SHARE
Survey of Health, Ageing and Retirement in Europe

Work, Retirement and Loss of Muscular Strength in Old Age

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Population Ageing and Health

- **The European population is ageing** at an unprecedentedly fast rate
- This poses a challenge to welfare state provisions for the older population and calls for policies to promote **healthy ageing**
- The ageing process is connected with typical **changes in the human body**, including a reduction in physical capacity, in terms of **muscle strength**

Muscle Strength and Health

- **SARCOPENIA** is a geriatric syndrome characterized by

  “Progressive loss of muscle mass and strength, with a risk of adverse outcomes such as disability, poor quality of life and death.”

  (European Working Group on Sarcopenia in Older People, 2010)

- Low muscle strength – measured by the **handgrip strength test** – is a ***strong predictor*** of
  - **<u>mobility</u>** limitations - Laurentani et al., 2003
  - functional **<u>disability</u>** - Syddal et al., 2003
  - cardiovascular diseases and **<u>mortality</u>** - Leong et al., 2015

Muscle Strength and Health

- Identifying factors that help to **preserve muscle strength** is crucial to improve physical functioning, increase longevity *and* save on medical care costs

- Janssen et al., 2004: in the US, **about 2% of total health expenditure** is attributable to the direct consequences of sarcopenia on disability, an estimate that is *bound to increase* due to population ageing

This Paper

- We contribute to this debate by estimating **the causal effects of the timing of retirement on the loss of muscular strength in Europe**
- To cope with the fiscal consequences of population ageing, European governments have **increased the minimum retirement age**
- The consequences on muscle strength loss are ambiguous:
    - ✘ In absence of physical exercise, work keeps the young old active, and early retirement anticipates people's disengagement from work.
    - ☑ Retirement reduces work-related physical strain, and allows to have more time to carry out physical exercise.

This Paper

WHAT WE DO

- We use **objective data on HANDGRIP STRENGTH**, collected in a harmonized way across European countries by SHARE
- We deal with **the endogeneity of the timing of retirement** using **instrumental variables** (changes in minimum retirement ages across countries and over time)
- We estimate heterogeneous effects by gender and occupation

WHAT WE FIND

- The **retirement transition** has a short term **protective causal effect** on muscle strength
- This protective effect is **short-lived**, as **retirement almost doubles the speed of muscle strength loss**
- The negative effects are stronger for men and blue collar workers

Related Literature

- The available empirical evidence about the effects of retirement on health **does not point in a single direction**
- Using European data from SHARE:
  - **Coe and Zamarro**, 2011, find positive short-term effects of retirement on self-reported health and on a health index (see also Eibich, 2015)
  - **Mazzonna and Peracchi**, 2015, consider time spent in retirement as the relevant treatment. They find negative effects on cognition and on indices of overall physical health
- Their focus is on overall health and cognitive abilities, not on specific pathologies, which might be more useful to inform policymakers
- Using self-reported measures can be problematic in cross-country studies because of reporting heterogeneity (Angelini et al., 2011, Peracchi and Rossetti, 2012)

The Data

- We exploit the **longitudinal dimension of SHARE** to build up a **2-wave panel dataset.**
  - We take 10 European countries that took part in all the first four waves
  - We consider a 4-year gap between observations:

    W1→W3 or **W2 refreshment sample→W4**
  - We pool males and females aged 50+, working or retired from work at baseline
  - We drop retirees who don’t receive a job-related pension and those who stopped working 10+ years before receiving the first pension
- **Final sample:** 19,664 baseline respondents, **10,872** of whom are still present at the follow-up

Handgrip Strength

- GS is measured in SHARE using a **harmonized protocol** across all countries and waves
- **Four measures** for each respondent, two for each hand
- We consider the maximum of the four observations as the relevant value for each respondent [Andersen-Ranberg et al., 2009]

- Outcome variable:

Follow-up GS level below the thresholds used for the diagnosis of sarcopenia: 20kg for females and 30kg for males (EWGSOP, 2010)

Empirical strategy

- We estimate the following **linear probability model**:

$$Y_{it} = \alpha + \beta_1 retired_{it-1} + \beta_2 YfromR_{it-1} + \beta_3 fromWtoR_{it} + \gamma lowGS_{it-1} + \delta X_{it-1} + \varepsilon_{it}$$

