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Governance of ageing and functional health: the impact of retirement policies on grip strength in Europe

Mohammad Almomani and Mohammad Al-Masaeid
Flinders University, Adelaide, Australia

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Abstract

Purpose – This paper aims to investigate how retirement and its duration affect functional health, using grip strength as an early biomarker of ageing. It examines the implications of pension policy and cultural context for physical functioning among older adults in Europe.

Design/methodology/approach – We analyse panel data from the Survey of Health, Ageing and Retirement in Europe, covering 2004–2019. A fixed effects instrumental variable (FE–IV) approach is employed, using eligibility for state pension age as an exogenous instrument to address endogeneity in retirement status.

Findings – Retirement improves grip strength, particularly among older women and in individualistic welfare regimes. However, extended time in retirement leads to functional decline, especially among men and in collectivist societies. These patterns suggest both health-promoting and health-risk phases within retirement, shaped by policy and cultural environments.

Originality/value – By linking pension eligibility rules with functional health outcomes across countries, this study provides governance-relevant evidence for designing retirement systems that support healthy ageing. Findings highlight the need for integrating physical resilience programs within retirement policy, tailored to national contexts and cultural norms, to reduce long-term health risks and promote equity in ageing.

Keywords Retirement, Grip strength, Healthy ageing, Pension eligibility, Functional health, Health system governance

Paper type Research article

1. Introduction

The demographic shift towards an ageing population presents significant challenges to global health systems and social structures. The population of Europeans aged 60 and over is projected to exceed 300 million by 2050, intensifying concerns about functional independence among older adults (WHO, 2024). As policymakers seek sustainable strategies to support ageing populations, understanding the health consequences of retirement, one of the most significant life transitions in later life, is vital for designing responsive and equitable retirement and health systems.

Several studies have examined the impact of retirement on health outcomes such as mortality, cardiovascular disease or mental health (e.g. Insler, 2014; Coe and Zamarro, 2011). While these outcomes are important, they often capture only the end stages of health deterioration and may not reflect earlier, modifiable changes in physical functioning. This study complements existing work by focusing on grip strength, a validated biomarker of ageing and a predictor of long-term morbidity and mortality, to detect early physiological changes. Grip strength, a widely recognised and objective biomarker of ageing, is used here as the outcome of interest. While it does not directly lead to health deterioration, it is a strong predictor of future morbidity, disability and mortality (Cooper *et al.*, 2010). Leong *et al.* (2015) found that reduced grip strength was linked to higher rates of all-cause and cardiovascular

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mortality across diverse populations. Similarly, a study by Wang *et al.* (2023) reported that among older adults, lower grip strength correlated with increased all-cause mortality and a higher burden of comorbidities. Consequently, it offers a valuable early signal of subclinical health changes, particularly among older adults.

This paper investigates the causal effect of retirement on grip strength across nine European countries, using data from the Survey of Health, Ageing and Retirement in Europe (SHARE) collected between 2004 and 2019, focusing on adults aged 50 and older. We exploit the recent reforms of state pensions in European countries, which have significantly changed the financial incentive for older people to retire. We employ the fixed effects instrumental variable (FE-IV) approach. Specifically, our IV is based on eligibility ages for normal retirement, which vary across countries, genders, birth cohorts and over time. In doing so, we assess how national retirement policies and welfare contexts shape health outcomes in later life.

Our analysis uncovers important heterogeneities: retirement improves grip strength for older women and in individualistic societies, but prolonged time in retirement is associated with functional decline, especially among men and in collectivistic welfare contexts. These findings highlight how cultural values, gender norms and institutional frameworks interact to shape the health consequences of retirement.

This study makes two contributions to the literature on ageing and health governance. First, it provides robust, cross-national evidence on how retirement policies influence early-stage physical decline, helping to identify leverage points for preventive public health action. Second, it introduces a cultural dimension to the analysis by categorising European countries as individualistic or collectivistic (Hofstede, 1984), offering insights into how social norms mediate the relationship between policy and health.

By linking pension system design to measurable health outcomes, this research informs the development of culturally sensitive and governance-oriented retirement policies that promote equity and resilience in ageing populations. The paper proceeds as follows: Section 2 reviews the literature, Section 3 outlines the institutional context of pension eligibility in Europe, Section 4 describes the data and methodology, Section 5 presents the results and Section 6 concludes with policy implications.

2. Literature review

From a theoretical standpoint, retirement could affect health via two countervailing mechanisms. On one hand, retirement may improve health by reducing work-related stress and allowing more time for physical activity and preventive care (Grossman, 1972). On the other hand, it may deteriorate health through social isolation, loss of routine and reduced cognitive or physical engagement (Bonsang *et al.*, 2012).

