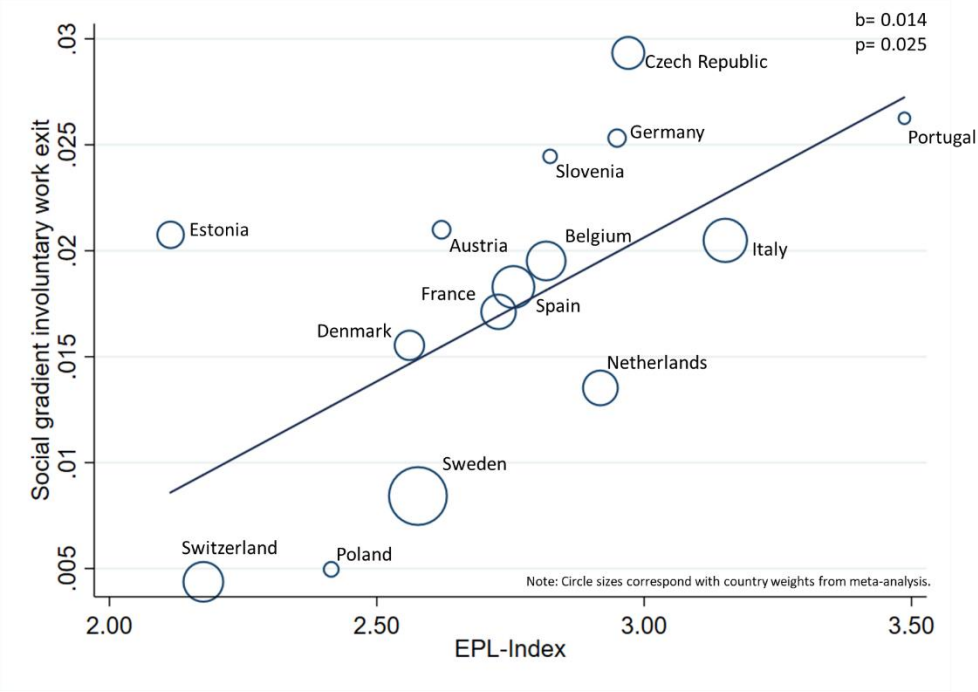

Figure 4a: Association between social gradient in involuntary work exit and EPL-Index.

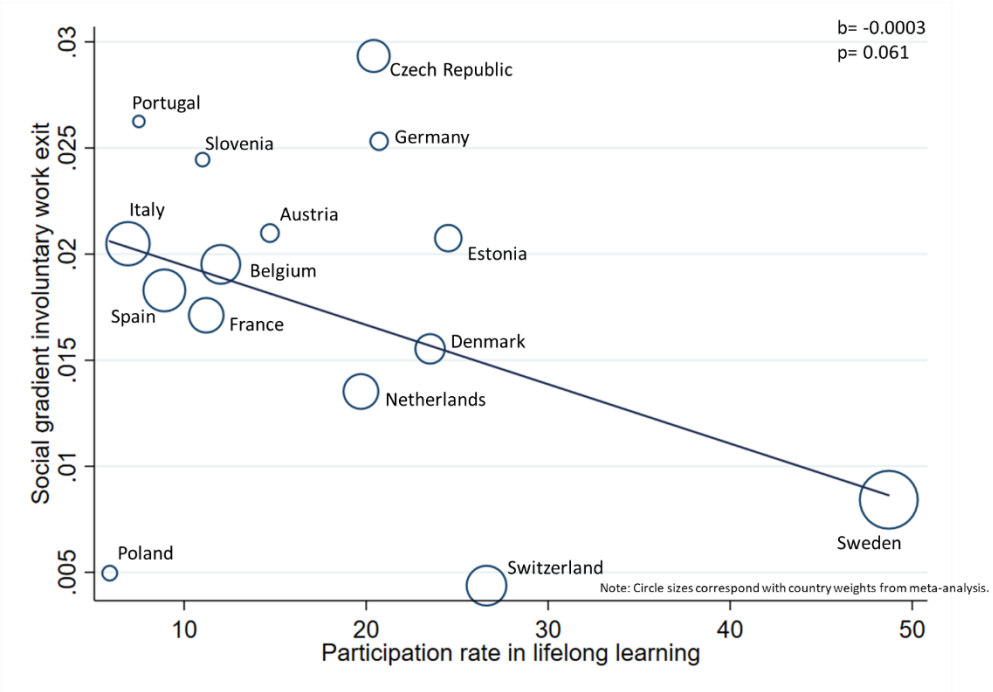

Figure 4b: Association between social gradient in involuntary work exit and older workers' participation rate in lifelong learning.

