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ORIGINAL PAPER

Healthier lifestyles after retirement in Europe? Evidence from SHARE

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Abstract This paper investigates changes in health behaviours upon retirement, using data drawn from the Survey of Health Ageing and Retirement in Europe. By exploiting changes in eligibility rules for early and statutory retirement, we identify the causal effect of retiring from work on smoking, alcohol drinking, engagement in physical activity and visits to the general practitioner or specialist. We provide evidence about individual heterogeneous effects related to gender, education, net wealth, early-life conditions and job characteristics. Our main results—obtained using fixed-effect two-stage least squares—show that changes in health behaviours occur upon retirement and may be a key mechanism through which the latter affects health. In particular, the probability of not practicing any physical activity decreases significantly after retirement, and this effect is stronger for individuals with higher education. We also find that different frameworks of European health care systems (i.e. countries with or without a gate-keeping system to regulate the access to specialist services) matter in shaping individuals' health behaviours after retirement. Our findings provide important information for the design of policies aiming to promote healthy lifestyles in later life, by identifying those who are potential target individuals and which factors may affect their behaviour. Our results also suggest the importance of policies promoting healthy lifestyles well before the end of the working life in order to anticipate the benefits deriving from individuals' health investments.

Keywords Retirement · Health behaviour · Fixed effects · Instrumental variables · SHARE

JEL classification I12 · I18 · J14 · J26

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Introduction

Most developed countries have recently passed legislation to increase retirement ages, in order to ensure the financial sustainability of social security systems. However, whether delaying retirement would improve the sustainability of health and social security programmes is still a matter of debate, given the potentially negative impact of such a policy on the health of the population. It may be that workers' health, especially for those who have been in strenuous occupations, deteriorates both physically and mentally, generating increases in health care expenditure; in this case, retirement may reduce the amount of work-related stress and strain and provides individuals with more leisure time that can be used to invest in their health (e.g., physical activity). For example, Gorry et al. [1] claim that policies increasing eligibility ages may have hidden costs due to a negative impact on individuals' health whose costs already represent a financial burden for public health care programs. If instead people are engaged in fulfilling jobs, within a smart and health promoting workplace, work may be a better guarantee of preserving individuals' health than retirement: in fact, workers have incentives to invest in their health in order to maintain their income. Likewise, retirement might negatively affect health when it leads to social isolation and a diminished sense of purpose [2].

Therefore, under these different perspectives, increasing retirement ages may have additional benefits besides reducing the cost of pensions. As we will show in next section, the literature has tried to distinguish empirically between the two scenarios but findings vary widely depending on different methodological choices.

There is evidence about the importance of health behaviours such as not smoking, moderate alcohol consumption and physical activity, as well as weight control, to reduce mortality and improve functional capacity, among middle-aged and elderly adults [3–5]. Promoting healthy lifestyles has therefore been one of the policy strategies that international organisations and national governments have pursued to influence individual behaviours. Examples of such policies are information campaigns about risk factors, health education and ad hoc incentives through taxation, regulations (e.g., labelling rules or smoking bans) or nudging [6, 7]. These interventions are targeted mainly at younger generations, who are considered to be less aware of health risks [8]. However, although elderly people may be better informed, they are less prone to change their lifestyle; they have had more time to develop habits and may be particularly set in their ways (see [9], with regard to food expenditure, for instance), suggesting that such policies will have less effect on them than on younger individuals.

According to [10], nevertheless, large behavioural changes may occur after retirement, which is almost always a remarkable life event, as a consequence of changes in terms of time discounting, incomes or beliefs about the future. For this reason, we focus on the role of retirement in shaping lifestyles in later life. By examining behavioural adjustments upon retirement, rather than health outcomes, we can shed more light on the mechanisms that could explain previous mixed findings on the impact of retirement on health. We will analyse smoking, alcohol consumption and low engagement in physical activity, which are three modifiable risk factors contributing to more than a quarter of the disease burden in developed countries, according to the World Health Organization [11].[1] We will also estimate the causal effect of retirement on health care utilization as measured by visits to a general practitioner and consultations with a specialist during the last 12 months.[2]

Given this background, we attempt to answer the following questions. Do individuals change their lifestyle upon retirement? Who are those more likely to invest in their health by pursuing healthy behaviours after retirement? The latter information can be useful for targeting purposes when designing policies relating to people in later life.

Our paper makes two new contributions to the empirical literature on the effects of retirement on individuals' health behaviour.

First, we analyse retirement and health behaviours in Europe within a multi-country framework. We therefore do not focus on one specific country as other studies have done, but we analyse changes in health behaviours using harmonised individual panel data drawn from the Survey of Health Ageing and Retirement in Europe (SHARE), a survey that offers the possibility of comparing several European countries using nationally representative samples of the population aged 50+. Our identification strategy therefore relies not only on gender and year of retirement differences in eligibility criteria but also exploits the heterogeneity among countries. Furthermore, this multi-country framework allows us to investigate the role of different institutional settings (i.e. different types of health care system) on post-retirement health behaviours.

Second, we investigate heterogeneity in retirement effects, exploiting very detailed objective and subjective individual information, especially about job characteristics and early-life conditions, never considered before in the literature. In this way, we are able to highlight some underlying mechanisms that may explain individuals' health investments upon retirement.

Our baseline estimates show that the probability of being inactive or not doing any vigorous physical activity decreases after retirement. We then provide evidence about individual heterogeneous effects on health behaviours upon retirement related especially to early-life conditions, education (we find stronger effects for individuals with higher education) and job characteristics, underlining the importance of the relief from work-related strain and time constraints as a barrier to engaging in regular physical activity.

These findings provide important information for the design of policies aiming to promote healthy lifestyles in later life, by identifying those who are potential target individuals, and which factors may affect their behaviour. Our results also suggest that the retirement and pre-retirement period may well offer a suitable opportunity to provide support for adopting a healthy lifestyle later in life. However, current policies, concerned mainly with the sustainability of social security systems, are progressively increasing retirement eligibility ages. This stresses the importance of policies promoting healthy lifestyles well before the end of the working life in order to anticipate the benefits deriving from individuals' health investments.

[1] These risk factors, together with unhealthy diet, have a strong impact on the onset of cardiovascular and respiratory diseases, cancers and diabetes, which account for 82 % of chronic diseases [12].

[2] Higher utilization of medical care after retirement can be the result of more treatment driven by health problems and/or an increased attitude for (or more time devoted to) prevention.

The paper is organised as follows. The next section presents a Literature review, followed by a section on Data and some descriptive statistics. The Empirical strategy is then described, followed by Results and Conclusions.

Literature review

In recent decades, the economic literature has investigated the relationship between health and retirement, but findings have been ambiguous, for various reasons. Some authors found, on the basis of physical or mental health indicators, that retirement helps to preserve good health (e.g., [13–19], while others estimated a negative or nil effect of retirement on health (e.g., [20–23]).[3] Mixed findings can be explained by different outcomes or empirical strategies used, as well as by the existence of several competing channels, such as lifestyles and access to health care, through which retirement affects health.[4]

In particular, according to Dave et al. [20] and Behncke [22], on the one hand, retirement could have a negative impact on health because of a decrease in work-related physical exercise, loss of ambition, or lower engagement in social or intellectual activities, accelerating the decline in health due to ageing. On the other hand, retirement provides individuals with less job-related stress and more leisure time; in addition, retirement may even increase investment in health since the retired have a lower marginal value of time, reducing the cost of health investment. For example, Bound and Waidmann [14], drawing on the standard Grossman's model of demand for health [25], highlight that, since non-work time increases after retirement, we would expect that individuals spend more time investing in their health, especially in activities that are time-intensive (e.g., time spent in health-promoting behaviours). As the authors point out, because of different job characteristics, these effects vary from one individual to another: some may experience positive effects, others negative or no effects of retirement on health.

Understanding the effect of retirement on individuals' health is quite important in order to fully assess the welfare and budgetary consequences of policies that increase retirement ages. Such policies might reduce retirement benefits and increase tax revenue through longer working lives, enhancing the financial sustainability of social security systems (as shown by [20]). Conversely, according to other studies, the same policies can produce indirect second-order effects in terms of health care utilization and related costs depending on their impact on individuals' health [1 and 17]. However, analysing the health consequences of retirement is not an easy task because the retirement decision is endogenous. For example, several studies have shown that people who experience negative shocks to health disproportionately select into retirement (e.g. [26]).

In this paper, we focus on health behaviours rather than health since lifestyles may play a key role in explaining health upon retirement. Some studies [27–29] have investigated behavioural changes in later life but consider retirement as exogenous. However, endogeneity issues have to be considered also when analysing the relationship between retirement and health behaviour.

To our knowledge, there are four studies that have specifically considered retirement and health behaviours accounting for an endogeneity bias. Looking at US data, drawn from the Health and Retirement Study (HRS), Insler [17] used an instrumental variables strategy based on individuals' predicted probability of working past ages 62 years and 65 years reported in the period in which they entered the sample, and found that retirement positively affects health through a reduction in smoking and an increase in exercise. Using the same dataset, Kämpfen and Maurer [30] provide instrumental variables estimates based on early and statutory retirement ages, showing that, when individuals retire, they increase physical exercise, meeting the federal government's 2008 Physical Activity Guidelines. Within a regression discontinuity framework, Eibich [31] found that, in Germany, retirement affects negatively smoking and outpatient care utilization, positively sleep duration, engagement in activities and alcohol consumption. Zhao et al. [32] used data from the Health and Retirement Survey, a longitudinal study conducted by the National Institute of Population and Social Security (IPSS) in Japan to show that, on retirement, individuals

[3] Although a complete literature review of the effect of retirement on health is beyond the scope of this paper, we provide here a brief description of the cited papers. Charles [13], Neuman [15] and Insler [17], looking at US data and accounting for endogeneity, find that retirement is beneficial for health when using subjective indicators. Focussing on the UK, Bound and Waidmann [14] highlight positive effects of retirement on health only for men, Johnston and Lee's [18] estimates point to similar conclusions only for subjective indicators. Coe and Zamarro [16] analyse European data—the first two waves of SHARE—finding positive effects of retirement on both a self-reported health indicator and a combination of subjective and objective measures of health. Kerkhofs and Lindeboom [19], using a fixed effect panel data model with Dutch data, find that health deteriorates with employment and labour market history. Dave et al. [20] estimate a negative effect of retirement on health (mental and physical) in the US using a fixed effect panel data model, whereas Lindeboom et al. [21] find no effects on mental health for the Netherlands. Behncke [22] estimates a negative effect of retirement on objective health indicators for the UK based on non-parametric matching and instrumental variable (IV) methods. Celidoni et al. [23], looking at cognitive decline as outcome, find a negative causal effect of retirement using the first, second and fourth wave of SHARE.

[4] See [24] for a more detailed theoretical discussion of the interactions between health and retirement.

significantly reduce their level of smoking and are more likely to exercise.[5]

We contribute to this literature in two ways. First, we analyse retirement and health behaviours in Europe within a multi-country framework. Second, we investigate in greater detail the heterogeneous effects of retirement on health behaviours linked to individuals' characteristics, considering also objective and subjective information about job characteristics and early-life conditions.[6]

Data

We use data drawn from SHARE, a multi-disciplinary survey that collects information on individuals aged 50 or over, plus their partner, regardless of age. The first wave of SHARE took place in 2004/2005 and involved eleven European countries. Other countries have been added in the following waves but in this paper we select only those that participated in all SHARE regular waves from 2004 to 2012—the first (2004/2005), second (2006/2007) and fourth (2011/2012) wave—to exploit the longitudinal dimension of the survey: Austria, Belgium, Denmark, France, Germany, Italy, the Netherlands, Spain, Sweden and Switzerland.[7] The third wave, called SHARELIFE, collects retrospective information, e.g. early-life conditions, that we will use to investigate heterogeneous effects related to retirement. We select individuals who self-report being retired from work or employed/self-employed and whose age is between 45 years and 85 years,[8] with no missing information about employment status, gender, education, age, marital status, number of grandchildren and health behaviours defined according to three dimensions: smoking, physical inactivity and alcohol consumption.