  - $\mathbf{Y_{it}}$ = low GS at t
  - $\mathbf{retired_{it-1}}$ = Retired at t-1
  - $\mathbf{YfromR_{it-1}}$ = Years from Retirement at t-1
  - $\mathbf{fromWtoR_{it}}$ = from Work to Retirement between t-1 and t
  - $\mathbf{lowGS_{t-1}}$ = low GS at t-1
  - $\mathbf{X_{it-1}}$ = baseline controls, including:
    - Country dummies, gender, education, age trends
    - Chronic conditions, functional limitations, obesity, no physical activity
    - Wealth, income and work history information
    - Contextual factors (somebody present, months between waves)

Empirical strategy

- We deal with the **endogeneity of retirement** using an **instrumental variables strategy**

- Our instruments are based on changes in minimum eligibility age for **early retirement pension (ER)** and **old-age pension (SR)** across European countries and over the years [Angelini et al., 2009].
  - $\mathbf{eligibleER_{it-1}}$ and $\mathbf{eligibleSR_{it-1}}$ indicate eligibility to ER and SR at baseline;
  - $\mathbf{YfromER_{it-1}}$ and $\mathbf{YfromSR_{it-1}}$ measure years since eligibility to ER and SR at baseline;
  - $\mathbf{fromNEtoE\_ER_{it}}$ and $\mathbf{fromNEtoE\_SR_{it}}$, measure whether individuals changed from being non-eligible to being eligible for ER and SR between the baseline and the follow-up.

Results – OLS and IV

Dependent variable: low follow-up GS

	(1) OLS	(2) IV	(3) OLS	(4) IV
Retired $_{it-1}$	-0.059***	-0.125***	-0.070***	-0.147***
	(0.014)	(0.032)	(0.014)	(0.030)
YfromR $_{it-1}$/100	0.435***	0.568**	0.556***	0.652**
	(0.117)	(0.285)	(0.118)	(0.279)
fromWtoR $_{it}$	-0.025**	-0.105***	-0.031***	-0.114***
	(0.010)	(0.039)	(0.010)	(0.037)
Age $_{it-1}$/100	0.843***	1.007***	0.943***	1.169***
	(0.097)	(0.250)	(0.100)	(0.244)
Observations	10,872	10,872	10,872	10,872
R-squared	0.250	0.245	0.234	0.228
Country dummies	Yes	Yes	Yes	Yes
Contextual factors	Yes	Yes	Yes	Yes
Basic covariates set	Yes	Yes	Yes	Yes
Other covariates	Yes	Yes	No	No
retired F-stat		54.89		58.17
YfromR F-stat		71.28		72.04
fromWtoR F-stat		89.59		94.19
Sargan test P-value		.31		.17

Comments – OLS

The **OLS** results suggest that:

- The likelihood of having a low follow-up GS increases with age by about 0.84 percentage points every year.
- Conditional on age, there is a negative association between transiting to retirement and muscle strength loss.
- On the other hand, the likelihood of experiencing a loss in GS increases by 0.43 percentage points for every year spent in retirement, **speeding up the age-related trend by about 50 percent,** a sizeable association.

Comments – OLS and IV

- IV estimates have the same signs as OLS ones, but are larger in magnitude.
- According to these estimates, **retirement speeds up the age-related trend in muscle strength by more than 50%**.
- This second long-run effect is sizeable in magnitude, and suggests that workers who have retired earlier fare worse than late-retirees in terms of muscle strength at late ages.

Heterogeneous effects by occupation

Dependent variable: low follow-up GS

	(1)	(2)
	BLUE AND WHITE COLLAR WORKERS	
	IV B	IV W
Retired $_{it-1}$	-0.104**	-0.156***
	(0.042)	(0.045)
Difference	0.052	
	(0.062)	
YfromR $_{it-1}$/100	0.858**	0.167
	(0.390)	(0.406)
Difference	0.691	
	(0.563)	
fromWtoR $_{it}$	-0.049	-0.181***
	(0.056)	(0.054)
Difference	0.132	
	(0.078)	
Age $_{it-1}$/100	0.751**	1.366***
	(0.348)	(0.341)
Observations	6,253	4,619

Heterogeneous effects by occupation

- The short-run positive effect of retirement on muscle strength is larger for white collars
- **The long-run negative effect of the time spent in retirement is larger and statistically different from zero only for blue collars**.
  - **Celidoni and Rebba, 2015**: only workers not employed in physically demanding jobs increase their level of physical activities after retirement