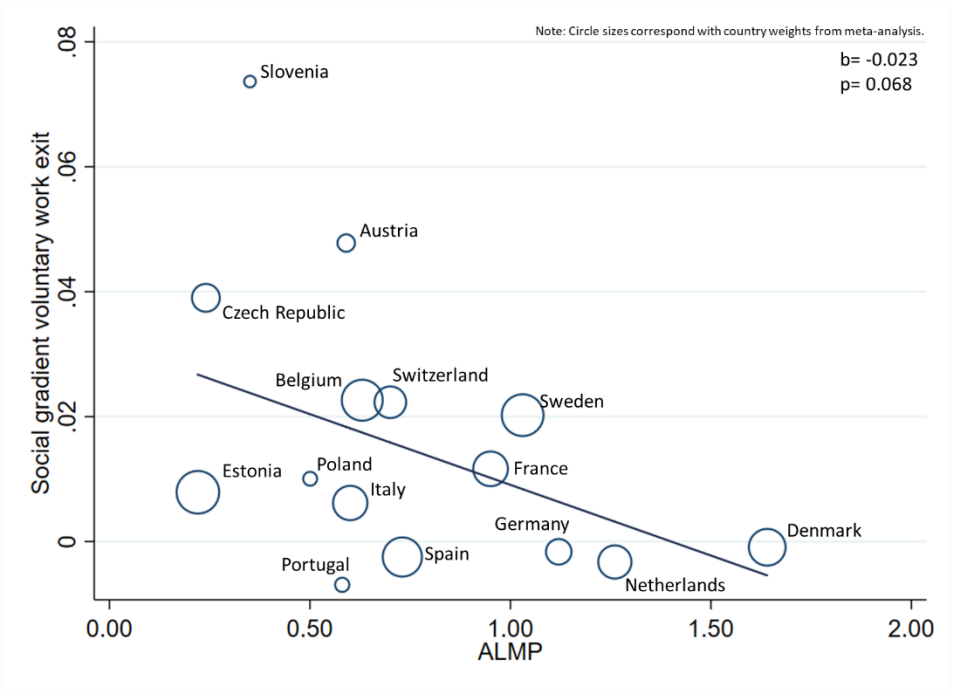

Figure 4c: Association between social gradient in voluntary work exit and active labor market expenditures as percentage of GDP.

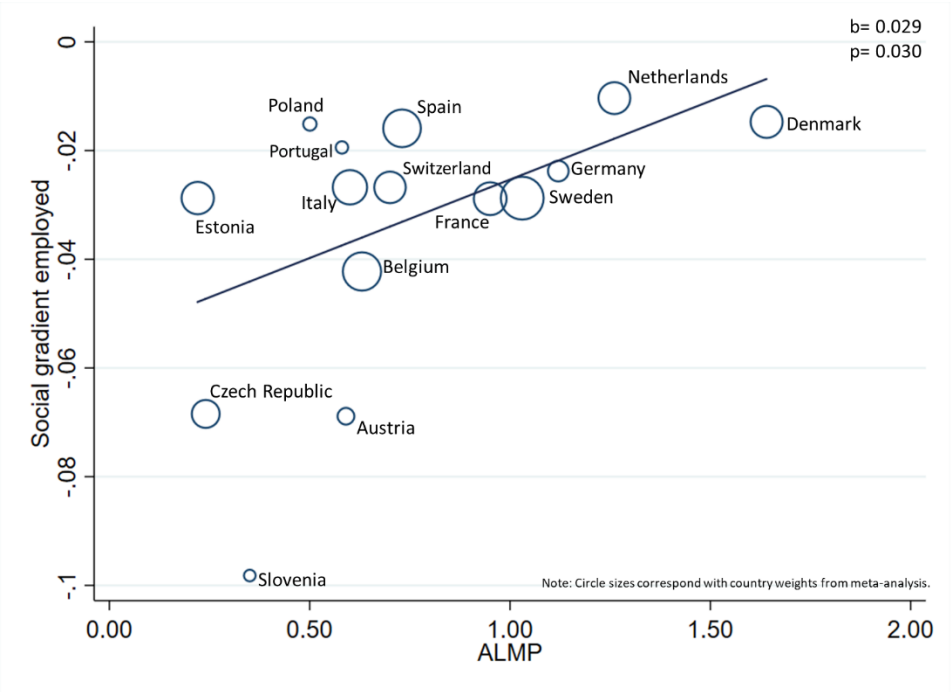

Figure 4d: Association between social gradient in staying employed and active labor market expenditures as percentage of GDP.