Smoking is a dummy variable that acquires value 1 if the individual currently smokes, and 0 otherwise. Engagement in activities is captured by two dummies: No activities, which takes value 1 if the person reports never or almost never practising any activity requiring either a moderate or substantial level of energy; No vigorous activities, which equals 1 if the respondent reports never or almost never taking part in sports or vigorous activities; this distinction can be suggestive of physical exercise intensity. Regarding alcohol consumption, since the questions have been changed over time, we are able to exploit only information about drinking frequency for all waves; we therefore define a variable Drink every day, which takes value 1 if the person reports drinking alcohol almost every day.[9]

We also consider two measures of health care use: the Number of visits to the general practitioner and a 0–1 dummy for having consulted a specialist in the last 12 months (Visits to the specialist).

A key variable in our analysis is retirement. We define as retired those individuals who self-declare to be retired from work. Retirement is considered an absorbing state: no transitions from retirement back to work are therefore observed. Since some respondents may report being retired simply because they left their main job, even though they are still working, we also use a narrower definition of retirement which combines self-reported employment status and information about paid work during the last four weeks before the interview (see Appendix 3, Table 6).[10]

Table 1 presents the summary statistics of health behaviour variables, socio-economic and demographic covariates.

In Figs. 1, 2, 3, 4, 5 and 6, we illustrate the relationship between health behaviours and age, distinguishing between higher (tertiary) and lower (secondary or primary) education levels,[11] pooling data from wave 1 to wave 4.

5 Another paper [33] reports an investigation into the effect of retirement on the number of days of inpatient care and mortality but is very specific, since it exploits an early retirement offer to military officers in Sweden.

6 It must also be observed that the relation between individual behaviour and health is of a simultaneous nature [34]: not only health behaviours can be treated as investments in health, according to the Grossman's theoretical perspective, but health status itself might constrain health investment options (e.g. disability might prevent physical exercise). We take into account the role of health as a determinant of health behaviour in the robustness analysis by including among the controls several health indicators (limitations in daily activities and chronic diseases) and show that our baseline results do not change.The robustness analysis is reported in Table 6.

7 Among the eleven countries in the first wave of SHARE, Greece is the only country that has not participated continuously.

8 Individuals whose age is lower than 50 years are typically spouses of the sampled person, who, according to the survey eligibility rules, is 50 years of age or older. By focusing on individuals whose age is between 45 year and 85 year, we do not include very young spouses and older people, who are typically very selected (this selection drops about the 5 % of observations in the initial sample). Individuals aged 45–49 year considered in the analysis represent the 0.06 % of the whole sample.

9 The possible responses to this question are: 'Almost every day', 'Five or six days a week', 'Three or four days a week', 'Once or twice a week', 'Once or twice a month', 'Less than once a month', 'Not at all in the last three months'. Only in waves 2 and 4 were respondents asked how many drinks they consume in a day. This information however does not distinguish precisely the type of drink (the percentage of alcohol by volume varies substantially depending on the type of drinks) and involves a larger measurement error. Even if the indicator we use does not properly capture drinking intensity, nevertheless it could be informative about changes in drinking behaviour. We will discuss this point more extensively in the "Results" section.

10 We also combined current self-reported retirement status with earnings/self-employment income of the previous year, obtaining summary statistics similar to those reported in Table 1.

11 ISCED 5–6 (International Standard Classification of Education) identifies individuals with tertiary education.

Table 1 Summary statistics

Variable	*N*	Mean	SD	Minimum	Maximum	Mean non-retirees	Mean retirees	*t*-Statistic
Health behaviours								
Smoking	32,420	0.172	0.377	0	1	0.225	0.138	20.558
No activities	32,413	0.063	0.243	0	1	0.025	0.087	−22.795
No vigorous activities	32,416	0.373	0.484	0	1	0.250	0.453	−37.641
Drink every day	32,424	0.271	0.445	0	1	0.224	0.302	−15.395
Number of visits to the general practitioner	32,172	3.607	4.226	0	30	2.455	4.352	−40.311
Visits to the specialist (yes/no)	32,409	0.441	0.496	0	1	0.383	0.478	−16.828
Retirement								
Retired	32,424	0.609	0.488	0	1			
Retired wave 1		0.527	0.499					
Retired wave 2		0.588	0.492					
Retired wave 4		0.707	0.455					
Retired—alternative definition[a]	32,424	0.548	0.498	0	1			
Retired—alternative definition wave 1		0.503	0.500					
Retired—alternative definition wave 2		0.523	0.499					
Retired—alternative definition wave 4		0.614	0.487					
Early retirement age (among males)	17,429	59.15	3.70					
Early retirement age (among females)	14,995	58.72	3.30					
Statutory retirement (among males)	17,429	64.31	1.86					
Statutory retirement (among females)	14,995	63.04	2.78					
Covariates								
# grandchildren	32,424	2.411	2.909	0	20	1.193	3.191	−64.056
Partner	32,424	0.772	0.420	0	1	0.826	0.736	18.937
Age	32,424	65.048	9.051	45	85	56.557	70.492	−204.911
# chronic diseases	32,424	1.422	1.366	0	10	0.913	1.749	−56.320
# adl	32,424	0.113	0.530	0	6	0.031	0.166	−22.671
# iadl	32,424	0.167	0.661	0	7	0.040	0.249	−28.162
Wave 1	32,424	0.297	0.457	0	1	0.359	0.257	19.914
Wave 2	32,424	0.370	0.483	0	1	0.391	0.357	6.081
Wave 4	32,424	0.333	0.471	0	1	0.250	0.386	−25.671
Female	32,424	0.462	0.499	0	1	0.501	0.437	11.298
ISCED 3_4	32,382	0.342	0.475	0	1	0.381	0.318	11.591
ISCED 5_6	32,382	0.263	0.440	0	1	0.352	0.206	29.428
First net wealth quartile (bottom)—*Qrtnetwealth_1*	32,424	0.202	0.402	0	1	0.168	0.224	−12.153
Second net wealth quartile—*Qrtnetwealth_2*	32,424	0.248	0.432	0	1	0.227	0.262	−7.201
Third net wealth quartile —*Qrtnetwealth_3*	32,424	0.270	0.444	0	1	0.278	0.266	2.414
Fourth net wealth quartile (top)—*Qrtnetwealth_4*	32,424	0.279	0.449	0	1	0.327	0.249	15.448
Few books when aged 10	28,034	0.386	0.487	0	1	0.244	0.468	−38.103
Above median (household net wealth)	32,424	0.550	0.498	0	1	0.605	0.514	16.099
Physically demanding job	26,495	0.492	0.500	0	1	0.471	0.505	−5.391
Time pressure due to heavy workload	26,508	0.475	0.499	0	1	0.422	0.510	−13.927
Blue collar	27,740	0.340	0.474	0	1	0.251	0.393	−24.317
Low skilled	27,740	0.495	0.500	0	1	0.473	0.508	−5.663
Always full time	27,602	0.840	0.367	0	1	0.772	0.879	−23.535
Country dummies								
AT	32,424	0.050	0.218	0	1	0.031	0.062	−12.735
DE	32,424	0.107	0.309	0	1	0.092	0.117	−6.903
SE	32,424	0.140	0.347	0	1	0.164	0.124	10.153

Table 1 continued

Variable	*N*	Mean	SD	Minimum	Maximum	Mean non-retirees	Mean retirees	*t*-Statistic
NL	32,424	0.089	0.284	0	1	0.116	0.071	13.727
ES	32,424	0.058	0.233	0	1	0.055	0.059	−1.596
IT	32,424	0.112	0.315	0	1	0.070	0.139	−19.344
FR	32,424	0.131	0.338	0	1	0.124	0.136	−3.057
DK	32,424	0.112	0.316	0	1	0.140	0.095	12.586
CH	32,424	0.064	0.244	0	1	0.084	0.051	11.955
BE	32,424	0.137	0.344	0	1	0.124	0.146	−5.575

[a] The alternative definition of retirement combines self-reported employment status and information about paid work during the last four weeks before the interview

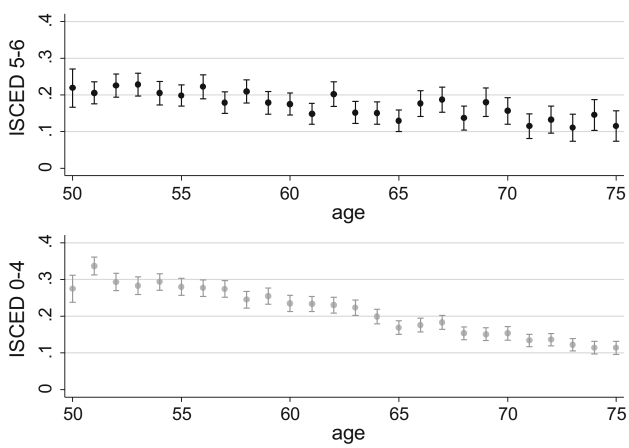

Fig. 1 Proportion of smokers, by age and education level

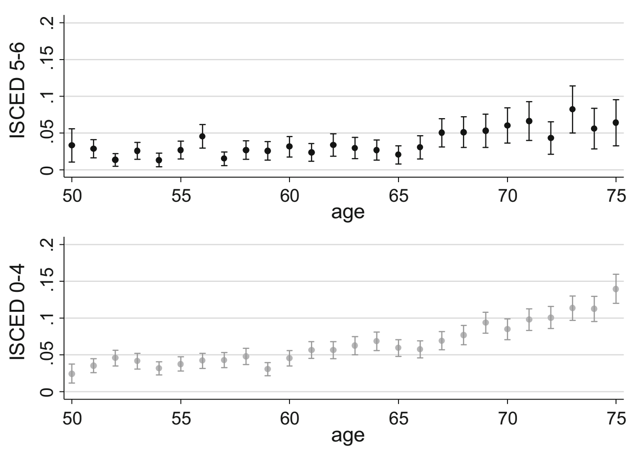

Fig. 2 Proportion of individuals not practising any activity, by age and education level

Figure 1 shows the (unweighted sample) proportion of smokers by age for individuals with higher and lower education respectively: among the latter, we can see a general negative association between smoking and age

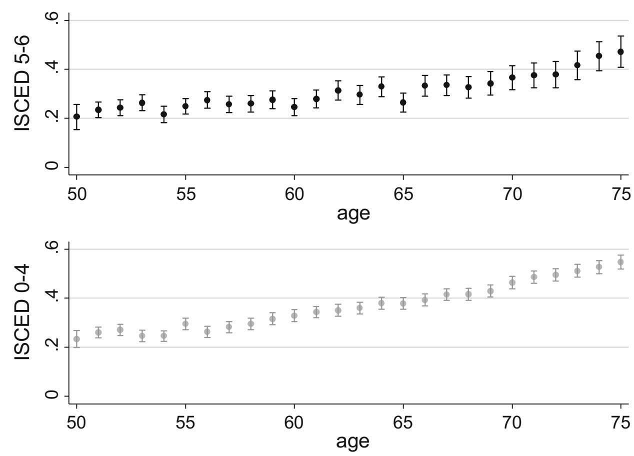

Fig. 3 Proportion of individuals not practising any vigorous activity, by age and education level

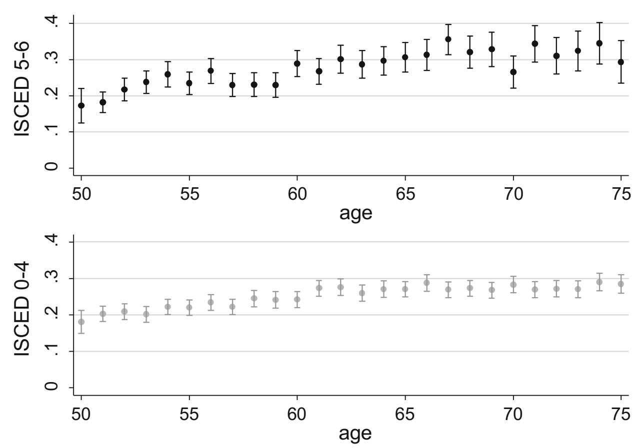

Fig. 4 Proportion of individuals drinking every day, by age and education level

(possibly due to selective mortality, as argued in [35], but no marked changes can be noticed around typical retirement ages (e.g., 65 years).