Heterogeneous effects by gender

Dependent variable: low follow-up GS

	(1)	(2)
	MALES AND FEMALES	
	IV M	IV F
Retired $_{it-1}$	-0.132***	-0.095*
	(0.040)	(0.050)
Difference	-0.037	
	(0.064)	
YfromR $_{it-1}$/100	0.789**	0.417
	(0.396)	(0.425)
Difference	0.372	
	(0.539)	
fromWtoR $_{it}$	-0.0639	-0.149**
	(0.050)	(0.061)
Difference	0.8	
	(0.079)	
Age $_{it-1}$/100	0.875***	1.042***
	(0.331)	(0.392)
Observations	6,253	4,619

Heterogeneous effects by gender

- **Men suffer stronger negative long-run consequences** from early retirement
- Women capitalize larger short-term positive gains from the transition to retirement.
  - **Positive selection** of women in our sample could be a plausible explanation.
  - **Stancanelli and Van Soest, 2012:** in France retirement of the wife significantly reduces the housework done by the man, but not vice versa
  - **Harris et al., 2014:** especially for males, retirement is accompanied by an increase in sedentary time and a decrease in the level of activities

Robustness

- Our results are robust to a battery of tests, including
  - Using a **Heckman sample selection model** to take care of **attrition**.
    - The **average time spent by the baseline interviewer to fill in the IV module** serves as an exclusion restriction for the selection equation
  - Using different specification for the **trends in age and YfromR**
  - Adding **interviewer fixed effects** and clustering by interviewer
  - Using just one instrument set at a time (**ER or SR**)
  - Including or excluding baseline covariates and $lowGS_{it-1}$
  - Dropping those **aged 80+**, for whom selective mortality may be an issue

Conclusions

- Although the transition to retirement has a **short-term positive causal effect** on muscle strength, **early retirement has negative long-run consequences**, contributing to anticipate the onset of sarcopenia.

- In spite of their limited popularity, **policies aimed at keeping the young old active until later ages have beneficial consequences for their muscle strength later in life**, and also help to save on medical care costs

- **Changes in lifestyles** after retirement may partly explain these patterns. However, **only self-reported data on the level of activities are available in SHARE**. A more detailed analysis about the pathways behind our results on muscle strength loss is left for future research (see Harris et al., 2014).

Thank you!


YAWN!
NO MATTER HOW OLD YOU ARE, YOU STILL NEED A REASON TO GET OUT OF BED IN THE MORNING.
MY REASON USED TO BE TO GO TO WORK.
NOW IT'S TO TAKE A NICE NAP.

Results – Covariates

	(1) IV
lowGS$_{it-1}$	0.305***
	(0.018)
Female	0.024***
	(0.008)
Wealth Q2	-0.028***
	(0.009)
Wealth Q3	-0.024**
	(0.010)
Wealth Q4	-0.027***
	(0.010)
Heart attack	0.033***
	(0.012)
Stroke	0.035
	(0.022)
Diabetes	0.043***
	(0.014)
Has ADL limitations	0.046**
	(0.018)
Has IADL limitations	0.074***
	(0.016)
Physical inactivity	0.083***
	(0.019)
Mnemonic ability	-0.007*
	(0.004)

Results – First stages

	(1) Retired $_{it-1}$	(2) YfromR $_{it-1}$/100	(3) fromWtoR $_{it}$
eligibleER $_{it-1}$	0.297***	0.016***	0.082*
	(0.055)	(0.004)	(0.044)
eligibleSR $_{it-1}$	0.391***	-0.013***	-0.185***
	(0.061)	(0.003)	(0.041)
YfromER $_{it-1}$/100	1.416***	0.433***	-1.684***
	(0.343)	(0.043)	(0.274)
YfromSR $_{it-1}$/100	-1.828***	0.502***	-0.188
	(0.406)	(0.048)	(0.328)
fromNEtoE_ER $_{it}$	0.042*	0.008***	0.112***
	(0.024)	(0.002)	(0.027)
fromNEtoE_SR $_{it}$	0.052	-0.005**	0.110***
	(0.050)	(0.002)	(0.041)
Observations	10,872	10,872	10,872
R-squared	0.747	0.828	0.186
Country dummies	Yes	Yes	Yes
Contextual factors	Yes	Yes	Yes
Basic covariates set	Yes	Yes	Yes
lowGS$_{it-1}$	Yes	Yes	Yes
Age$_{it-1}$/100	Yes	Yes	Yes
Other covariates	Yes	Yes	Yes

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Panel Attrition

- Our data suffer from **panel attrition**: we lose around **45 percent** of the baseline sample at the 4-year follow-up.