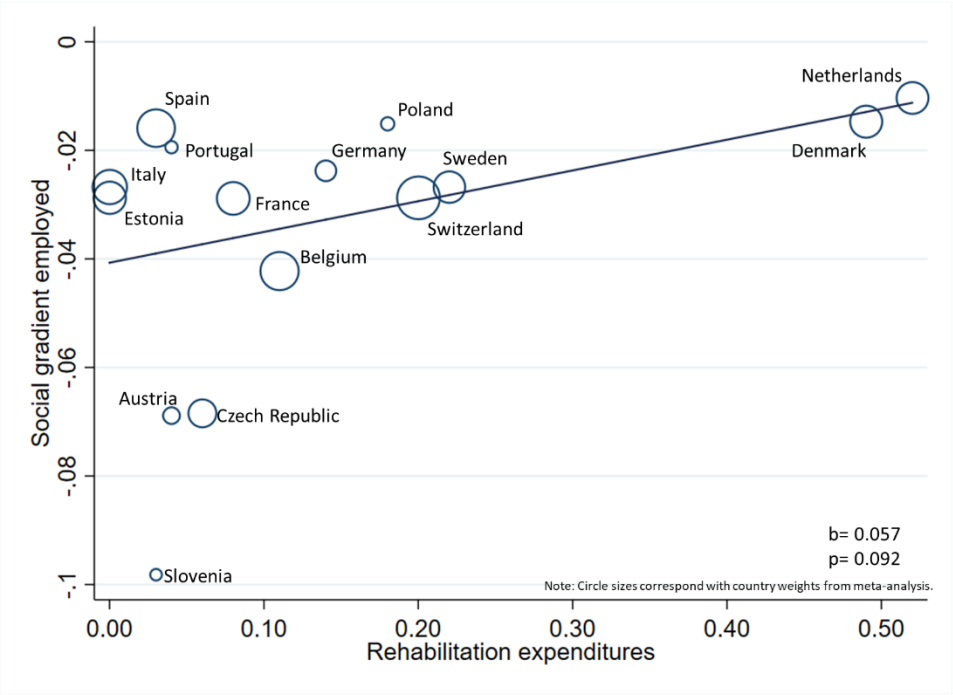

Figure 4e: Association between social gradient in staying employed and rehabilitation expenditures as percentage of GDP.

5.6.4. Sensitivity Analysis

We checked the validity of our findings with several robustness tests. We added self-rated health as a control variable in the time-discrete event history models. In almost all countries, poorer self-rated health increased the probability of an involuntary work exit but not of a voluntary exit. Educational differences remained significant but effect sizes became slightly smaller.

Furthermore, analyses were estimated for men and women separately as some countries, for instance Poland, Austria, Italy, and Slovenia have gendered retirement schemes. The average probability of an involuntary work exit overall countries was 2 pp higher for low educated compared to high educated workers for men and 1pp higher for women (see Figure 5a and Figure 6a in appendix). Only small differences existed, for example, German lower educated men had the highest probability of an involuntary work exit and higher educated Dutch women

had a higher probability of a voluntary work exit. It seems that the way in which education influences work exit is largely the same for women and men, which is in line with previous research (Radl 2013; Riekhoff and Järnefelt 2017). Nevertheless, the gendered policy structure on the macro level led to slightly different results for men and women (see table 4 and 5 in appendix). *Pull* factors, especially higher PLMP were associated with a lower social gradient in voluntary work exit and in staying employed among women. Also *need* factors, namely, early retirement age was associated with the social gradient in any type of women's work exit. A higher early retirement age was associated with a decreased social gradient in involuntary and voluntary work exit and an increase in the social gradient of staying employed. The association between *maintain* factors and the social gradient in work exit was almost the same for men and women. Only ALMPs were associated with a smaller social gradient in any type of work exit among women but not among men. Also *push* factors, namely the EPL-index indicating stricter employment protection led to an increasing social gradient in involuntary work exit only for men.

Additionally, we estimated the associations between the social gradients and the average of the institutional factors over the observation period, as it is not possible to consider time-varying macro indicators in random meta-regressions. As there is not much variation over time in most indicators, all associations remain significant or became even stronger except the association between the social gradient in staying employed and rehabilitation expenditures (see table 6 in appendix). Moreover, an increasing early retirement age was associated with a smaller social gradient in voluntary work exit and staying employed.

Furthermore, the social gradient was estimated with only considering involuntary retirement pathways and excluding unemployment work exits. Thus, the social gradient in involuntary work exit was slightly larger in most countries but also became insignificant in some countries due to the smaller sample size (see Figure 7 a to c in appendix).