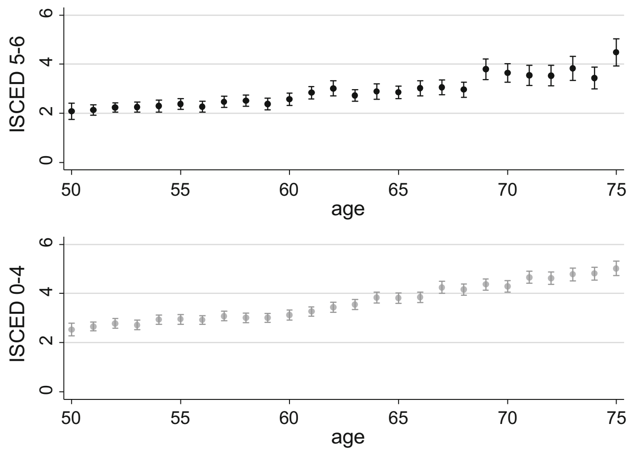

Fig. 5 Number of visits to the general practitioner, by age and education level

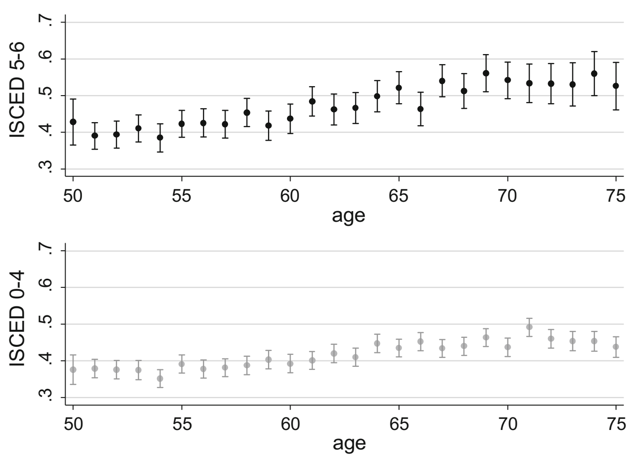

Fig. 6 Proportion of individuals having had consultations with specialists, by age and education level

Figures 2 and 3 show the proportion of inactive individuals, i.e. those who do not practise any activity (Fig. 2) or any vigorous activity (Fig. 3), by age. The two graphs highlight a positive association with age, but it is notable that, among highly educated individuals, there is a spike in the proportion of inactive people at age 56 years when looking at activities requiring a moderate level of energy, and a decrease at age 65 in terms of vigorous activities. Among lower educated individuals, the proportion of inactive people increases at 55 years when considering vigorous activities. Figure 4 shows the proportion of individuals, by age, who drink alcohol almost every day, revealing a slight increase after age 60 years for both highly educated and less well educated people. Figures 5 and 6 show the average number of visits to the general practitioner, and the proportion of individuals who have had at least one consultation with specialists in the last year, by age and education level: significant increases in the average number of visits to the general practitioner are seen after age 68 years, for both highly educated and less well educated individuals, and the figure for those who have had consultations with a specialist increases significantly after the age of 70 years for less well educated individuals.[12]

The figures provide a first descriptive evidence of possible changes in health behaviours around retirement age. In the next section, we will explain the empirical strategy used to identify the causal effect of retirement on health behaviours.

Empirical strategy

The effect of retirement on health behaviours

This study aims to discover whether individuals change their health behaviours upon retirement. To this end, we propose the following specification:

$$y_{it} = \alpha_1 \text{retired}_{it} + X_{it}\beta + u_{it} \quad (1)$$

$$u_{it} = \mu_i + \varepsilon_{it}, \quad (2)$$

where y_{it} is the outcome of interest (i.e., the health behaviour variable), X_{it} is a vector of individual characteristics (e.g., age, gender, marital status, educational level, etc.); the error term u_{it} can be decomposed into unobserved time-invariant heterogeneity (μ_i) and an idiosyncratic error term (ε_{it}). We are interested in α_1, the coefficient associated with retired. Standard ordinary least squares (OLS) estimates of α_1 yield unbiased results if the orthogonality condition is satisfied (i.e. retirement should not be correlated with the error term); however, this is unlikely to hold. As pointed out in the literature (e.g., [13–16]), when assessing the role of retirement on health, endogeneity issues have to be taken into account. The same applies to health behaviours, since retirement is a choice that individuals make for several unobservable reasons that could also affect lifestyles. To control for observed and unobserved time-invariant individual heterogeneity, we estimate individual fixed-effects (FE) panel data models.[13]

Using FE models allows us to account for observable characteristics (such as gender, country, birth cohort and educational attainment) that do not vary over time and may

[12] Less well educated people generally show a lower probability of contacting a specialist at all ages; this is probably due to their reduced access to this type of health care, owing to a lack of information or economic resources.

[13] We also performed a Hausman test in order to ascertain the inconsistency of random effects (RE) estimates. The results obtained, not shown here but available on request, support the inconsistency of RE.

be important sources of bias,[14] as well as for unobserved time-invariant factors that could confound our estimates. However, controlling for time-invariant characteristics is not enough to permit causal interpretations, since we need to account also for time-varying individual unobserved factors and reverse causality: health behaviours, also through their interaction with health conditions, may induce retirement. We overcome this problem by adopting an instrumental variable (IV) approach. We exploit the information about changes in eligibility rules for early retirement and old-age pension across several European countries and over time as instruments for retirement (see Appendix 1 for a detailed description).[15] Using changes in pension eligibility rules as instruments for retirement is a widespread methodological choice in the literature (see, for instance, [37, 38] and [16]).[16]

We run FE two-stage least squares (FE-2SLS), our preferred specification, to estimate the effect of retirement on health behaviours; however, for completeness we report also OLS, FE and pooled two-stage least squares (2SLS) estimates. In the FE-2SLS specification, since we exploit the within-individual variability, to be able to identify the effect of retirement, we need a sufficient number of respondents who switch from employment to retirement. In our sample, we have 1999 transitions into retirement.[17]

The relevance of our instruments can be tested directly by looking at F-statistics for the excluded instruments ([39] and critical values for weak identification [40]; see the section Results).[18] The validity assumption, which requires that the instruments affect health behaviours only through retirement (and can be therefore excluded from the structural equation) is supported by the fact that changes in eligibility rules arguably represent a source of exogenous variability in social security regulations that are unlikely to have a direct effect on our outcomes.

Thus, based on retirement eligibility criteria among countries, over time and between genders, we define as instruments two zero–one dummies indicating whether the individual is eligible or not either for early (EligibleER) or statutory (normal) retirement (EligibleSR), respectively.

For binary outcomes, we specify a linear probability model[19] where we control for marital status (having a partner), education, age, age squared, household net wealth quartile dummies[20] and the number of grandchildren (to account for grandparenting effects). The same set of covariates is used when looking at the continuous variable Number of visits to the general practitioner.

Coe and Zamarro [16] and Zamarro et al. [43], looking at the effect of retirement on health using SHARE data, noticed that panel attrition may be a problem, because people in poor health due to unhealthy behaviours are more likely to exit the panel, and this may lead to invalid inference. We have performed a robustness analysis (see Appendix 4) following [44], showing that attrition is not an issue in our case.

Heterogeneous effects

We investigated in greater detail heterogeneity in retirement effects related to gender, education, early-life conditions, household net wealth and job features. To this end, we estimated our models separately for males and females, highly (Isced5_6) and less well (Isced0_4) educated individuals. The sample was also split according to an indicator of early-life conditions, Few books, representing the presence of fewer than 25 books at the parental home at age ten; this information, collected in SHARELIFE, can be considered a proxy for parental education and economic status during childhood.[21] We consider heterogeneity

[14] See, for instance, Bingley and Martinello [36], who argue the relevance of education not only as a determinant of health in later life but also as an appropriate control when using retirement ages as an instrument for the retirement decision: differences in retirement ages across countries are associated positively with multi-country differences in average educational levels.

[15] For pensioners eligibility rules refer to the reported retirement year, for employed individuals eligibility is defined according to the interview year.

[16] Similarly to [38], in Appendix 2, we show in Figs. 7 and 8 the histograms of retirement age by country for males and females, highlighting in dark gray/black the range of early/statutory retirement eligibility ages. Figures 7 and 8 show that there is significant variability across countries and gender in eligibility criteria, and that we are able to predict important peaks in the retirement age. This evidence supports our identification strategy.

[17] Of these, 5.10 % of transitions occurred in Austria, 9.20 % in Germany, 17.36 % in Sweden, 10.66 % in the Netherlands, 4.85 % in Spain, 8.75 % in Italy, 13.76 % in France, 11.71 % in Denmark, 6.15 % in Switzerland and 12.46 % in Belgium. The heterogeneity in the number of transitions observed across countries can be the result of several factors—institutional factors related to eligibility criteria, gender specific labour market participation, sampling or response behaviour.

[18] Even if critical values do not refer to cases when standard errors are clustered, according to Baum et al. [41], they can nevertheless be used to reveal weak identification issues.

[19] According to Angrist and Pischke [42, p. 198], regardless of whether the outcome variable is binary, non-negative or continuously distributed, IV-2SLS captures the local average treatment effects we are interested in.

[20] Net wealth quartiles are based on imputed data. See http://www.share-project.org for detailed documentation about the imputation procedure. Results do not change whether we use equivalent household net wealth quartiles, or equivalent household net income quartiles with the square root of the household size as equivalence scale (results are available upon request).

[21] This indicator has been used also by Brunello et al. [45], who highlight the importance of early-life interventions to capture lower returns to college for individuals who grew up in disadvantaged households.

related to wealth by providing estimates for individuals having household net wealth below or above a country-specific yearly median value. Finally, to understand whether job characteristics play a crucial role in explaining how individuals change their behaviours upon retirement, we exploit work quality and job information collected in SHARELIFE and regular waves (first, second and fourth).

Retirement may indeed be beneficial for those working in physically demanding and stressful occupations, based on the evidence that working in manual jobs negatively affects health (see for instance [46]) and may induce people to adopt unhealthy behaviours such as smoking. In SHARE, a battery of work quality questions is asked, differing between SHARELIFE and regular waves. In order to make use of comparable information available in all waves, we take account of two specific questions related to strenuousness and time pressure. Work quality indicators are related to the main job for retired individuals, and to the last job for those still working.[22] Respondents are asked whether the job was/is physically demanding and whether it exerted/exerts heavy time pressure.[23] Based on the answers, we consider separately those individuals who agree (or strongly agree) with the statement and those who disagree (or strongly disagree). To support the evidence based on self-reported job characteristics, which may suffer from differences in reporting style (see for instance [48, 49]) or justification bias, we classify individuals as either blue/white collar or low/high skilled workers,[24] using job descriptions provided by the respondent. The related question in the SHARE questionnaire is able to capture mainly the first digit of the International Standard Classification of Occupations (ISCO-88 code).[25]

Results

In Table 2, we report pooled 2SLS and fixed-effect 2SLS estimates (our preferred specification) for each health behaviour considered as an outcome; for comparison, we also report pooled OLS and fixed effects specifications. The estimated standard errors are robust to clustering at the country and cohort level.

Table 2 column 1 (OLS estimates) represents only a partial (not significant) association between retirement and smoking. Column 2 (FE estimates) shows that, when we account for time-invariant heterogeneity, transiting into retirement is associated with a higher probability of quitting smoking. Columns 3 and 4 report 2SLS and FE-2SLS estimates respectively: when we account for the endogeneity of retirement, we find no statistically significant effects on the probability of smoking. In Table 2, we also report selected first-stage coefficients, showing the relevance and strength of our instruments: the coefficients of being eligible for early and statutory retirement are always highly significant (at the 1 % level) and the F-statistics[26] on the excluded instruments are well above ten [39], and the critical values for weak identification testing [40]. As in previous studies [52, 37, 38, 16], our results therefore confirm that eligibility rules are important determinants of retirement decisions.