Much of the existing literature on the health effects of retirement has focused on major health events and diagnosed conditions, such as cardiovascular disease, depression or disability in activities of daily living (ADL) (Rohwedder and Willis, 2010). Coe and Zamarro (2011) used SHARE data and an IV strategy exploiting statutory retirement ages to show that retirement improves self-rated health. In contrast, Behncke (2012) found that retirement can worsen objective health outcomes, particularly among less-educated groups, using similar identification techniques. These outcomes, while important, often represent the later stages of health deterioration. As such, they may overlook the more subtle, early physiological signals that precede serious impairment.

Baumann and Madero-Cabib (2021) showed that welfare regimes buffer retirement-related physical decline, with Scandinavian systems outperforming liberal ones. Steiber and Kohli (2017) highlighted gender heterogeneity, showing that continued employment past retirement age is more physically protective for men. These findings align with prior evidence from Staubli and Zweimüller (2013), who showed that increasing early retirement ages can improve health indirectly by maintaining physical engagement. Sharma *et al.* (2022) assess community health governance in India by evaluating the functionality of Village Health Sanitation and

Nutrition Committees, revealing how variations in committee composition, funding flows and supervisory mechanisms shape the delivery of preventive services at the local level.

Retirement has been shown to improve self-reported health and reduce stress, particularly among individuals in demanding occupations, though such findings are typically based on subjective health assessments rather than objective physical measures like grip strength (e.g. Eibich, 2015; Mazzonna and Peracchi, 2017).

Recent work has shifted attention to objective physical health markers, especially grip strength, which is a validated predictor of morbidity and mortality (Cooper *et al.*, 2010). However, few studies until recently treated it as a primary outcome. Zwar *et al.* (2025) used SHARE data to analyse longitudinal changes in grip strength, highlighting how this physical capacity evolves in older adults across Europe and interacts with caregiving roles.

Post-retirement changes in lifestyle, such as reduced occupational strain, increased time for exercise or improved sleep, may have significant implications for muscle strength and physical resilience. Yet the causal relationship between retirement timing and grip strength, as an early functional outcome, remains underexplored. In addition, differences across gender and cultural welfare models may further shape these effects, as men and women may differ in work-life patterns and institutional contexts influence how retirement is experienced (Börsch-Supan and Coile, 2020; Möhring, 2015).

3. Normal state pension eligibility in Europe

Intersectoral collaboration among government bodies to establish a good health reform can identify trust, knowledge sharing and aligned incentives (De Bekker *et al.*, 2024). The retirement income systems across European countries are broadly shaped by three key components: (1) public pension schemes, which are mandatory, state-managed schemes typically financed; (2) occupational or employer-sponsored pensions and (3) voluntary private savings and insurance schemes (European Parliament, 2023). Our focus is on the publicly provided state pension, which often offers a statutory retirement age that can be leveraged for identifying exogenous variation in retirement timing, useful for the causal identification of retirement's impact on grip strength.

While European countries differ in their design of pension systems, most have implemented a normal retirement age which signals the age at which individuals become eligible for full state pension benefits. This age has been subject to periodic reforms in recent decades, driven by fiscal pressures and demographic ageing. For instance, in Germany, the retirement age has been gradually increasing from 65 to 67, while in Italy, the eligibility age varies across cohorts and gender due to reforms like the Fornero law. In the Nordic countries, such as Sweden and Denmark, retirement age is increasingly linked to life expectancy, making it a dynamic policy lever.

4. Data

This paper utilises data from the Survey of Health, Ageing and Retirement in Europe (SHARE), a comprehensive dataset focusing on various aspects of ageing and well-being in Europe (Börsch-Supan *et al.*, 2013). The SHARE dataset is a well-rounded and inclusive multidisciplinary dataset that encompasses a wide range of European countries. The SHARE dataset consists of panel data, indicating that most participants were observed multiple times. It spans 28 European countries and Israel across 9 waves. The first wave was conducted in 2004–2005, and the latest in 2021–2022. To determine the causal relationship between retirement and grip strength, we use seven waves of the SHARE dataset covering the period 2004–2019. We exclude other waves due to missing data for grip strength. We make our analysis for nine European countries (Austria, Germany, Sweden, Spain, Italy, France, Denmark, Switzerland and Belgium).

4.1 Variables

Grip strength in the SHARE was measured in kilograms using a handheld dynamometer (Smedley, S Dynamometer, manufactured by Tsutsumi Co. Ltd. (TTM), Tokyo, 100 kg capacity). Each participant performed two tests per hand, alternating between hands while seated with elbows bent at 90° and arms close to the torso. To maintain data quality, only those with two valid readings per hand and a difference of no more than 20 kg on one hand were included. The final grip strength value was defined as the maximum grip strength among the measurements.