5.7. Conclusions and Discussion

Against the background of the policy shift towards extending working lives the aim of the study was to identify educational differences in voluntary and involuntary work exit and if these differences vary by institutional characteristics. Educational inequalities existed primarily in involuntary work exit. In 13 out of 15 countries lower educated workers were more likely to exit work involuntarily than higher educated workers. On the contrary, no educational differences in voluntary work exit existed in most countries. Overall, lower educated were more likely to exit work than higher educated workers, especially in Slovenia, Austria, and Czech Republic. Institutional *pull* as well as *need* factors could not explain the social gradient in work exit. *Push* factors, in particular the EPL-index was associated with a social gradient in involuntary work exit. Stricter employment protection led to a higher social gradient in involuntary work exit. This effect was stronger among men than women. Strong employment protection seems to lead to an even stronger labor market segmentation between low and high educated workers, because of the firms reduced propensity to hire low educated workers covered by strong employment protections and collective agreements. *Maintain* factors led to a smaller gradient in work exit. Active labor market expenditures were associated with a smaller social gradient in voluntary work exit and staying employed. A higher participation rate in lifelong learning was linked to a smaller social gradient in involuntary work exit and higher expenditures in sheltered employment and rehabilitation were associated with a smaller gradient in staying employed. Results show that investments in job-related non formal education, such as courses and workshops to obtain new skills, especially for lower educated workers can help to prolong working lives. Particularly for older workers, changing working conditions due to digitalization might be more challenging and further on-the-job training potentially decrease this burden. New numbers of the Adult Education Survey already show,

that the participation rate of older workers in lifelong learning increased on average by 10% during the last nine years among most European countries (Eurostat 2019b).

Overall, active labor market politics providing training or employment and recruitment incentives seems to be an effective measure to reduce educational inequalities in work exit for both men and women. How to provide effective on-the-job training on the firm level might be a task for future research.

Small differences existed in voluntary work exit between men and women. For women, *pull* factors, namely passive labor market expenditures offering generous benefits and preretirement programs for maintaining the living standard after work exit were associated with a smaller gradient in voluntary work exit and staying employed. Furthermore, *need* factors, in particular, a higher early retirement age in which pension benefits can be claimed, was associated with a decreasing social gradient in involuntary as well as voluntary work exit and an increasing in staying employed among women. Women's decision to exit the labor market voluntarily largely depends on the generosity of pension programs and compensations for forgone earnings. Men, on the other hand, seem not to be affected be institutional factors when exiting the labor market voluntarily. Women's decision to exit work might depend more on the spouse employment status as well. Previous research showed, that married women are more likely to retire early than divorced women (Finch 2014). Analyzing the dyadic structure of labor market exit decisions and how institutional factors influence joined work exit decisions could be a task for future research.

This study contributes to previous research by empirically testing institutional factors that also include those aiming at delaying retirement and hence, extending the *push* and *pull* approach. Especially *maintain* factors which intending to improve opportunities of older workers to stay in employment are in effective measures to do so. Not only education in early life, also further on-the-job training later on can help to reduce the social gradient in involuntary work exit.

Moreover, from a social policy perspective it is more important to consider work exit and not only retirement entry. Work exit also includes becoming unemployed or a homemaker which is not covered by observing retirement entries. Since social security systems must already intervene in case of a work exit which can occur much earlier than retirement entries and leads to higher costs considering unemployment benefits besides pension claims. Using a meta-analysis, which can be seen as a more conservative method for testing country differences we showed that p*ull* and *need* factors were not associated with a social gradient in work exit (Brons et al. 2017; Bryan and Jenkins 2016). This result is in line with previous research using data covering the same observation period starting in the early 2000s (Ebbinghaus and Hofäcker 2013; Ebbinghaus and Radl 2015). These findings suggest that the much discussed increase in retirement age alone may not directly lead to an increasing social gradient in work exit. Rather, it is an interplay of various factors influencing the social gradient in different ways.

A limitation of the study is that a further distinction between types of work exit, for instance, unemployment, disability retirement, early retirement, and statutory retirement, and not only between voluntary and involuntary work exit was not possible to due to small sample sizes in most countries. Even if the allocation to voluntary and involuntary work exit was done by adopting a classification from previous research there might be a risk that a self-perceived and objectively involuntary work exit might have been subjectively voluntary. However, a measure asking people if it was their own choice to exit work was not available. Moreover, only educational differences could be taken into account. Another measure besides education for social class would have been desirable as the opportunity structure of older workers depends on their level of employability which is not only determined by education (Radl 2013). Nevertheless, ISCO codes for occupations have only been collected during the first wave of the SHARE and not in subsequent waves. Besides, results show that *pull* as well as *need* factors could not explain the social gradient in work exit. Educational inequalities in work exit seem

to be unrelated, e.g. to the unemployment rate of older workers. Another possibility could be that a higher unemployment rate might affect the social gradient in involuntary work exit differently, e.g. during a recession (Ebbinghaus and Radl 2015). The macro indicators were mostly measured in 2004 before the great recession in most European countries and including longitudinal measures of the macro indicators was not possible in a meta-analysis framework. Nevertheless, this study showed that a social gradient in involuntary work exit is present in most European countries which can have serious negative consequences for individual workers well-being, such as poorer life satisfaction, lower self-rated health, higher risk of depression, and lower old-age income (Ebbinghaus and Radl, 2015; Heisig, 2017; Hyde et al., 2015). For lower educated workers it is more difficult to reach the new goal of extending working lives. This may lead to rising social inequalities between lower and higher educated workers. Investments in active labor market expenditures, especially in lifelong learning and rehabilitation for lower educated, may help to reduce the social gradient in involuntary work exit. This should be considered by policy-makers, employers and trade-unions.