With regard to engagement in activities (Table 2, columns 5–8), we find a significant effect in the pooled OLS regression (column 5), where retirement is associated with a reduction in the probability of being inactive, while no significant effects are estimated in the fixed-effect model (column 6). Columns 7 and 8 of Table 2 show that, accounting for endogeneity, retirement causes a highly significant reduction in the probability of being inactive.

In columns 9–12 of Table 2, we focus on the effect of retirement on sports and vigorous activities. 2SLS estimates show that retirement causes a reduction in the probability of being inactive, in line with what we have seen when looking at activities requiring a moderate level of energy.[27]

We stress that the identification strategy, with regard to FE-2SLS estimates, relies on those individuals who switch between waves from employed or self-employed to retired;

[22] This has to be taken into account when interpreting our results, since we are combining at the same time long exposure to particular job characteristics and more recent effects of the last job. Short-term exposure is for those who changed job characteristics at the end of their work career.

[23] According to [47], the two questions are related to the dimensions of physical and psychosocial work quality.

[24] Based on the job description provided, we use the following classification: high skilled white collar (legislator, senior official, manager, professional, technician or associate professional); low skilled white collar (clerk, service worker, shop and market sales worker, armed forces); high skilled blue collar (skilled agricultural or fishery worker, craft and related trade workers, plant and machine operator or assembler); low skilled blue collar (elementary occupation).

[25] Even if not influenced by reporting heterogeneity, these second job categorisations have been criticised for being too coarse and unable to capture the multi-dimensional burden of a job [50]. Detailed ISCO coding could be used to construct a physical or a psycho-social job burden index, as proposed by Kroll [51], but unfortunately this information is available only in wave 1 for the last/current job.

[26] The reported F-statistic is the Kleibergen-Paap rk Wald F-statistic, which deals with clustered standard errors and corresponds to the standard F-statistic on the excluded instruments when there is a single endogenous variable.

[27] It may be argued that intensity of physical activity is not well captured by our two indicators: especially for those in physically demanding occupations, it may be that, although transiting into retirement leads to a higher probability of exercising, this does not translate into an increased burning of calories [53]. But, as we will see later, this behavioural change is attributable to white collar workers who usually have more sedentary jobs.

Table 2 The effect of retirement on health behaviours

	Smoking				No activities				No vigorous activities			
	(1) OLS	(2) FE	(3) 2SLS	(4) FE-2SLS	(5) OLS	(6) FE	(7) 2SLS	(8) FE-2SLS	(9) OLS	(10) FE	(11) 2SLS	(12) FE-2SLS
Retired	−0.006	−0.017**	−0.030	−0.024	−0.008**	−0.006	−0.050***	−0.045***	0.046***	−0.002	−0.056**	−0.088***
	(0.009)	(0.007)	(0.024)	(0.022)	(0.004)	(0.006)	(0.012)	(0.016)	(0.011)	(0.013)	(0.026)	(0.031)
# Grandchildren/10	−0.001	−0.046***	−0.000	−0.045***	−0.006	−0.015	−0.004	−0.011	−0.029**	−0.035	−0.024**	−0.027
	(0.011)	(0.017)	(0.011)	(0.017)	(0.008)	(0.021)	(0.008)	(0.021)	(0.011)	(0.028)	(0.011)	(0.029)
Partner	−0.047***	−0.015*	−0.047***	−0.015*	−0.001	0.005	−0.000	0.005	0.002	0.025	0.004	0.025
	(0.008)	(0.009)	(0.008)	(0.009)	(0.004)	(0.010)	(0.004)	(0.010)	(0.008)	(0.020)	(0.008)	(0.020)
Age	−0.000	−0.011**	0.005	−0.010	−0.027***	−0.043***	−0.018***	−0.039***	−0.036***	−0.034***	−0.014*	−0.025**
	(0.005)	(0.005)	(0.007)	(0.006)	(0.003)	(0.006)	(0.003)	(0.006)	(0.005)	(0.011)	(0.007)	(0.012)
Age^2/100	−0.005	0.004	−0.008*	0.004	0.024***	0.035***	0.018***	0.032***	0.036***	0.041***	0.022***	0.034***
	(0.004)	(0.003)	(0.005)	(0.004)	(0.002)	(0.003)	(0.002)	(0.003)	(0.004)	(0.005)	(0.005)	(0.006)
Qrtnetwealth_1	0.043***	0.001	0.043***	0.001	0.030***	−0.003	0.030***	−0.002	0.066***	0.003	0.066***	0.005
	(0.008)	(0.006)	(0.008)	(0.006)	(0.005)	(0.006)	(0.005)	(0.006)	(0.009)	(0.011)	(0.009)	(0.011)
Qrtnetwealth_3	−0.024***	−0.005	−0.024***	−0.005	−0.010***	−0.003	−0.010***	−0.003	−0.016**	0.011	−0.016**	0.011
	(0.006)	(0.004)	(0.006)	(0.004)	(0.004)	(0.005)	(0.004)	(0.005)	(0.007)	(0.010)	(0.007)	(0.010)
Qrtnetwealth _4	−0.038***	−0.013**	−0.039***	−0.013**	−0.017***	0.001	−0.019***	0.001	−0.048***	0.012	−0.052***	0.011
	(0.007)	(0.006)	(0.007)	(0.006)	(0.004)	(0.006)	(0.004)	(0.006)	(0.007)	(0.012)	(0.008)	(0.012)
Female	−0.042***		−0.041***		0.016***		0.016***		0.083***		0.085***	
	(0.007)		(0.007)		(0.003)		(0.003)		(0.007)		(0.007)	
ISCED3_4	−0.003		−0.003		−0.012***		−0.012***		−0.016**		−0.017**	
	(0.008)		(0.008)		(0.004)		(0.004)		(0.008)		(0.008)	
ISCED5_6	−0.026***		−0.027***		−0.014***		−0.016***		−0.015*		−0.020**	
	(0.009)		(0.009)		(0.004)		(0.004)		(0.008)		(0.009)	
Country dummies	✔		✔		✔		✔		✔		✔	
Wave dummies	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Observations	32,375	32,375	32,375	32,375	32,367	32,367	32,367	32,367	32,372	32,372	32,372	32,372
Individuals	13,465	13,465	13,465	13,465	13,464	13,464	13,464	13,464	13,466	13,466	13,466	13,466
R-squared	0.040	0.003	0.040	0.003	0.069	0.022	0.067	0.020	0.108	0.017	0.104	0.015
F-test statistic			364.384	151.202			364.826	151.897			364.803	151.693
First stage												
EligibleER			0.240***	0.171***			0.241***	0.171***			0.241***	0.171***
			(0.022)	(0.021)			(0.022)	(0.021)			(0.022)	(0.021)
EligibleSR			0.354***	0.303***			0.354***	0.304***			0.354***	0.303***
			(0.021)	(0.024)			(0.021)	(0.024)			(0.021)	(0.024)

Table 2 continued

	Drink every day				Number of visits to the general practitioner				Visits to the specialist			
	(13) OLS	(14) FE	(15) 2SLS	(16) FE-2SLS	(17) OLS	(18) FE	(19) 2SLS	(20) FE-2SLS	(21) OLS	(22) FE	(23) 2SLS	(24) FE-2SLS
Retired	0.045***	0.029***	0.019	0.048**	0.421***	−0.005	−0.177	−0.310	0.047***	0.009	0.094***	0.066
	(0.009)	(0.009)	(0.023)	(0.024)	(0.085)	(0.096)	(0.203)	(0.278)	(0.011)	(0.014)	(0.023)	(0.043)
# Grandchildren/10	−0.022*	0.016	−0.021*	0.014	0.143	−0.198	0.169	−0.167	−0.007	0.001	−0.009	−0.005
	(0.011)	(0.023)	(0.012)	(0.023)	(0.119)	(0.257)	(0.120)	(0.259)	(0.012)	(0.031)	(0.012)	(0.031)
Partner	0.040***	0.019	0.040***	0.019	−0.065	−0.314**	−0.052	−0.314**	0.015*	−0.051***	0.014*	−0.051***
	(0.008)	(0.014)	(0.008)	(0.014)	(0.077)	(0.142)	(0.077)	(0.142)	(0.008)	(0.019)	(0.008)	(0.019)
Age	0.011**	−0.002	0.017***	−0.004	−0.100*	−0.131	0.030	−0.098	0.004	−0.015	−0.007	−0.021*
	(0.005)	(0.007)	(0.007)	(0.008)	(0.051)	(0.087)	(0.064)	(0.089)	(0.005)	(0.012)	(0.007)	(0.012)
Age^2/100	−0.007*	−0.008*	−0.010**	−0.007	0.131***	0.096*	0.051	0.074	−0.001	0.005	0.006	0.009
	(0.004)	(0.004)	(0.005)	(0.005)	(0.039)	(0.051)	(0.045)	(0.054)	(0.004)	(0.007)	(0.005)	(0.007)
Qrtnetwealth _1	−0.005	0.005	−0.006	0.005	0.287***	0.026	0.285***	0.030	0.005	−0.011	0.005	−0.011
	(0.008)	(0.008)	(0.008)	(0.008)	(0.085)	(0.099)	(0.085)	(0.100)	(0.008)	(0.012)	(0.008)	(0.012)
Qrtnetwealth _3	0.014*	0.002	0.014*	0.002	−0.297***	−0.023	−0.299***	−0.024	0.009	0.008	0.009	0.009
	(0.007)	(0.007)	(0.007)	(0.007)	(0.065)	(0.074)	(0.065)	(0.074)	(0.008)	(0.010)	(0.007)	(0.010)
Qrtnetwealth _4	0.050***	0.022***	0.049***	0.022***	−0.619***	−0.054	−0.638***	−0.058	0.031***	0.017	0.032***	0.017
	(0.008)	(0.008)	(0.008)	(0.008)	(0.078)	(0.092)	(0.079)	(0.092)	(0.008)	(0.013)	(0.008)	(0.013)
Female	−0.146***		−0.146***		0.247***		0.257***		0.082***		0.081***	
	(0.009)		(0.009)		(0.061)		(0.061)		(0.008)		(0.008)	
ISCED3_4	0.023***		0.023***		−0.239***		−0.244***		0.041***		0.042***	
	(0.008)		(0.008)		(0.065)		(0.065)		(0.008)		(0.008)	
ISCED5_6	0.064***		0.063***		−0.433***		−0.462***		0.088***		0.090***	
	(0.009)		(0.009)		(0.075)		(0.077)		(0.009)		(0.010)	
Country dummies	✔		✔		✔		✔		✔		✔	
Wave dummies	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Obs	32,382	32,382	32,382	32,382	32,011	32,011	32,011	32,011	32,358	32,358	32,358	32,358
Individuals	13,468	13,468	13,468	13,468	13,343	13,343	13,343	13,343	13,459	13,459	13,459	13,459
R-squared	0.117	0.002	0.117	0.002	0.142	0.009	0.140	0.008	0.067	0.010	0.067	0.009
F-test statistic			364.713	151.654			361.297	151.465			363.049	151.754

therefore, we are able to estimate a short- (or medium-) rather than long-term effect of retirement on health behaviours.[28]

Table 2, columns 13–16 report estimates for the probability of consuming alcohol every day. OLS and FE estimates are confirmed by FE-2SLS results: the transition into retirement causes changes in drinking behaviour, in line with the literature. Eibich's [31], for instance, find that, in Germany, retirement causes a statistically significant increase in the probability of regular drinking and a reduction in the probability of no alcohol consumption.

In columns 17–20 of Table 2, we focus on the number of visits to a general practitioner in the last twelve months. Retirement is associated with a higher number of visits in the OLS specification, but no significant causal effects are estimated by 2SLS.

The last four columns of Table 2 show that retirement is associated with a higher probability of having contact with a specialist in the last twelve months (column 21), but the causal effect is confirmed only in the pooled 2SLS specification (column 23), while no significant effects are estimated when exploiting the within-individual variability in the data with FE-2SLS (column 24).