- **Does attrition affect our estimates?**

  - If those whose health is declining are more likely to dropout, as found by Bristle et al., 2014, our longitudinal sample will be composed of the fitter only
  - Conclusions drawn for the longitudinal subsample do not necessarily generalize to the whole population

Panel Attrition

- Do "stayers" differ in terms of observables?

	(1) Full sample	(2) Stayers - Full sample
Age $_{it-1}$	63.646	-0.768***
		(0.113)
Female	0.424	0.004
		(0.006)
Post-secondary education	0.276	0.025***
		(0.005)
Wealth Q4	0.254	0.009*
		(0.005)
Has ADL limitations	0.065	-0.013***
		(0.003)
lowGS $_{it-1}$	0.129	-0.03***
		(0.004)
Retired $_{it-1}$	0.534	-0.02***
		(0.006)
YfromR $_{it-1}$	5.302	-0.796***
		(0.082)

Panel Attrition

- Sample selection correction for the IV estimates – **"IV Heckit" model.**

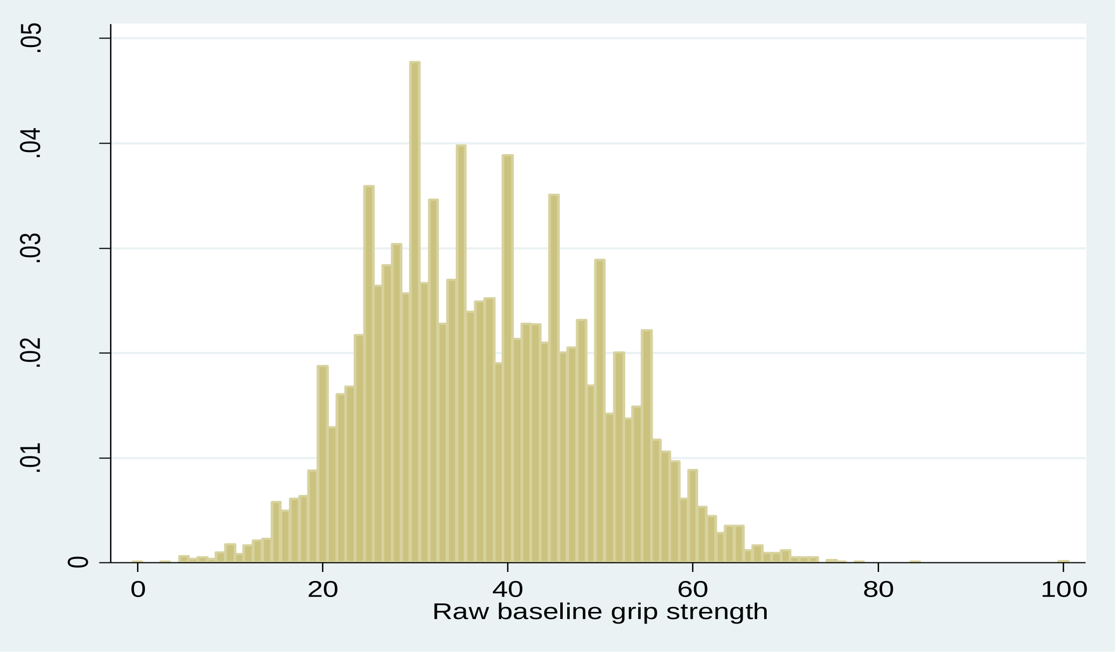
- We use the average **time used by interviewers to fill in a questionnaire** where they provide self-reported information about the respondent, the house where the family lived and about interview quality **as an exclusion restriction to identify the selection process**
- **Slower interviewers could upset respondents** and decrease their willingness to cooperate