5.8. Acknowledgements

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5.10. Appendix

Table 3: Meta-regression of institutional factors on type of work exit.

		Involuntary work exit	Voluntary work exit	No work exit
Institutional factor	Indicator	Coef.	Coef.	Coef.
Pull	PLMP	-0.001	-0.007	0.009
	Formal retirement age	-0.001	-0.002	0.002
Push	Unemployment rate	0.001	-0.002	0.001
	EPL-Index	0.014**	-0.008	-0.005
Need	Net replacement rate	0.0001	0.0002	-0.0002
	Early retirement age	-0.001	-0.003	0.004
	Lifelong learning	-0.0003*	0.0001	0.0001
Maintain	ALMP	-0.007	-0.023*	0.029**
	Rehabilitation expenditures	-0.020	-0.037	0.057*

*p<0.1, **p<0.5, ***p<0.01

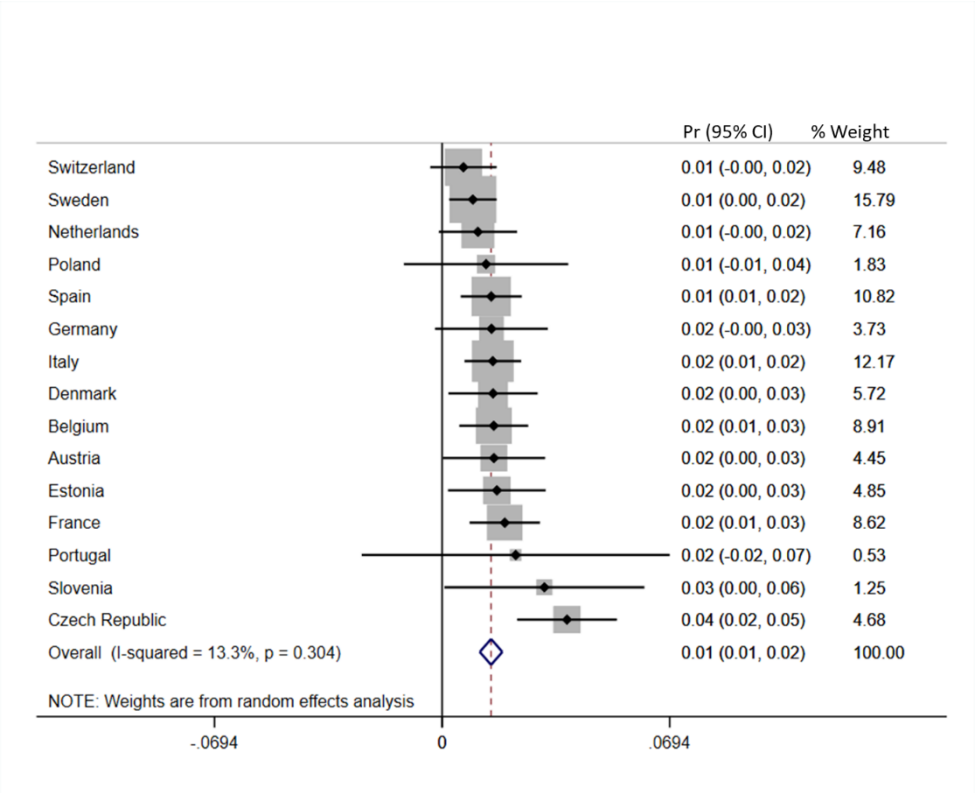

Figure 5a: Social gradient in involuntary work exit among women.