In Appendix 3, Table 6, we report additional robustness analysis for our 2SLS estimates. The baseline results do not change: whether we include among controls the number of chronic diseases and limitations in the basic and instrumental activities of daily living (ADLs and IADLs);[29] if we allow the non-linear age effect to be country-specific; if we exclude older individuals, aged over 75 years; if we use an alternative definition of retirement, considering as retired those individuals that not only self-report being retired but also did not do any paid work in the four weeks before the interview; or if we include also the number of children as control. We gain only a marginal significance in the FE-2SLS for the probability of smoking when accounting for country-specific non-linear age effects.

Table 2 continued

	Drink every day				Number of visits to the general practitioner				Visits to the specialist			
	(13) OLS	(14) FE	(15) 2SLS	(16) FE-2SLS	(17) OLS	(18) FE	(19) 2SLS	(20) FE-2SLS	(21) OLS	(22) FE	(23) 2SLS	(24) FE-2SLS
First stage												
EligibleER			0.241***	0.171***			0.239***	0.171***			0.241***	0.171***
			(0.022)	(0.021)			(0.022)	(0.021)			(0.022)	(0.021)
EligibleSR			0.354***	0.304***			0.356***	0.305***			0.354***	0.304***
			(0.021)	(0.024)			(0.021)	(0.024)			(0.021)	(0.024)

Clustered standard errors in parentheses by cohort and country. F-test statistic on the excluded instruments corresponds to the Kleibergen-Paap rk Wald F-statistic, which deals with clustered standard errors. Stock and Yogo's [40] critical values are (10 %, 15 %, 20 %, 25 % maximal IV size): 19.93, 11.59, 8.75, 7.25. For the first stage equation, we report only estimates for the two instrumental variables used. *OLS* = ordinary least squares, *FE* = fixed-effects, *2SLS* = two-stage least squares, FE-2SLS = fixed-effects two-stage least squares

* $P < 0.1$, ** $P < 0.05$, *** $P < 0.01$

[28] It can be seen that 2SLS point estimates are larger than OLS. One possible explanation is that we capture the effect of retirement for those individuals who are driven into retirement by the pension eligibility rules we use as instruments, leading to a Local Average Treatment Effect interpretation [54]. Additionally, fixed-effects estimates are also susceptible to attenuation bias if the retirement variable is affected by a measurement error [55]. In fact, some respondents may self-report being retired simply because they left their main job, even though they are still working full- or part-time [16], or they may misreport the retirement year [56]. Moreover, as suggested by Angrist and Pischke [42, p. 167], with multiple instruments, one can run overidentification tests as formal tests of treatment effect homogeneity. For all outcomes considered in Table 2, the Sargan-Hansen test of over-identifying restriction does not reject the null of the J test; results are available upon request.

[29] We tried including also depression and self reported health among controls but results—available upon request—do not change.

The estimates shown so far are based on pooled data from the selected ten European countries.[30] We also run FE-2SLS estimates grouping countries according to the existence of a gate-keeping system to access specialist health care services: countries with general practitioners acting as gate-keepers (Denmark, Italy, the Netherlands, Spain and Sweden), and countries without a gate-keeping system (Austria, Belgium, France, Germany and Switzerland). The aim is to investigate whether there are group-specific significant differences from our baseline results possibly related to different institutional frameworks. The estimates in Table 3 suggest the existence of differential retirement effects on some health behaviours that could be linked to the type of health care system.

First, in countries with gate-keeping, individuals are significantly less likely to be inactive after retirement, and this effect still remains once Mediterranean countries (Italy and Spain), characterised by higher rates of sedentariness, are considered separately from Denmark, the Netherlands and Sweden.[31] Gate-keeping systems require the authorisation of referrals to specialists by designated primary care providers, such as the general practitioners. In these systems the role of general practitioners in nudging healthier lifestyles (including increased physical activity)—in order to prevent diseases and the use of secondary health care services—is therefore emphasized, especially where there is an involvement of primary care physicians in chronic disease management.[32] In countries where general practitioners do not act as gate-keepers, individuals access directly specialist physicians who provide secondary health

Table 3 The effect of retirement on health behaviours—FE-2SLS—by type of health care system

Dependent variable	Smoking		No activities		No vigorous activities		Drink every day		Number of visits to the general practitioner		Visits to the specialist	
	Gate-keeping	No gate-keeping	Gate-keeping	No gate-keeping	Gate-keeping	No gate-keeping	Gate-keeping	No gate-keeping	Gate-keeping	No gate-keeping	Gate-keeping	No gate-keeping
Retired	−0.034	−0.007	−0.064***	−0.019	−0.108***	−0.056	0.065**	0.024	0.033	−0.783*	0.035	0.112
	(0.025)	(0.039)	(0.020)	(0.026)	(0.039)	(0.050)	(0.032)	(0.037)	(0.367)	(0.454)	(0.049)	(0.078)
Obs	16,536	15,839	16,532	15,835	16,534	15,838	16,540	15,842	16,321	15,690	16,528	15,830
# individuals	6944	6521	6943	6521	6944	6522	6946	6522	6871	6472	6941	6518
R2	0.006	0.005	0.024	0.017	0.014	0.017	0.002	0.003	0.009	0.008	0.015	0.004
F-test statistic	123.816	58.723	123.974	59.034	123.963	58.871	123.871	58.872	124.650	58.442	123.924	58.886

Gate-keeping countries are Denmark, Italy, the Netherlands, Spain and Sweden; countries without gate-keeping are Austria, Belgium, France, Germany and Switzerland. All regressions include age, age squared(/100), a binary indicator for having a partner, household net wealth quartiles dummies, the number of grandchildren, and wave dummies. Clustered standard errors in parentheses by cohort and country. F-test statistic on the excluded instruments corresponds to the Kleibergen-Paap rk Wald F-statistic, which deals with clustered standard errors. Stock and Yogo's [40] critical values are (10 %, 15 %, 20 %, 25 % maximal IV size): 19.93, 11.59, 8.75, 7.25

* $P < 0.1$, ** $P < 0.05$, *** $P < 0.01$

[30] We also run FE-2SLS estimates separately by country—these are available upon request.

[31] FE-2SLS estimates regarding inactivity (i.e. exercise requiring either a moderate or a substantial level of energy) are −0.0294 (SE 0.0134) for Denmark, the Netherlands and Sweden and −0.137 (SE 0.0777) for Mediterranean countries.

[32] Excluding the Netherlands—which is a private mandatory health insurance system evolving from a previous social health insurance—the other countries with gate-keeping (Denmark, Italy, Spain and Sweden) are all National Health Services, financed mainly by taxes and providing universal coverage (Beveridgean systems). If we consider only Beveridgean systems, the results of Table 3 still hold (the estimated coefficient for exercise requiring either a moderate or a substantial level of energy is −0.0789 (SE 0.0222) and significant at 1 %, whereas for exercise requiring a substantial level of energy the coefficient is −0.165 (SE 0.0409) and significant at 1 %. This may be interpreted as a result of more systematic interventions in these countries—through community care and counselling—to promote physical exercise, involving a number of actors even outside the health care sector. According to a report on policy development in the area of nutrition, physical activity and the prevention of obesity [57], Denmark, Italy, Spain and Sweden stand out among the other countries since they implemented specific actions involving multiple settings (schools, workplaces, health care services), and various sectors of government (environment, agriculture, sport, research and housing) at all levels (national, regional and local).

care treatments and may have lower incentive to promote healthy lifestyles through counselling.

Table 3 also shows that in countries with gate-keeping, individuals are more likely to drink regularly after retirement. However, as we will explain below, regular alcohol consumption cannot be simply interpreted as a signal of unhealthy behaviour.

Moreover, Table 3 suggests that different health care settings may also influence the access to outpatient care services after retirement: in countries without gate-keeping, retirees significantly reduce the number of visits to general practitioners.[33] This result, which is in line with Eibich's [31] findings for Germany, may depend on the fact that, after retirement, the probability to be diagnosed a chronic disease increases, and therefore individuals are more prone to access directly specialists where a prior referral by the general practitioner is not required. However, this should be considered as a short-term effect, given the identification strategy we used.

The estimates in Table 3 suggest that different frameworks of European health care systems matter in shaping individuals' health behaviours after retirement, even though the analysed effects might be short-lived. However, a complete analysis of actual determinants of these effects is rather complex and deserves further investigation.

In Table 4, we analyse heterogeneity in retirement effects by estimating the FE-2SLS model of Table 2 in subgroups defined according to gender, education, early-life condition, household net wealth and job characteristics.

According to our estimates, heterogeneous retirement effects in smoking behaviour may be observed. In particular, we find a statistically significant (at 5 % level) negative effect for individuals classified as blue collar. For individuals with physically demanding jobs, a negative significant (at 10 % level) effect of transiting into retirement is estimated. These results are in line with those of Eibich's [31], who looked at behavioural differences related to occupational strain.

The transition into retirement causes a significant reduction in the probability of being inactive among individuals of both sexes, with a partner, with high parental socio-economic status during childhood ("no few books"), whose job entailed time pressure, or who has been classified as white collar or highly skilled. In addition, comparing the effect of retirement on the probability of being inactive between highly educated and less well educated individuals, we can see that the point estimate for the former is larger. Table 4 shows also that retirement has a negative and significant effect on the probability of never, or almost never, practising vigorous activities among individuals of both sexes who have a partner, those with high parental socio-economic status during childhood, whose net wealth is above median, whose job was not physically demanding or was classified as white collar/highly skilled. These results are in line with Eibich's [31] findings for Germany, with the conclusions of the systematic review conducted by Barnett et al. [58] and with some descriptive evidence [59, 45] about the role of job characteristics in determining heterogeneity of the retirement effect.[34]

A significant increase in drinking behaviour (at the 5 % level) due to retirement is estimated only for male individuals, those without a partner, those with low parental socio-economic status during childhood, or whose job entailed time pressure; transiting into retirement has a significant positive effect (at the 10 % level) on the probability of drinking every day for individuals whose net wealth is below median. While smoking and inactivity are undoubtedly unhealthy behaviours, changes in alcohol drinking habits, captured by our binary indicator, cannot be clearly evaluated, since we do not have an indicator of drinking intensity for all waves. However, our result can be suggestive of a potential vulnerable sector of the population. Although previous studies suggest that regular alcohol consumption does not necessarily have a negative effect on health [61, 31], the alcohol-related burden of disease among older age groups, owing to their lower ability to handle the same levels and patterns of alcohol consumption they had had in their younger days, is an increasing public health concern [62].

Regarding health care use, we find a significant increase (at the 10 % level) on the probability of having a specialist visit only for male retirees and for those with a partner.

In general, the analysis of heterogeneity in retirement effects highlights a systematic socio-economic gradient across different dimensions, and the protective role of partnership.

So far, the heterogeneity analysis suggests, among other things, the role of a reduced occupational strain to explain part of the behavioural change due to retirement. It is, however, true also that non-work time increases after retirement, so that time constraints are no more a major barrier to time-intensive activities, such regular physical exercise. To investigate the role of time constraints in explaining the effect of retirement on physical activity, we estimate our FE-2SLS model for subgroups of individuals

[33] No income or wealth effect are considered in our discussion, since we include in our specifications net wealth quartile dummies that should control for those effects.

[34] For individuals with physically demanding jobs in particular, transiting into retirement does not affect significantly the probability of practising sports and vigorous activities. This is in line with the estimated effect of early retirement on body mass index [60].