Reliability of grip strength measurement was evaluated using the intraclass correlation coefficient (ICC). As shown in Table 1, the ICC was 0.85 (95% CI: 0.848–0.852), suggesting very high internal consistency, with most of the variance explained by differences between individuals. Approximately 85% of the total variance in grip strength can be attributed to differences between individuals rather than within-individual variation across measurements. This finding is reinforcing confidence in the reliability of this biomarker of early ageing.

Nevertheless, potential sources of variability remain, such as differences in participant effort, device calibration and testing protocols across countries. Although calibration logs were not uniformly available, SHARE's harmonised measurement protocol and centralised training for field staff help mitigate cross-country discrepancies. To evaluate the robustness of our inclusion threshold, we conducted sensitivity analyses using narrower (≤15 kg) and wider

Table 1. Intraclass correlation coefficient (ICC) for grip strength measurement

Statistic	Estimate	Std. Error	95% confidence interval
ICC	0.850	0.00094	[0.848, 0.852]
Between-individual variance	122.76	0.74	[121.31, 124.23]
Within-individual variance	21.67	0.08	[21.51, 21.84]

Note(s): ICC = Intraclass correlation coefficient. Estimates are based on SHARE data (2004–2019)

Table 2. Sensitivity analysis of grip strength inclusion thresholds (FE-IV estimates)

	First stage	Second stage	First stage	Second stage
Panel A	≤15 kg		≤25 kg	
Retirement		1.003*** (0.401)		1.087*** (0.379)
State pension age eligibility	0.149*** (0.005)		0.161*** (0.379)	
Observations	108,920		132,450	
Individuals	35,612		42,105	
F-statistic (IV)	1123.45		124.88	
Panel B				
Log (retirement duration)		−2.672*** (0.894)		−2.431*** (0.842)
Log (duration of being age eligible for state pension)	0.088*** (0.017)		0.093*** (0.016)	
Observations	108,920		132,450	
Individuals	35,612		42,105	
F-statistic (IV)	198.76		215.34	

Note(s): FE-IV estimates using alternative inclusion thresholds for within-hand grip strength difference. Control variables include age, age squared, age cubed, education, marital status, income, body weight, IADL, ADL, cognitive functions, country, and wave dummies. Standard errors clustered at the individual level are shown in parentheses

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

($\leq$25 kg) cut-offs. As shown in Table 2, the FE–IV estimates for both retirement and retirement duration remained statistically significant and directionally consistent across all thresholds. This confirms that our findings are not sensitive to the choice of inclusion criteria.

In addition, we performed a simulated robustness test by randomly excluding 10% of observations with borderline inclusion values – specifically, those with within-hand grip strength differences between 18 and 20 kg. The results, presented in Table 3, show that the estimated coefficients for retirement and retirement duration remain statistically significant and consistent with our main findings. This further reinforces confidence in the validity of grip strength as a biomarker of early functional ageing and supports the reliability of our empirical strategy.

In the literature, there are two definitions of retirement. First, people who do not participate in the labour force are considered retired. This definition has drawbacks in that homemakers, sick people with disabilities and the unemployed can be considered retired. Second, self-reported retirement is regarded as a good indicator and has been widely used in economics (Kesavayuth *et al.*, 2018). Therefore, we use self-reported retirement as an indicator of retirement.

We use a set of control variables [1] to isolate their effect on grip strength: age, age square, age cubed, male dummy, education dummies, marital status dummies, income, cognitive functions [2], body weight dummies, number of chronic diseases, instrumental activities of daily living (IADL), ADL, wave dummies and countries.

4.2 Empirical strategy

We use the following model to examine the relationship between retirement and IADLs:

$$GS_{it} = \beta_0 + \beta_1 Ret_{it} + \beta_2 C_{it} + \mu_i + \epsilon_{it} \quad (1)$$

GS_{it} refers to grip strength of individual i at time t. The variable Ret_{it} indicates retirement status; take the value 1 if the individual is retired and 0 otherwise. Control variables[3] are denoted by C_{it}. μ_i represents individual FE and ϵ_{it} is the error term.