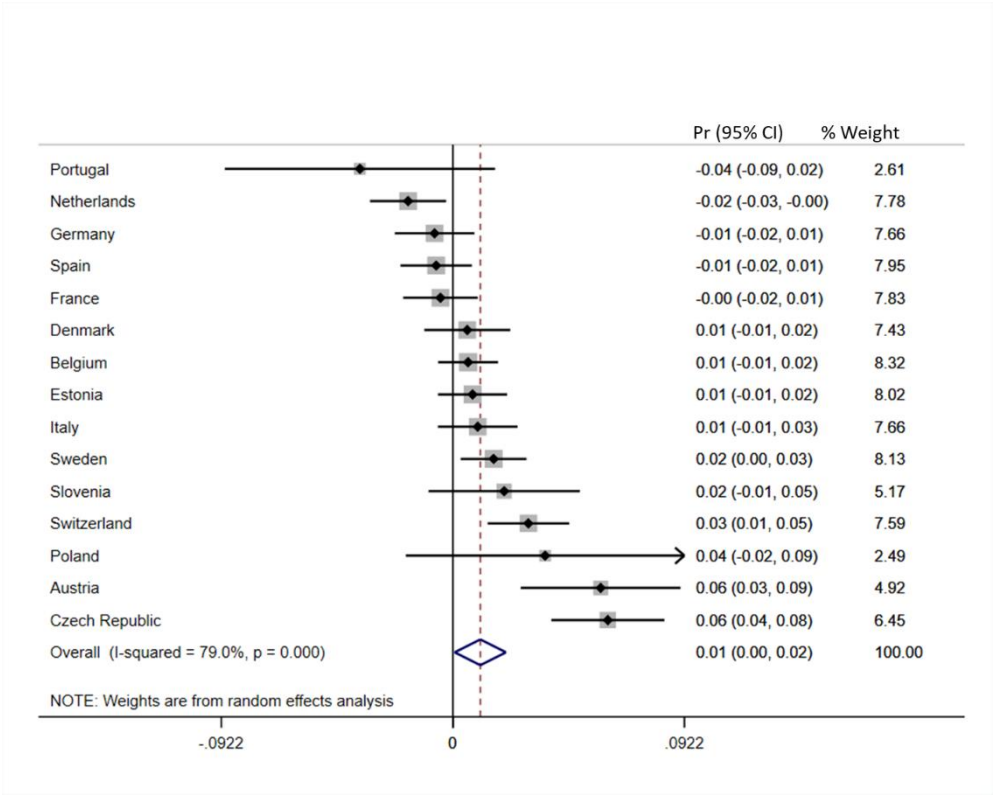

Figure 5b: Social gradient in voluntary work exit among women.

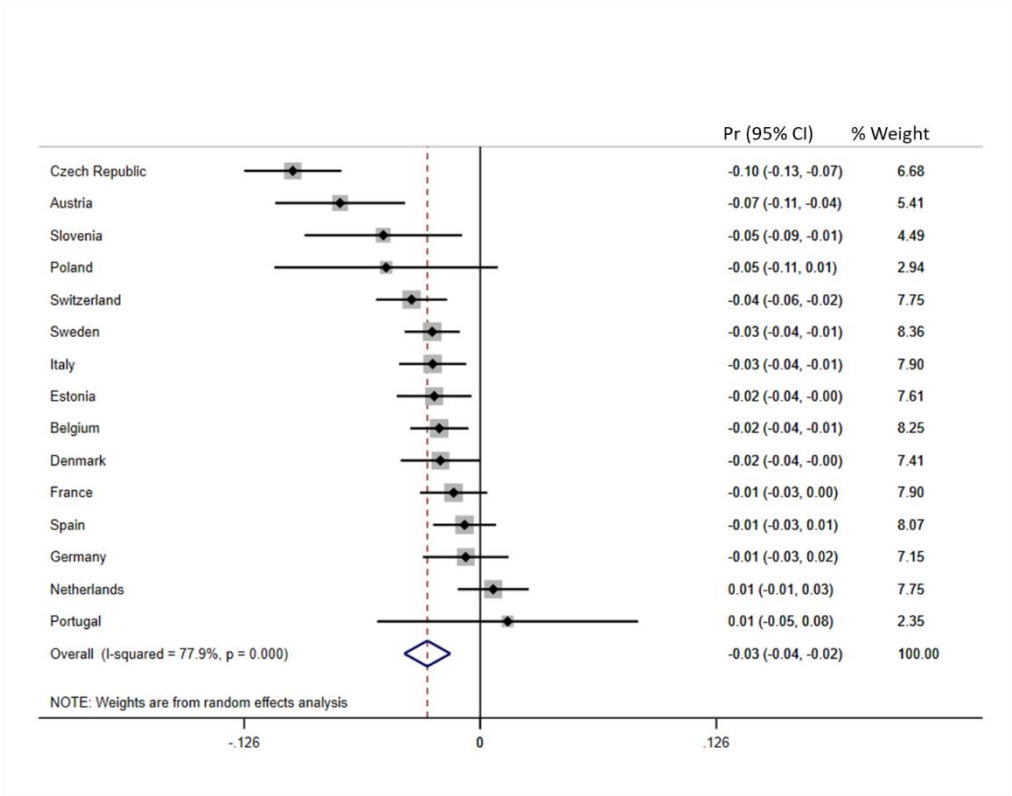

Figure 5c: Social gradient in staying employed among women.