Table 4 The effect of retirement on health behaviours—heterogeneous effects—FE-2SLS

Dependent variable	Gender		Partner		Education		Few books when aged 10 years		Net wealth	
	Male	Female	No	Yes	ISCED 0-4	ISCED 5-6	No	Yes	Below median	Above median
Smoking										
Retired	−0.0471	0.00624	−0.0331	−0.0125	−0.0408	0.0149	−0.0423	−0.0198	−0.0507	−0.0179
	(0.0355)	(0.0242)	(0.0539)	(0.0252)	(0.0270)	(0.0331)	(0.0266)	(0.0491)	(0.0395)	(0.0294)
Obs	17,401	14,974	6665	24,399	23,864	8511	17,185	10,809	11,678	15,046
Individuals	7229	6236	2750	10,260	9951	3514	7028	4384	5096	6467
R-squared	0.002	0.002	0.002	0.003	0.003	0.003	0.003	0.004	0.003	0.004
F-test statistic	103.903	122.326	42.375	152.796	135.733	91.372	187.049	78.712	92.476	140.195
No activities										
Retired	−0.0489**	−0.0429**	0.0178	−0.0497***	−0.0358*	−0.0557***	−0.0359**	−0.0723	−0.0196	−0.0210
	(0.0204)	(0.0215)	(0.0399)	(0.0172)	(0.0201)	(0.0214)	(0.0159)	(0.0477)	(0.0298)	(0.0192)
Obs	17,402	14,965	6661	24,395	23,861	8506	17,184	10,804	11,675	15,041
Individuals	7230	6234	2748	10,260	9952	3512	7029	4383	5095	6466
R-squared	0.021	0.020	0.038	0.016	0.025	0.005	0.020	0.022	0.030	0.015
F-test statistic	104.409	123.662	43.833	152.975	136.151	91.875	187.794	78.694	93.907	140.820
No vigorous activities										
Retired	−0.0870*	−0.0859**	−0.0184	−0.102***	−0.0592*	−0.139**	−0.103***	−0.0440	0.0202	−0.0867**
	(0.0467)	(0.0406)	(0.0900)	(0.0351)	(0.0353)	(0.0580)	(0.0349)	(0.0839)	(0.0634)	(0.0427)
Obs	17,404	14,968	6661	24,398	23,861	8511	17,187	10,804	11,675	15,046
Individuals	7231	6235	2748	10,261	9952	3514	7030	4383	5095	6468
R-squared	0.015	0.015	0.032	0.011	0.019	0.011	0.017	0.020	0.022	0.016
F-test statistic	103.940	123.668	43.833	152.975	136.151	91.543	187.188	78.694	93.907	140.367
Drink every day										
Retired	0.0788**	0.0135	0.105**	0.0386	0.0305	0.0659	0.00986	0.142**	0.0762*	0.0494
	(0.0384)	(0.0285)	(0.0509)	(0.0292)	(0.0297)	(0.0457)	(0.0319)	(0.0625)	(0.0452)	(0.0388)
Obs	17,405	14,977	6666	24,405	23,869	8513	17,189	10,809	11,679	15,052
Individuals	0.001	0.004	0.002	0.002	0.003	0.002	0.002	0.002	0.003	0.003
R-squared	7231	6237	2750	10,263	9953	3515	7030	4384	5096	6470
F-test statistic	103.943	123.650	43.847	152.906	136.157	91.497	187.188	78.712	93.909	140.399
Number of visits to the general practitioner										
Retired	−0.269	−0.459	−0.634	−0.243	−0.412	−0.123	−0.161	−0.882	−0.321	−0.532
	(0.423)	(0.305)	(0.645)	(0.320)	(0.350)	(0.413)	(0.286)	(0.861)	(0.513)	(0.349)
Obs	17,196	14,815	6578	24,140	23,540	8471	17,070	10,607	11,480	14,942
Individuals	7161	6182	2720	10,173	9841	3502	6994	4319	5020	6426
R-squared	0.013	0.006	0.006	0.009	0.007	0.015	0.010	0.005	0.009	0.009
F-test statistic	103.405	123.857	44.327	153.209	134.927	91.851	188.509	77.183	92.694	141.441
Visits to the specialist										
Retired	0.101*	0.0215	−0.0468	0.0797*	0.0551	0.104	0.0599	−0.0222	0.0232	0.0657
	(0.0580)	(0.0570)	(0.0993)	(0.0444)	(0.0505)	(0.0701)	(0.0449)	(0.0956)	(0.0703)	(0.0544)
Obs	17,390	14,968	6662	24,386	23,854	8504	17,177	10,803	11,669	15,044
Individuals	7226	6233	2748	10,256	9948	3511	7025	4383	5092	6467
R-squared	0.016	0.004	0.012	0.007	0.008	0.014	0.009	0.012	0.012	0.010
F-test statistic	104.106	123.436	43.822	153.099	136.345	91.367	187.032	78.655	93.922	140.295

Table 4 continued

Dep. Var.	Time pressure due to heavy workload		Physically demanding job		Job		Job	
	No	Yes	No	Yes	White collar	Blue collar	High skilled	Low skilled
Smoking								
Retired	−0.0245	−0.0316	−0.0207	−0.0798*	−0.0104	−0.122**	−0.0293	−0.0394
	(0.0400)	(0.0344)	(0.0316)	(0.0411)	(0.0243)	(0.0554)	(0.0322)	(0.0300)
Obs	12,067	11,889	12,806	11,631	18,109	9353	13,818	13,557
Individuals	4951	4895	5222	4785	7367	3831	5623	5532
R-squared	0.002	0.001	0.003	0.001	0.003	−0.007	0.004	0.002
F-test statistic	100.325	130.410	117.023	114.985	186.431	71.129	111.417	132.185
No activities								
Retired	−0.0245	−0.0640**	−0.0254	−0.0525	−0.0395**	−0.0282	−0.0446**	−0.0280
	(0.0279)	(0.0276)	(0.0192)	(0.0322)	(0.0169)	(0.0437)	(0.0197)	(0.0279)
Obs	12,063	11,886	12,802	11,628	18,103	9353	13,819	13,550
Individuals	4950	4895	5221	4785	7366	3832	5625	5530
R-squared	0.020	0.023	0.016	0.028	0.020	0.023	0.017	0.026
F-test statistic	100.930	130.567	117.397	115.096	187.107	71.180	111.578	132.718
No vigorous activities								
Retired	0.00171	−0.0323	−0.121**	0.0457	−0.0894**	−0.0448	−0.171***	0.0543
	(0.0608)	(0.0523)	(0.0520)	(0.0561)	(0.0350)	(0.0780)	(0.0488)	(0.0508)
Obs	12,065	11,887	12,804	11,629	18,106	9353	13,820	13,552
Individuals	4951	4895	5222	4785	7367	3832	5625	5531
R-squared	0.019	0.019	0.013	0.026	0.016	0.021	0.007	0.022
F-test statistic	100.302	130.568	117.009	115.096	186.541	71.180	71.180	132.182
Drink every day								
Retired	−0.0474	0.107**	−0.00455	0.0380	0.0405	0.0175	0.0293	0.0427
	(0.0453)	(0.0448)	(0.0386)	(0.0475)	(0.0318)	(0.0591)	(0.0393)	(0.0386)
Obs	12,067	11,891	12,806	11,633	18,111	9355	13,822	13,557
# individuals	0.003	0.001	0.003	0.004	0.002	0.005	0.002	0.003
R2	4951	4896	5222	4786	7368	3832	5625	5532
F-test statistic	100.325	130.570	117.023	115.096	186.553	71.181	111.586	132.185
Number of visits to the general practitioner								
Retired	−0.303	0.112	−0.356	0.00694	−0.366	−0.433	0.109	−0.617
	(0.459)	(0.580)	(0.347)	(0.598)	(0.300)	(0.782)	(0.409)	(0.428)
Obs	11,953	11,738	12,711	11,459	17,993	9171	13,687	13,392
# individuals	4914	4850	5192	4732	7331	3775	5582	5482
R2	0.008	0.012	0.011	0.008	0.010	0.007	0.013	0.006
F-test statistic	100.765	129.388	118.240	113.229	184.707	68.946	108.426	133.205
Visits to the specialist								
Retired	0.0823	0.0845	0.0234	0.0680	0.0395	0.0730	0.0922	0.0119
	(0.0651)	(0.0713)	(0.0677)	(0.0706)	(0.0506)	(0.0876)	(0.0621)	(0.0583)
Obs	12,060	11,882	12,804	11,621	18,099	9349	13,812	13,549
# individuals	4948	4893	5221	4782	7364	3830	5622	5529
R2	0.013	0.009	0.013	0.009	0.011	0.009	0.014	0.009
F-test statistic	99.970	130.765	116.791	115.222	186.224	71.197	111.538	132.054

All regressions include age, age squared(/100), a binary indicator for having a partner, household net wealth quartiles dummies, the number of grandchildren, and wave dummies. Clustered standard errors in parentheses by cohort and country. F-test statistic on the excluded instruments corresponds to the Kleibergen-Paap rk Wald F-statistic, which deals with clustered standard errors. Stock and Yogo's [40] critical values are (10 %, 15 %, 20 %, 25 % maximal IV size): 19.93, 11.59, 8.75, 7.25

* $P < 0.1$, ** $P < 0.05$, *** $P < 0.01$

Table 5 The effect of retirement on the probability of being inactive—heterogeneous effects—FE-2SLS

Dependent variable	No activities		No vigorous activities	
	Always full time	Not always full time	Always full time	Not always full time
Retired	−0.0387*	−0.0334	−0.0826**	−0.0554
	(0.0212)	(0.0300)	(0.0406)	(0.0601)
Obs	23,131	4423	23,132	4425
# individuals	9412	1810	9412	1811
R2	0.021	0.023	0.018	0.017
F-test statistic	144.682	110.833	144.682	110.499

All regressions include age, age squared(/100), a binary indicator for having a partner, household net wealth quartiles dummies, the number of grandchildren, and wave dummies. Clustered standard errors in parentheses by cohort and country. F-test statistic on the excluded instruments corresponds to the Kleibergen-Paap rk Wald F-statistic, which deals with clustered standard errors. Stock and Yogo's [40] critical values are (10 %, 15 %, 20 %, 25 % maximal IV size): 19.93, 11.59, 8.75, 7.25

* $P < 0.1$, ** $P < 0.05$, *** $P < 0.01$

working/having worked always full-time or not (Table 5 based on SHARELIFE information).

The results show that significant effects (in terms of increased activity) are estimated only for the subgroup of individuals having worked/still working full-time, supporting the mechanism through which retirement provides individuals with more leisure time that can be devoted to physical exercise.

Conclusions

In this paper, we focussed on behavioural adjustments upon retirement, to shed more light on the mechanisms that could explain previous mixed findings about the impact of retirement on health.

Accounting for the endogenous choice of retirement, we were able to estimate the causal effect of retirement on smoking, drinking behaviour, engagement in activities and contacts with doctors (general practitioners and specialists).

Our baseline estimates show that the probability of being inactive or not doing any vigorous physical activity decreases with retirement: individuals provided with more leisure time change their behaviour in terms of engagement in activities; this corresponds to the so-called honeymoon phase [63, 64]. Our findings therefore underline the importance of time constraints as a major barrier to engaging in regular physical activity. Our estimates, moreover, show a significant effect of retirement on the probability of regular alcohol drinking, confirming other empirical results [31], even though this does not necessarily imply a worsening in health behaviours.

We also observe the existence of differential retirement effects by grouping countries according to the type of health care system. In particular, we find that in countries with a gate-keeping system people are significantly less likely to be inactive after retirement. This effect might suggest that the health care systems configuration plays a role in determining individuals' health investments upon retirement, although further investigation is needed.

We also provide another innovative contribution to the literature by looking at individual heterogeneous effects of retirement not only linked to gender, education, and net wealth (as other studies have done) but also related to a larger set of objective and subjective individual information about early-life conditions and job characteristics. In particular, we find larger effects for higher educated people and for those with high parental socio-economic status during childhood, who are more likely to change lifestyles after retirement, increasing their physical activity. This is in line with the so-called 'education gradient' [65, 66], in which health behaviours can be seen as mediating factors through which education influences health [67]. Job characteristics also play a role in relation to physical exercise: individuals who have been classified as white collar or highly skilled increase significantly the probability of engagement in physical activities (both moderate and vigorous); those whose job entailed time pressure reduce significantly the probability of being inactive, while retirement from less physically demanding occupations increases the probability of engagement in sports or vigorous activities. We highlight also the role of time constraints as barrier to engage in regular physical activity.

Our results provide important information for the design of policies aiming to promote healthy lifestyles in later life, by identifying those who are potential target individuals and which factors may affect their behaviour. According to our study, poorly educated individuals show smaller effects regarding engagement in activities after retirement. This provides support for active ageing policies, particularly in the field of participation for that group of the population (e.g. adapted physical activity programmes responsive to older adults' educational levels and cultural preferences; see [68–70]).