Table 3. Simulated robustness test: Exclusion of borderline grip strength observations (FE-IV estimates)

Panel A	First stage	Second stage
Retirement		1.024*** (0.392)
State pension age eligibility	0.158*** (0.004)	
F-statistics	1187.32	
Observations	114,782	
Individuals	37,920	

Panel B	First stage	Second stage
Log (retirement duration)		−2.487*** (0.874)
Fist stage (log duration of being age eligible for state pension)	0.091*** (0.015)	
F-statistics	201.46	
Observations	114,782	
Individuals	37,920	

Note(s): FE-IV estimates after excluding 10% of observations with within-hand grip strength differences between 18 and 20 kg. Control variables include age, age squared, age cubed, education, marital status, income, body weight, IADL, ADL, cognitive functions, country, and wave dummies. Standard errors clustered at the individual level are shown in parentheses

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

Determining the causal impact of retirement status (Ret_{it}) on grip strength (GS_{it}) is challenging due to the likely endogeneity of retirement. Causality may run in reverse: individuals with declining grip strength may be more likely to retire earlier, creating a potential bias due to reverse causality. Additionally, time-varying unobserved factors, such as changes in workload intensity, lifestyle adjustments or health-related behaviours may simultaneously influence both grip strength and the decision to retire. Moreover, there could be unobserved variables that influence both the decision to retire and grip strength. Therefore, we implement a FE–IV approach. This strategy addresses endogeneity concerns arising from unobserved individual heterogeneity and potential reverse causality between retirement and health. The following equations illustrate the (FE–IV) estimation:

$$Ret_{it} = \beta_0 + \beta_1 EliAge_{it} + \beta_2 C_{it} + \nu_i + \varepsilon_{it} \tag{2}$$

$$GS_{it} = \beta_0 + \beta_1 \widehat{Ret_{it}} + \beta_2 C_{it} + \mu_i + \epsilon_{it} \tag{3}$$

In Equation (2), normal state pension age eligibility $EliAge_{it}$ is the instrument for retirement status Ret_{it} and ν_i is the individual FE. In Equation (3), $\widehat{Ret_{it}}$ is the predicted retirement derived from the first-stage FE estimation of Equation (2). Since $\widehat{Ret_{it}}$ is predicted using $EliAge_{it}$ and C_{it}, it is uncorrelated to unobserved confounders absorbed in ϵ_{it}. Therefore, in the second stage, an FE estimation of Equation (3) can produce the estimation of β that uncovers the causal effects of retirement on grip strength. We adjust standard errors for clustering at the individual level to account for heteroskedasticity and arbitrary serial correlations across the waves of the SHARE survey. The IV approach relies on two key assumptions: relevance and exclusion.

The IV approach depends on two key assumptions: relevance and exclusion. Choosing an appropriate instrument for retirement is crucial for the effectiveness of the FE–IV method. In our case, eligibility for normal state pension age eligibility serves as the instrument, which influences grip strength only through its effect on individuals' retirement behaviour. As shown below, the relevance condition holds, as there is a strong link between state pension age eligibility and retirement status.

Table 4 presents the summary statistics. A slightly higher percentage of people in our group are women (about 53%). A slightly higher percentage of people in our group are women (about 53%). Respondents in our sample have a medium level of education, and the average family size is 2.36 members. Most of our sample reported their health as good or fair. Table 1 shows the descriptive statistics for retirement status in both genders.

Table 4 summarises the retirement status of men and women, highlighting several key differences. Retired individuals report greater difficulty with IADL than those who are still in the workforce. On average, retirees are approximately 72 years old for both genders, whereas non-retired men and women are younger – about 57 and 61 years old, respectively. These age differences partly reflect gendered work trajectories, with women more likely to have interrupted careers due to caregiving responsibilities, which can delay retirement (Evertsson *et al.*, 2016). Among retirees, men are more commonly married and cohabiting with a spouse, while women are more frequently widowed. Educational attainment also plays a role, as men with higher education levels tend to retire later. Furthermore, non-retired individuals generally live in larger households than those who are retired.

5. Results

5.1 The impact of retirement on grip strength

Table 5 shows the results obtained from fixed-effect (FE) and fixed-effects IV (FE–IV) estimations.

FE estimates are shown in the second column of Table 5. The results show that there is little positive correlation between retirement and grip strength. However, as we mentioned above,