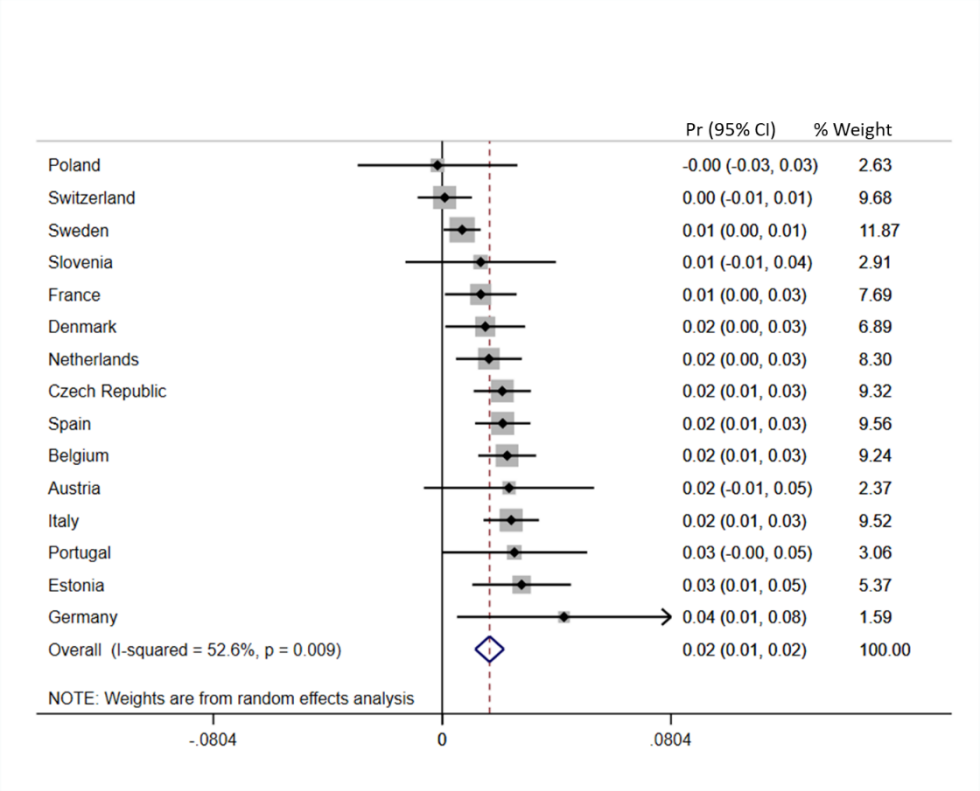

Figure 6a: Social gradient in involuntary work exit among men.

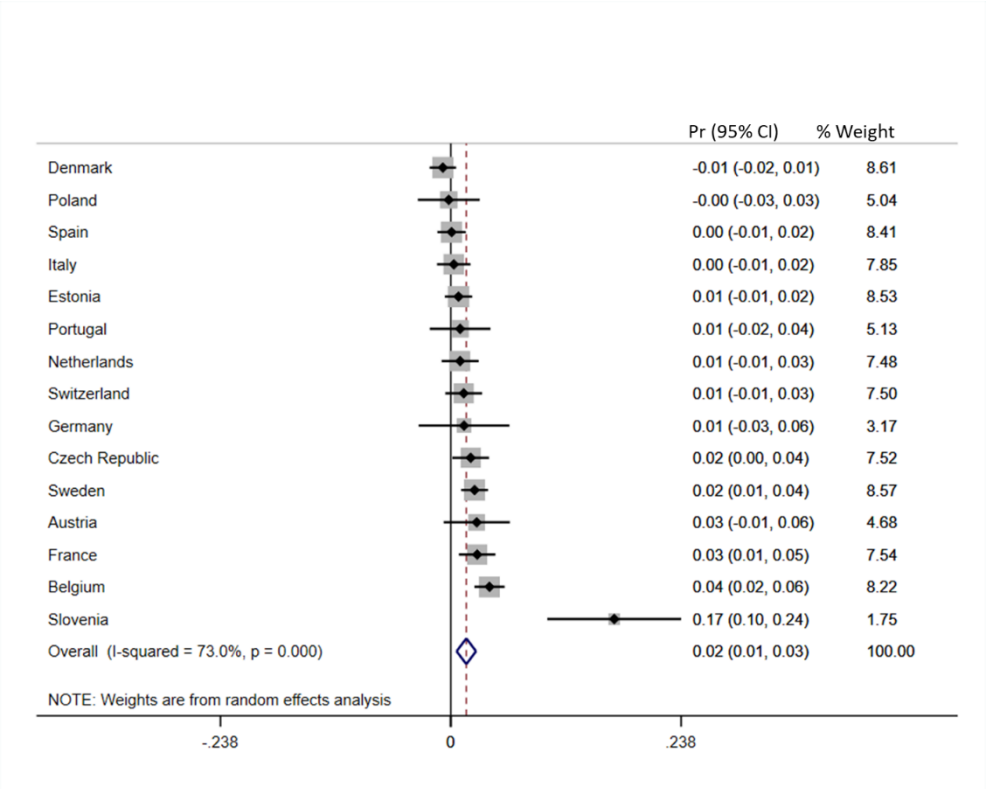

Figure 6b: Social gradient in voluntary work exit among men.