Our results also suggest that the retirement and pre-retirement period may well offer a suitable opportunity to provide support for adopting a healthy lifestyle later in life. In this respect, our findings are in line with certain general policy proposals put forward by the World Health Organization (WHO; [71]) about active ageing: 'Provide education and learning opportunities throughout the life course; and recognize and enable the active participation of people in economic development activities, formal and informal work and voluntary activities as they age, according to their individual needs, preferences and capacities.' Regarding physical activity, the WHO [71] suggests the importance of supporting culturally appropriate community programmes that stimulate activity, and are organised and led by older people themselves. However, evidence that strenuous physical work may hasten disabilities, preventing physical exercise, additionally requires health promotion efforts already at work aimed at providing relief from repetitive, strenuous tasks, and making adjustments to avoid unsafe physical movement.

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Compliance with ethical standards

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Conflict of interest The two authors are involved in a scientific capacity in the design and running of the Survey on Health, Ageing and Retirement in Europe (SHARE), which is the main data source used in the paper. They declare that they have no conflict of interest and no relevant or material financial interests that relate to the research described in this paper.

Appendix 1

The initial sources of information about eligibility criteria are Gruber and Wise (1999, 2010) and Wise (2012). Other country-specific auxiliary data sources are given below. ER early retirement. SR statutory (normal) retirement.

Austria (see Staubli and Zweimüller 2011)

ER: 60 for men and 55 for women until 2001. From 2001 until 2004, early retirement depends on year of birth. For men it is 61 until 1942 and 62 from 1943 onwards. For women it is 56 for those born in 1947, 57 for those born between 1948 and 1951, 58 for those born from 1952 onwards. From 2005 onwards, it is 62.

SR: 65 for men and 60 for women.

Belgium (see Jousten et al. 2010)

ER: No early retirement until 1966, 60 afterwards for men, for women 55 until 1986 and 60 from 1987.

SR: 65 for men, for women 60 until 1996, 61 from 1997 to 1999, 62 from 2000 to 2002, 63 from 2003 to 2005, 64 from 2006 to 2008, 65 from 2009.

Denmark (see Bingley et al. 2010)

ER: 60 for both men and women consistently, except from 1992 to 1993, when the ER was lowered to 55, and from 1994 to 1995, when it was 50.

SR: 67 until 2003, 65 from 2004, for both men and women.

France (see Hamblin 2013)

ER: No early retirement until 1963. 60 from 1963 to 1980, 55 from 1981 onwards.

SR: 65 until 1982 and 60 from 1983 to 2010; from 2011 60 for those born up to 1952, 61 for those born between 1953 and 1954, and 62 for those born since 1955.

Germany (see Berkel and Börsch-Supan 2004, and Mazzonna and Peracchi 2014, DRV 2015)

ER: For men, no early retirement until 1972, 60 from 1973 until 2003, 63 from 2004 onwards. For women, no early retirement in 1961, 60 from 1962.

SR: 65 for all.

Italy (see Angelini et al. 2009; Mazzonna and Peracchi 2014)

ER: from 1965 to 1995, early retirement was possible at any age with 35 years of contributions[35] (25 in the public sector) for both men and women; from 1996 it was increased stepwise up to 57 for both the private and public sector (58 for self-employed).

SR: The statutory retirement age was 60 (65 in the public sector) for men and 55 (60 in the public sector) for women from 1961 to 1993. Several consecutive reforms (1992, 1995 and 1998) increased the statutory retirement age to 65 for men and 60 for women with step-wise increments from 1994.

Netherlands (see Euwals et al. 2010)

ER: No early retirement until 1974. 60 from 1975 onwards, for both men and women.

SR: 65 for both men and women.

Spain (see Blanco 2000; Mazzonna and Peracchi 2014)

ER: 64 until 1982, 60 from 1983 to 1993, 61 from 1994 onwards, for both men and women.

SR: 65 for both men and women.

Sweden (see Mazzonna and Peracchi 2014)

ER: No early retirement until 1962, 60 from 1963 to 1997, 61 from 1998 onwards.

SR: 67 for both men and women until 1994, 65 from 1995 onwards.

Switzerland (see Dorn and Sousa-Poza 2003; Mazzonna and Peracchi 2014)

ER: No early retirement until 1996 for men and until 2000 for women. Then, 64 for men from 1997 until 2000 and 63 from 2001, for women 62 from 2001.

SR: 65 for men, for women 63 until 1963, 62 from 1964 until 2000, 63 from 2001 to 2004, 64 from 2005.

[35] We use work experience to define eligibility.

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Note: The graphs report retirement age histograms by country and gender, highlighting in dark gray early retirement ages in black statutory (normal) retirement ages—that have changed over time for the cohorts considered (see Appendix 1). Within each bin, we show the proportion of individuals declaring why they retired.

Appendix 2

See Figs. 7 and 8.

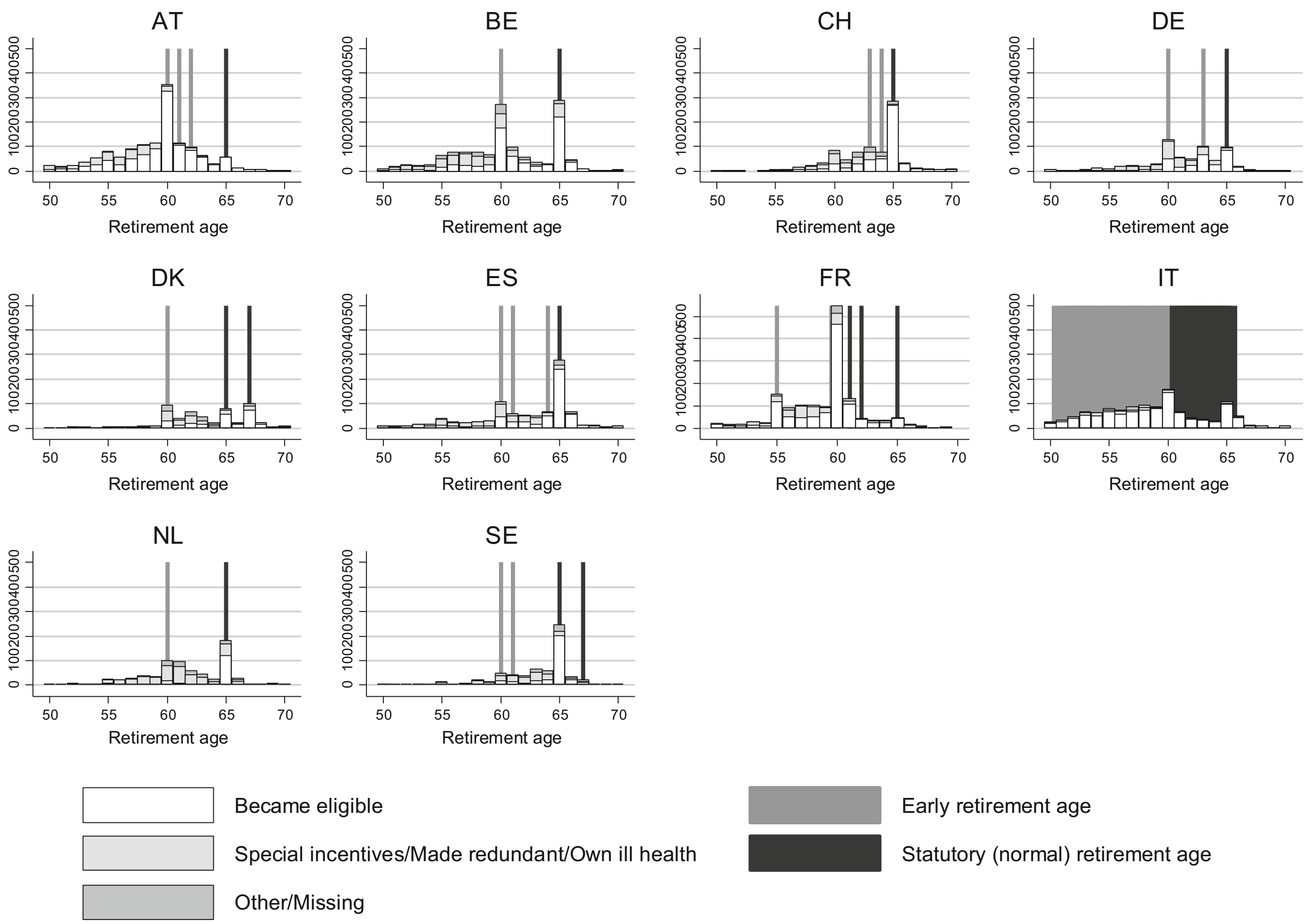

Fig. 7 Early and statutory (normal) eligibility ages for pension benefits, males

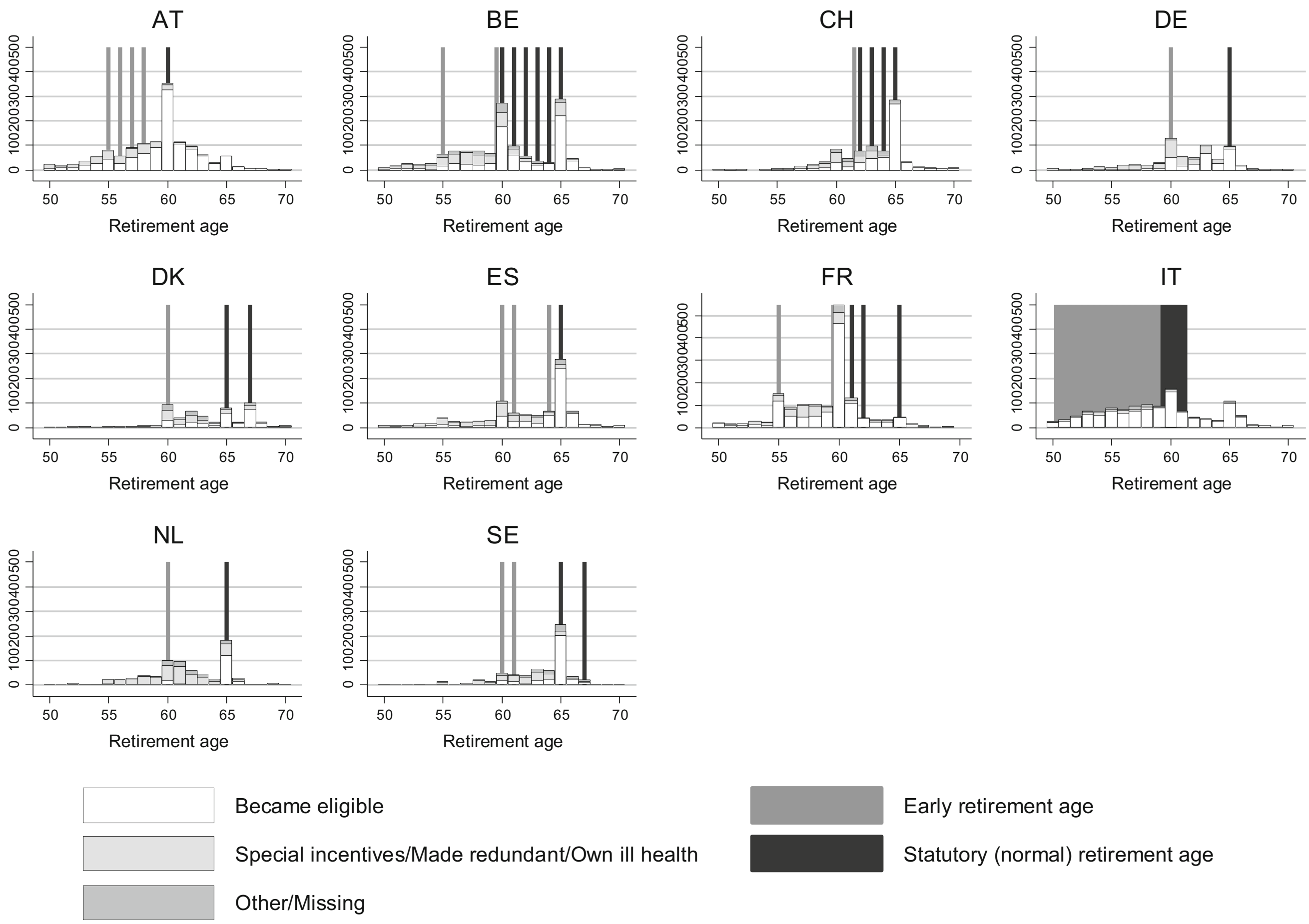

Fig. 8 Early and statutory (normal) eligibility ages for pension benefits, females

Appendix 3

See Table 6.