Table 4. Descriptive statistics

	Male Retired	Not retired	Female Retired	Not retired
Grip strength	39.890 (9.520)	47.305 (9.581)	24.753 (6.385)	27.624 (7.189)
Age	72.116 (7.831)	58.522 (6.422)	72.030 (8.044)	62.221 (10.177)
Marital status				
Married, living with spouse	0.761	0.573	0.706	0.761
Registered partnership	0.067	0.115	0.107	0.102
Not married	0.049	0.094	0.058	0.057
Widowed	0.087	0.030	0.262	0.135
Education				
No education	0.055	0.035	0.051	0.064
Low education	0.366	0.265	0.406	0.484
Medium education	0.346	0.417	0.336	0.331
High education	0.233	0.283	0.207	0.230
Number of chronic diseases	1.858 (1.523)	1.217 (1.316)	2.018 (1.602)	1.491 (1.515)
Body weight				
Underweight	0.019	0.008	0.047	0.033
Healthy Weight	0.289	0.120	0.368	0.192
Overweight	0.423	0.176	0.307	0.169
Obesity	0.270	0.699	0.278	0.568
IADLs	0.091 (0.288)	0.045 (0.206)	0.107 (0.309)	0.092 (0.288)
ADLs	0.119 (0.324)	0.068 (0.252)	0.129 (0.335)	0.106 (0.308)
Fluency	19.150 (7.079)	22.011 (7.367)	19.598 (7.178)	20.188 (7.917)
Memory	8.130 (3.531)	9.89 (3.402)	9.100 (3.766)	9.754 (4.013)
State pension age eligibility	0.967	0.747	0.963	0.713
Observations	59,376	85,792	55,742	106,828

Note(s): Data from SHARE 2004–2019. Standard errors clustered at the individual level appear in parentheses

Table 5. The impact of retirement on grip strength

Outcome variable: Grip strength	Fixed effect	Fixed effect with IV
Retirement	0.127** (0.054)	1.071*** (0.375)
First stage (State pension age eligibility)		0.182*** (0.004)
F-statistic on the excluded instrument		1870.845

Note(s): Control variables: age, age squared, age cubed, education dummies, marital status dummies, income, Body weight dummies, IADL, ADL, cognitive functions, country, and wave dummies. Standard errors clustered at the individual level are reported in parentheses
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

we have an endogeneity problem; therefore, we use the two-stage FE–IV approach. Statistical evidence in the third column of Table 5 indicates that state pension age eligibility is a strong IV. In the first stage, it is evident that the IV significantly influences retirement decisions. If an older individual reaches the eligible age for state pension, the probability of retirement increases by 18% points. Moreover, the F-statistics on the excluded instrument is 1870.845, for exceeding the rule-of-thumb threshold of 10. The second-stage results are shown in the third column in Table 3. The results demonstrate that retirement has a positive and statistically significant effect on difficulties in grip strength.

5.2 *The impact of retirement duration on grip strength*

In Section 4.4, retirement was viewed as a distinct shift in lifestyle. The findings presented in Table 5, based on Equation (3), assessed the effect of moving from employment into retirement on grip strength. In this section, however, retirement is considered as a continuous process of adaptation, capturing the longer-term effects of being out of the labour force (Bonsang *et al.*, 2012; Zhu and Onur, 2023). Adjusting to retirement can be gradual, as it may take time for retirees to adapt to the lifestyle changes linking with leaving labour force. Grip strength may change after retiring for an extended period. Therefore, grip strength may change as retirees spend more time in retirement.

In the SHARE dataset, respondents indicated the year in which they left the labour force. Using this information, we calculate each retiree's retirement duration, denoted as $RetDur_{it}$ which represents the time elapsed between the reported retirement year and the year of the interview. This is defined as $RetDur_{it} = Max\{Year_{it} - RetYear_{it}, 0\}$. Additionally, we calculate the duration of being age eligible for the state pension, denoted as $EliDur_{it}$ which captures the time since they first became eligible for state pension, i.e. $EliDur_{it} = Max\{Year_{it} - EliYear_{it}, 0\}$. As Table 5 shows a strong positive linkage between pension eligibility and retirement behaviour, we anticipate a high degree of correlation between $RetDur_{it}$ and $EliDur_{it}$.

To analyse the relationship between retirement duration and grip strength, we use the following model:

$$Log\,(RetDur_{it} + 1) = Log\,(EliDur_{it} + 1)\theta + \chi_{it}\lambda + \nu_i + \varepsilon_{it} \tag{4}$$

$$GS_{it} = Log\,(\widehat{RetDur}_{it} + 1)\beta + \chi_{it}\lambda + \nu_i + \varepsilon_{it} \tag{5}$$

Equations (4) and (5) are estimated via FE–IV. In the first-stage, FE estimation of Equation (4), $(EliDur_{it} + 1)$ is the instrument for $Log\,(RetDur_{it} + 1)$. In the second stage, we replace $Log\,(RetDur_{it} + 1)$ with its predictor $\widehat{RetDur}_{it}$ obtained in the first stage and then perform an FE estimation of Equation (5). The logarithmic transformation duration variables follow that in Bonsang *et al*. (2012) and Zhu and Onur (2023). In Equation (5), the logarithmic retirement duration allows the changes in grip strength for individuals to be nonlinearly related to retirement duration. Table 3 presents the results from both FE and FE–IV estimations of the impact of retirement on grip strength.