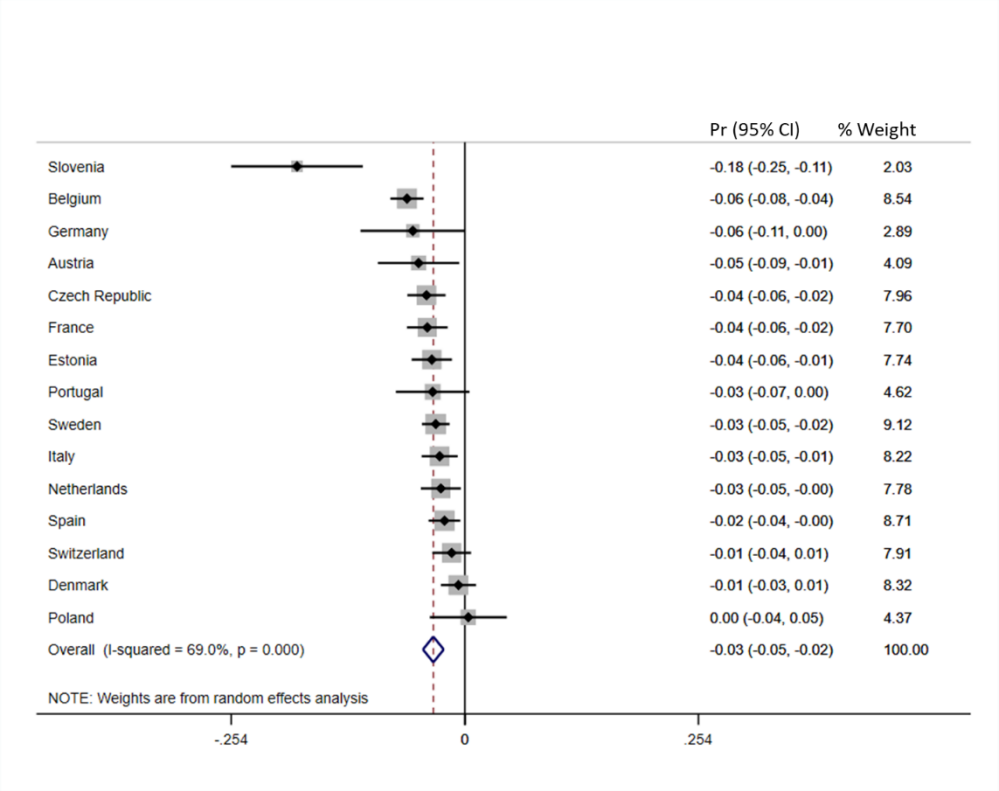

Figure 6c: Social gradient in staying employed among men.

Table 4: Meta-regression of institutional factors on type of work exit of women.

Women		Involuntary work exit	Voluntary work exit	No work exit
Institutional factor	Indicator	Coef.	Coef.	Coef.
Pull	PLMP	-0.002	-0.017**	0.020**
	Formal retirement age	-0.001	-0.004	0.005
Push	Unemployment rate	0.001	-0.003	0.002
	EPL-Index	0.009	-0.022	0.012
Need	Net replacement rate	-0.0001	-0.0001	0.0001
	Early retirement age	-0.001*	-0.005*	0.006*
	Lifelong learning	-0.0002*	0.0003	-0.0001
Maintain	ALMP	-0.008	-0.027*	0.038**
	Rehabilitation expenditures	-0.015	-0.035	0.055

*p<0.1, **p<0.5, ***p<0.01

Table 5: Meta-regression of institutional factors on type of work exit of men.

Men		Involuntary work exit	Voluntary work exit	No work exit
Institutional factor	Indicator	Coef.	Coef.	Coef.
Pull	PLMP	-0.0004	-0.0004	0.001
	Formal retirement age	0.00001	-0.001	0.001
Push	Unemployment rate	0.002	-0.001	-0.001
	EPL-Index	0.017**	0.006	-0.018
Need	Net replacement rate	0.0001	0.0002	-0.0003
	Early retirement age	-0.001	-0.002	0.003
	Lifelong learning	-0.001**	0.00004	0.0003
Maintain	ALMP	-0.006	-0.015	0.022
	Rehabilitation expenditures	-0.021	-0.033	0.054

*p<0.1, **p<0.5, ***p<0.01

Table 6: Meta-regression of average institutional factors on type of work exit.

		Involuntary work exit	Voluntary work exit	No work exit
Institutional factor	Indicator	Coef.	Coef.	Coef.
Pull	PLMP	-0.001	-0.012	0.011
	Formal retirement age	-0.001	-0.004	0.004
Push	Unemployment rate	0.001	-0.002	0.002
	EPL-Index	0.013*	-0.002	-0.011
Need	Net replacement rate	0.0001	-0.0001	-0.0002
	Early retirement age	-0.001	-0.005*	0.006**
	Lifelong learning	-0.0004***	-0.0001	0.0004
Maintain	ALMP	-0.007	-0.023*	0.029**
	Rehabilitation expenditures	-0.018	-0.031	0.050

*p<0.1, **p<0.5, ***p<0.01