Table 6 The effect of retirement on health behaviours—robustness—2SLS estimates

	(1) Smoking	(2)	(3) No activities	(4)	(5) No vigorous activities	(6)	(7) Drink every day	(8)	(9) Number of visits to the general practitioner	(10)	(11) Visits to the specialist	(12)
	2SLS	FE-2SLS	2SLS	FE-2SLS	2SLS	FE-2SLS	2SLS	FE-2SLS	2SLS	FE-2SLS	2SLS	FE-2SLS
With health controls												
Retired	−0.029	−0.024	−0.033***	−0.037**	−0.046*	−0.086***	0.015	0.046*	−0.162	−0.313	0.088***	0.062
	(0.024)	(0.022)	(0.010)	(0.015)	(0.026)	(0.032)	(0.023)	(0.024)	(0.197)	(0.274)	(0.023)	(0.043)
Obs	32,375	32,375	32,367	32,367	32,372	32,372	32,382	32,382	32,011	32,011	32,358	32,358
Individuals	13,465	13,465	13,464	13,464	13,466	13,466	13,468	13,468	13,343	13,343	13,459	13,459
F-test statistic	366.306	151.305	366.758	151.995	366.739	151.792	366.652	151.753	363.222	151.594	364.948	151.862
Country-specific age effects												
Retired	−0.035	−0.033*	−0.024**	−0.039**	−0.032	−0.081***	0.048**	0.043*	0.071	−0.254	0.102***	0.069*
	(0.023)	(0.020)	(0.010)	(0.016)	(0.025)	(0.031)	(0.023)	(0.024)	(0.184)	(0.274)	(0.023)	(0.039)
Obs	32,375	32,375	32,367	32,367	32,372	32,372	32,382	32,382	32,011	32,011	32,358	32,358
Individuals	13,465	13,465	13,464	13,464	13,466	13,466	13,468	13,468	13,459	13,343	13,459	13,459
F-test statistic	391.452	167.548	392.091	168.530	391.804	168.276	391.779	168.219	388.434	167.830	390.314	168.315
Age 50-75												
Retired	−0.025	−0.016	−0.020*	−0.036**	−0.048	−0.079**	0.038	0.034	−0.303	−0.371	0.097***	0.063
	(0.028)	(0.024)	(0.012)	(0.017)	(0.031)	(0.033)	(0.026)	(0.025)	(0.248)	(0.295)	(0.028)	(0.046)
Obs	25,671	25,671	25,662	25,662	25,667	25,667	25,676	25,676	25,448	25,448	25,662	25,662
Individuals	10,836	10,836	10,834	10,834	10,836	10,836	10,838	10,838	10,755	10,755	10,832	10,832
F-test statistic	248.206	139.140	248.457	139.780	248.256	139.555	248.338	139.522	245.702	139.416	247.128	139.682
Alternative definition of retirement												
Retired	−0.043	−0.047	−0.062***	−0.083***	−0.074**	−0.170***	0.021	0.089**	−0.155	−0.471	0.119***	0.125
	(0.030)	(0.041)	(0.015)	(0.030)	(0.034)	(0.062)	(0.029)	(0.044)	(0.257)	(0.521)	(0.028)	(0.078)
Obs	32,375	32,375	32,367	32,367	32,372	32,372	32,382	32,382	32,011	32,011	32,358	32,358
Individuals	13,465	13,465	13,464	13,464	13,466	13,466	13,468	13,468	13,343	13,343	13,459	13,459
F-test statistic	179.713	74.596	179.552	74.428	179.934	74.356	179.887	74.382	177.924	74.115	179.223	74.321
Including number of children												
Retired	−0.032	−0.023	−0.051***	−0.046***	−0.057**	−0.086***	0.018	0.047**	−0.172	−0.308	0.089***	0.060
	(0.024)	(0.022)	(0.012)	(0.015)	(0.026)	(0.031)	(0.023)	(0.024)	(0.202)	(0.277)	(0.023)	(0.042)
Obs	32,286	32,286	32,278	32,278	32,283	32,283	32,293	32,293	31,921	31,921	32,269	32,269
Individuals	13,431	13,431	13,430	13,430	13,432	13,432	13,434	13,434	13,308	13,308	13,425	13,425
F-test statistic	364.573	152.416	364.977	153.120	365.008	152.919	364.931	152.880	361.300	152.629	363.242	152.979

All FE-2SLS regressions include age, age squared(/100), a binary indicator for having a partner, household net wealth quartiles dummies, the number of grandchildren, and wave dummies. 2SLS regressions include additionally education indicators, gender and country dummies. The alternative definition of retirement combines self-reported employment status and information about paid work during the last four weeks before the interview. Clustered standard errors in parentheses by cohort and country. F-test statistic on the excluded instruments corresponds to the Kleibergen-Paap rk Wald F-statistic, which deals with clustered standard errors. Stock and Yogo's [40] critical values are (10 %, 15 %, 20 %, 25 % maximal IV size): 19.93, 11.59, 8.75, 7.25

* $P < 0.1$, ** $P < 0.05$, *** $P < 0.01$

Appendix 4

Following Jones et al. (2013) and Verbeek and Nijman (1992), an initial test for non-response bias is to include in our 2SLS specification two variables describing the pattern of survey response: nextwave and allwaves. The former indicates whether the individual participated in the next wave, the latter identifies individuals who participated in all three waves. In the FE-2SLS, only nextwave is included, since allwaves is a time-invariant characteristic. As Jones et al. (2013) suggested, there should be no intrinsic reason why the survey response should have an effect on individuals' health behaviours, but, in the presence of selection bias there will be a statistical association between survey response variables and our outcome measures. Table 7 shows that there is a statistical association between survey response variables and our outcome measures, but generally not for our FE-2SLS specifications. One possible strategy to see whether attrition might be problematic for our results is to compare estimates between balanced and unbalanced panel sample (see Jones et al. 2013, and Cheng and Trivedi 2015). In the absence of non-response bias, these estimates should be comparable, as may be seen in Table 8.

Additional references

Cheng, T. C., and Trivedi, P. K., 2015. "Attrition Bias in Panel Data: A Sheep in Wolf's Clothing? A Case Study Based on the Mabel Survey," Health Economics, 24:1101–1117.

Verbeek, M. and Nijman, T., 1992. "Testing for Selectivity Bias in Panel Data Models", International Economic Review, 33: 681–703.

Table 7 The effect of retirement on health behaviours—robustness—attrition I

	(1) Smoking	(2)	(3) No activities	(4)	(5) No vigorous activities	(6)	(7) Drink every day	(8)	(9) Number of visits to the general practitioner	(10)	(11) Visits to the specialist	(12)
	2SLS	FE-2SLS	2SLS	FE-2SLS	2SLS	FE-2SLS	2SLS	FE-2SLS	2SLS	FE-2SLS	2SLS	FE-2SLS
Retired	−0.028	−0.023	−0.050***	−0.045***	−0.057**	−0.088***	0.020	0.048**	−0.156	−0.310	0.095***	0.066
	(0.024)	(0.022)	(0.012)	(0.016)	(0.026)	(0.031)	(0.023)	(0.024)	(0.205)	(0.278)	(0.023)	(0.043)
Nextwave	−0.030***	−0.012**	−0.012*	−0.005	−0.005	0.007	−0.009	−0.004	−0.207**	0.014	0.004	−0.002
	(0.009)	(0.006)	(0.006)	(0.007)	(0.012)	(0.014)	(0.010)	(0.010)	(0.099)	(0.101)	(0.012)	(0.015)
Allwaves	−0.006		−0.011***		−0.018***		0.007		0.055		0.019***	
	(0.006)		(0.003)		(0.007)		(0.006)		(0.061)		(0.007)	
Obs	32,375	32,375	32,367	32,367	32,372	32,372	32,382	32,382	32,011	32,011	32,358	32,358
Individuals	13,465	13,465	13,464	13,464	13,466	13,466	13,468	13,468	13,343	13,343	13,459	13,459
F-test statistic	362.175	151.197	362.578	151.887	362.593	151.687	362.498	151.648	359.276	151.433	360.917	151.747

All FE-2SLS regressions include age, age squared(/100), a binary indicator for having a partner, household net wealth quartiles dummies, the number of grandchildren, and wave dummies. 2SLS regressions include additionally education indicators, gender and country dummies. Clustered standard errors in parentheses by cohort and country. F-test statistic on the excluded instruments corresponds to the Kleibergen-Paap rk Wald F-statistic, which deals with clustered standard errors. Stock and Yogo's (2005) critical values are (10 %, 15 %, 20 %, 25 % maximal IV size): 19.93, 11.59, 8.75, 7.25

* $P < 0.1$, ** $P < 0.05$, *** $P < 0.01$

Table 8 The effect of retirement on health behaviours—robustness—attrition II

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Smoking				No activities				No vigorous activities			
	2SLS		FE-2SLS		2SLS		FE-2SLS		2SLS		FE-2SLS	
	Balanced	Unbalanced	Balanced	Unbalanced	Balanced	Unbalanced	Balanced	Unbalanced	Balanced	Unbalanced	Balanced	Unbalanced
Retired	−0.023	−0.030	−0.023	−0.024	−0.049***	−0.050***	−0.036*	−0.045***	−0.070**	−0.056**	−0.085**	−0.088***
	(0.029)	(0.024)	(0.024)	(0.022)	(0.015)	(0.012)	(0.019)	(0.016)	(0.032)	(0.026)	(0.041)	(0.031)
Obs	20,409	32,375	20,409	32,375	20,403	32,367	20,403	32,367	20,404	32,372	20,404	32,372
Individuals	7482	13,465	7482	13,465	7482	13,464	7482	13,464	7482	13,466	7482	13,466
F-test statistic	298.007	364.384	135.194	151.202	298.317	364.826	135.778	151.897	298.401	364.803	135.781	151.693
	Drink every day				Number of visits to the general practitioner				Visits to the specialist			
	2SLS		FE-2SLS		2SLS		FE-2SLS		2SLS		FE-2SLS	
	Balanced	Unbalanced	Balanced	Unbalanced	Balanced	Unbalanced	Balanced	Unbalanced	Balanced	Unbalanced	Balanced	Unbalanced
Retired	0.044	0.019	0.025	0.048**	−0.021	−0.177	−0.227	−0.310	0.094***	0.094***	0.063	0.066
	(0.028)	(0.023)	(0.030)	(0.024)	(0.275)	(0.203)	(0.338)	(0.278)	(0.031)	(0.023)	(0.048)	(0.043)
Obs	20,412	32,382	20,412	32,382	20,177	32,011	20,177	32,011	20,402	32,358	20,402	32,358
Individuals	7483	13,468	7483	13,468	7426	13,343	7426	13,343	7481	13,459	7481	13,459
F-test statistic	298.370	364.713	135.786	151.654	294.008	361.297	134.576	151.465	296.706	363.049	135.815	151.754

All FE-2SLS regressions include age, age squared(/100), a binary indicator for having a partner, household net wealth quartiles dummies, the number of grandchildren and wave dummies. 2SLS regressions include additionally education indicators, gender and country dummies. Clustered standard errors in parentheses by cohort and country. F-test statistic on the excluded instruments corresponds to the Kleibergen-Paap rk Wald F-statistic which deals with clustered standard errors. Stock and Yogo's (2005) critical values are (10, 15, 20, 25 % maximal IV size): 19.93, 11.59, 8.75, 7.25. The balanced sample includes individuals that participated in all the three waves

* $P < 0.1$, ** $P < 0.05$, *** $P < 0.01$

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