Table 6 presents the results of both FE and FE–IV estimations examining the relationship between retirement duration (log-transformed) and grip strength. The estimates reveal a substantial divergence between the two methods, underscoring the importance of accounting for endogeneity in retirement decisions.

Table 6. The impact of retirement duration on grip strength

Outcome variable: Grip strength	Fixed effect	Fixed effect with IV
Log (retirement duration)	0.102 (0.063)	−8.016*** (2.761)
First stage (log duration of being age eligible for state pension)		0.096*** (0.018)
F-statistic on the excluded instrument		29.294

Note(s): Control variables: age, age squared, age cubed, education dummies, marital status dummies, income, Body weight dummies, IADL, ADL, cognitive functions, country, and wave dummies. Standard errors clustered at the individual level are reported in parentheses
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

5.3 Heterogeneity analysis

5.3.1 By gender. To explore differences by gender, we estimated Equation (3) separately for men and women. The results are shown in Table 7.

We find that retirement has an insignificant effect on grip strength for men. In contrast, it has a positive and statistically significant effect for women. Transition to retirement increases grip strength by 1.651 in older women. This aligns with the study by Celidoni and Rebba (2017), who also found positive retirement effects for women. Men's occupations might typically be more physically demanding, meaning retirement does not substantially change their physical routines, whereas women in less physically active roles might experience significant benefits from retirement. Moreover, women may experience higher stress levels from balancing employment with household responsibilities, so retirement could significantly alleviate these stressors, positively affecting them.

Table 8 shows the effect of retirement duration on grip strength by gender. We find that time spent in retirement has an insignificant impact on grip strength for both genders. However, estimating separate models for people reduces statistical power and may introduce weak instrument bias, especially when sample sizes differ and the instrument performs unequally across subgroups. To address these issues and formally test for gender differences, we estimate a fully interacted FE-IV model, which includes an interaction term between retirement

Table 7. The impact of retirement on grip strength by gender

	Males		Females	
Variable	First stage	Second stage	First stage	Second stage
Retirement		0.568 (0.690)		1.651*** (0.411)
First stage (State pension age eligibility)	0.170*** (0.006)		0.189*** (0.005)	
Observations	58,728		69,252	
Individuals	19,065		22,211	
F-statistic (IV)	830.53		1013.72	

Note(s): Control variables: age, age squared, age cubed, education dummies, marital status dummies, income, Body weight dummies, IADL, ADL, cognitive functions, country, and wave dummies. Standard errors clustered at the individual level are reported in parentheses

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

Table 8. Impact of retirement duration on grip strength by gender (FE-IV estimates)

	Males		Females	
Variable	First stage	Second stage	First stage	Second stage
Log (retirement duration)		2.528 (11.334)		−1.956 (1.235)
Fist stage (log duration of being age eligible for state pension)	−0.038*** (0.029)		0.189*** (0.023)	
Observations	29,682		26,478	
Individuals	10,355		9,358	
F-statistic (IV)	1.729		65.93	

Note(s): Control variables: age, age squared, age cubed, education dummies, marital status dummies, income, Body weight dummies, IADL, ADL, cognitive functions, country, and wave dummies. Standard errors clustered at the individual level are reported in parentheses

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

duration and a female dummy. This allows us to estimate both the main effect for men and the differential effect for women within a unified and statistically efficient framework.

Table 9 reports the results from the interaction model. The baseline coefficient for retirement duration is negative and statistically significant for men, indicating that longer retirement is associated with declines in grip strength. The interaction term for women is positive, which attenuates the magnitude of the negative baseline effect. However, the implied overall effect for women remains negative, consistent with the main results. These findings suggest that the detrimental impact of prolonged retirement on grip strength is stronger among men than women, a pattern aligned with previous research on gender differences in retirement and health (Van der Noordt *et al*., 2014).

The stronger negative effect of retirement duration for men may result from a more abrupt transition from full-time employment to inactivity, particularly for those previously engaged in physically demanding occupations. This sudden withdrawal from structured labour may accelerate muscle atrophy and physical decline, especially if not replaced with compensatory physical activities.

5.3.2 By region. We apply Hofstede's cultural theory (1984), which classifies countries as either collectivist or individualist. Collectivist cultures (Spain, Italy and France) emphasise strong family ties and obligations. In contrast, individualist cultures (Austria, Germany, Sweden, Denmark, Switzerland and Belgium) prioritise personal freedom and self-interest over group obligations).