Panel Attrition

Dependent variable: low follow-up GS

	(1) Standard IV	(2) First Stage Probit	(3) IV with sample selection correction
retired	-0.089***		-0.098***
	(0.031)		(0.031)
YfromR	1.097***		0.843***
	(0.193)		(0.246)
Age_{it-1}/100	0.600***		0.762***
	(0.207)		(0.225)
Time to fill in the IV questionnaire		-0.020**	
		(0.009)	
Time to fill in the IV questionnaire - mis		-0.199***	
		(0.052)	
Inverse Mills ratio			0.122
			(0.077)
Observations	10,872	19,664	10,872
R-squared	0.244		0.246
Covariates	Yes	Yes	Yes
retired F-stat	277.6		151.7
YfromR F-stat	340.3		182.2
Sargan test P-value	.14		.27

Rounding of grip strength



- Grip strength is affected by **rounding by interviewers** to multiples of 5 or 10
- In the paper we have estimated a **statistical model for rounding** as in Hejtian and Rubin, 1990, and Battistin, Miniaci and Weber, 2003, and we find that **the true GS value is ignorable in the coarsening process**.

A Statistical Model for Rounding

- GS rounding can be treated as a **coarsened data problem** (Hejtian and Rubin, 1990, 1991; Battistin, Miniaci and Weber, 2003).

- Rounded data are **coarsened at random (CAR)** if the true GS value is ignorable for the coarsening mechanism.

- In that case, the rounded nature of the data can be ignored as far as correct inference on the parameters of interest is concerned.

- We develop **a statistical model for rounding** to test for CAR.

A Statistical Model for Rounding

- Let $\boldsymbol{s_i}$ **be the true grip strength value** for individual *i*, $f \sim f(s, \theta)$.
- In presence of rounding **only a coarsened version of** $\boldsymbol{s_i}$**,** $\boldsymbol{s_i^*}$**, is observed.**
- Let $\boldsymbol{g_i}$ **be the heaping propensity** for observation *i*.
- We posit an **ordered probit model for** $\boldsymbol{g_i}$, with three categories
  - **G1**: Rounding to the nearest integer
  - **G2**: Rounding to the nearest multiple of 5
  - **G3**: Rounding to the nearest multiple of 10

A Statistical Model for Rounding

- We assume **that $\boldsymbol{g_i}$ and $\boldsymbol{s_i}$ univocally determine the observed value $\boldsymbol{s_i^*}$**: any s_i^* implies a region H(s_i^*) of $(g_{i,}\ s_i)$ that map to s_i^*.

- We define the regions of (g_i, s_i) that correspond to rounded measurements, 5-year multiples, and 10-year multiples as

$$
\begin{gathered}
H_1 = (-\infty, \xi_1) \times [s_i^* - 0.5, s_i^* + 0.5) \\
H_2 = [\xi_1, \xi_2) \times [s_i^* - 2.5, s_i^* + 2.5) \\
H_3 = [\xi_2, +\infty) \times [s_i^* - 5, s_i^* + 5)
\end{gathered}
$$

- Hence, **H($\boldsymbol{s_i^*}$)** is defined as follows:

$$
H(s_i^*) = \begin{cases} H_1 & & s_i^* \neq 0\ mod\ 5 \\ H_1 \cup H_2 & if & s_i^* = 0\ mod\ 5 \\ H_1 \cup H_2 \cup H_3 & & s_i^* = 0\ mod\ 10 \end{cases}
$$

A Statistical Model for Rounding

- We specify a normal linear regression model for $s_i \mid X_i$, and an Ordered Probit model for $g_i \mid s_i, Z_i$

$$f(s_i|X_i;\beta,\log(\sigma)) \sim N(X_i\beta,\sigma^2)$$

$$f(g_i|s_i,Z_i;\gamma) \sim N(\gamma_1 s_i + Z_i\gamma_2, 1)$$

- $\boldsymbol{X_i}$: wide set of **correlates** of grip strength, purely predictive function,very flexible specification; $\boldsymbol{Z_i}$: **instruments** for rounding
  - We use **paradata** about **interviewers' average time to complete the GS module:** interviewers who were slower at carrying out the test could have been more prone to commit errors reporting the data to make up for the longer time spent doing the test.

- Estimation is via ML and s.e. are clustered by interviewer.

- **If $\boldsymbol{\gamma_1 = 0}$ the coarsening mechanism is CAR**, and the true grip strength is ignorable for the rounding process

A Statistical Model for Rounding

γ_1	-0.001 (0.0013)
IW Time to complete the GS module	-.0008 *** (0.0003)
IW Time to complete the GS module – mis	-.0047 (0.067)
χ^2 test of joint significance of the instruments (p-value)	0.028