Table 10 presents the descriptive statistics for the impact of retirement on grip strength. In the individualistic countries, transition to retirement statistically significantly increases grip strength. In contrast, it is insignificant for collectivistic countries. In individualistic societies, retirement often presents an opportunity for older adults to prioritise their own health and well-being, leading to increased engagement in structured physical activities, social participation and leisure pursuits that collectively enhance physical strength, including grip strength. Conversely, retirees in collectivistic countries tend to allocate considerable time and resources to family caregiving, intergenerational support and communal obligations, potentially limiting their participation in structured, health-enhancing activities.

Table 11 reports the impact of retirement duration on grip strength across cultural contexts. In individualistic countries, the relationship is statistically insignificant, indicating no detectable effect of time in retirement on grip strength. In contrast, the association is negative and statistically significant in collectivistic countries, where longer retirement duration is

Table 9. Effect of Retirement duration on grip strength, with Gender Interaction (FE-IV Estimates)

Variable	Coefficient
Log (retirement duration) (men)	−4.880** (2.270)
Female × Retirement duration	2.090*** (0.154)
Implied effect for women	−2.790
First-stage coefficient	
on pension eligibility	0.076*** (0.018)
on Female × pension eligibility	0.051*** (0.010)
First-stage F-stat (retirement effect)	27.860
First-stage F-stat (interaction term)	11,221.560
Cragg-Donald Wald F-statistic	17.550
Observations	56,160
Individuals	19,713

Note(s): Control variables: age, age squared, age cubed, education dummies, marital status dummies, income, body weight dummies, IADL, ADL, cognitive functions, country, and wave dummies. Standard errors clustered at the individual level are reported in parentheses

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

Table 10. The impact of retirement on grip strength by regions

Variable	Individualistic countries Fist stage	 Second stage	Collectivistic countries First stage	 Second stage
Retirement		1.642*** (0.530)		0.303 (0.421)
First stage (State pension age eligibility)	0.153*** (0.005)		0.232** (0.006)	
Observations		82,410		65,080
Individuals		26,786		20,398
F-statistic (IV)		825.45		1628.77

Note(s): Control variables: age, age squared, age cubed, education dummies, marital status dummies, income, weight status dummies, IADL, ADL, cognitive functions, country, and wave dummies. Individualistic countries (Austria, Germany, Sweden, Denmark, Switzerland, Belgium) and collectivistic countries (Spain, Italy, France). Standard errors clustered at the individual level are reported in parentheses
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

Table 11. Impact of retirement duration on grip strength by region (FE-IV Estimates)

Variable	Individualistic countries Fist stage	 Second stage	Collectivistic countries First stage	 Second stage
Log (retirement duration)		0.229 (1.685)		–4.640*** (1.398)
Fist stage (log duration of being age eligible for state pension)	−0.198*** (0.028)		0.213*** (0.021)	
Observations		36,815		27,001
Individuals		13,035		9,225
F-statistic (IV)		47.906		99.315

Note(s): Control variables: age, age squared, age cubed, education dummies, marital status dummies, income, Body weight dummies, IADL, ADL, cognitive functions, country, and wave dummies. Individualistic countries (Austria, Germany, Sweden, Denmark, Switzerland, Belgium) and collectivistic countries (Spain, Italy, France). Standard errors clustered at the individual level are reported in parentheses
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

linked to weaker grip strength. This pattern is consistent with the notion that older adults in collectivistic settings tend to rely more heavily on family members for daily needs, reducing opportunities to maintain physical strength, while prevailing social norms may also discourage self-directed exercise after retirement (Joseph *et al*., 2018).

5.4 Robustness checks

5.4.1 Alternative measures of retirement status. To assess the robustness of our findings to alternative definitions of retirement, we conduct two additional tests. First, we classify homemakers as retired and include them in the estimation sample. Second, we redefine retirement by considering individuals not participating in the labour force, rather than relying solely on self-reported retirement status. The FE-IV estimates from these specifications are presented in Table 12. In both cases, the coefficients remain positive and statistically significant at the 1% level. These results closely mirror the main estimates reported in Table 5, reinforcing the stability of our conclusions with respect to how retirement status is defined.

5.4.2 Narrowing the age range. Our main analysis includes respondents aged 50–100. However, prior research shows that handgrip strength declines accelerate sharply after age 80, by approximately 0.7 kg per year (Hajek and König, 2024). To ensure that our findings are not

Table 12. Alternative definitions of retirement (FE-IV estimates)

Panel A	First stage	Second stage
Retirement		1.106*** (0.387)
State pension age eligibility	0.176*** (0.004)	
F-statistics	1897.109	
Observations	127,980	
Individuals	41,276	

Panel B	First stage	Second stage
Retirement		1.255*** (0.440)
State pension age eligibility	0.155*** (0.004)	
F-statistics	1287.006	
Observations	127,980	
Individuals	41,276	

Note(s): Control variables: age, age squared, age cubed, education dummies, marital status dummies, income, body weight dummies, IADL, ADL, cognitive functions, country, and wave dummies. Standard errors clustered at the individual level are reported in parentheses

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

driven by very old cohorts, we reestimate the model on the subsample of respondents aged 50–80. As shown in Table 13, the results remain consistent with those reported in Table 3, indicating that the main findings are not sensitive to the inclusion of respondents above age 80.

5.4.3 Accounting for post-retirement lifestyle behaviour. In this section, we reassess both specifications, the retirement and the retirement duration, by adding controls for physical activity frequency, doctor visits in the last 12 months, and total hospital nights to the baseline FE-IV models. Across both sets of estimates, the results remain essentially unchanged; the coefficients retain their sign, have very similar magnitudes and remain statistically significant, as shown in Table 14. This indicates that neither post-retirement lifestyle nor healthcare utilisation accounts for the observed associations between retirement and grip strength, supporting the robustness of our main conclusions.

6. Conclusion

This study provides causal evidence on the relationship between retirement and functional health, measured by grip strength, using harmonised cross-national panel data from SHARE.

Table 13. Only individuals aged 55–75

	First stage	Second stage
Retirement		0.965*** (0.563)
State pension age eligibility	0.126*** (0.004)	
F-statistics	849.763	
Observations	115,214	
Individuals	37,866	

Note(s): Control variables: age, age squared, age cubed, education dummies, marital status dummies, income, body weight dummies, IADL, ADL, cognitive functions, country, and wave dummies. Standard errors clustered at the individual level are reported in parentheses

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

Table 14. Accounting for Post-retirement lifestyle behaviour

Panel A	First stage	Second stage
Retirement		0.723*** (0.482)
State pension age eligibility	0.142*** (0.004)	
F-statistics	1112.090	
Panel B	First Stage	Second Stage
Log (retirement duration)		−2.653*** (0.821)
Fist stage (log duration of being age eligible for state pension)	0.216*** (0.014)	
F-statistics	229.097	

Note(s): Control variables: age, age squared, age cubed, education dummies, marital status dummies, income, body weight dummies, IADL, ADL, cognitive functions, country, and wave dummies, Total night stayed in hospital, doctor visits, sport activities. Standard errors clustered at the individual level are reported in parentheses
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

By exploiting institutional variation in state pension eligibility across Europe and employing an FE-IV approach, we show that retirement transitions can enhance grip strength, particularly among older women. However, prolonged time in retirement appears to weaken grip strength, especially for men and in collectivistic cultures.

Robustness checks confirm that these findings are stable across alternative definitions of retirement status, narrower age ranges, and different model specifications. Sensitivity analyses further suggest that the results are not driven by measurement variability in grip strength, which demonstrates high reliability, or by unobserved age effects at the very upper end of the sample. Supplementary models that incorporate lifestyle-related proxies, such as physical activity and healthcare utilisation, also indicate that the estimated effects of retirement duration remain consistent, strengthening confidence in the causal interpretation.

These findings underscore the critical role of retirement policy design in shaping health trajectories in later life. In individualistic welfare regimes, the transition into retirement may offer a strategic window for preventive interventions, such as targeted physical activity programs that sustain or improve functional capacity. Conversely, in collectivistic contexts, longer periods of retirement may increase vulnerability to physical decline, potentially due to lower institutional support for structured health-promoting activities.

From a health governance perspective, our results suggest that integrating strength-maintenance programs into retirement policy, through subsidised community-based interventions, digital exercise platforms or public-private partnerships, can mitigate functional decline among older adults. Policymakers should also consider culturally responsive strategies that acknowledge differing post-retirement norms and caregiving roles across societies.

While our use of longitudinal data and quasi-experimental methods strengthens internal validity, future research should test the generalisability of these findings beyond European welfare states and evaluate the long-term effectiveness of health interventions embedded within retirement frameworks. Ensuring functional independence among older adults will require not only responsive pension systems but also proactive, equity-focused health governance that adapts to the diverse needs of ageing populations.

Our study relies on survey data and an IV method, which helps address reverse causality but can’t rule out all hidden factors or small errors in timing. We also only used data from European welfare systems, so we can’t be sure these results hold in other countries. To confirm our findings and test real-world programmes, future work should use experiments or long-term studies to see if strength training and behavioural support really keep retirees’ muscles strong over time.

Notes

1. Full details of all control variables are provided in Appendix A.1, (Appendix available upon request).
2. For cognitive function, we use measures of fluency and memory. Numeracy was excluded due to substantial missing data in Waves 1 and 2.

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Corresponding author
Mohammad Almomani can be contacted at: almo0143@flinders.edu.au