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ARTICLE

Is there a consensus on the health consequences of retirement? A literature review

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Abstract

We investigate the causal effect of retirement on health through literature. We explore the potential mechanisms which explain three effects: the switch from employment to retirement, later retirement, and earlier retirement. The empirical strategies used to identify the causal effects are mainly based on the observation of changes in health status at the legal age for retirement entitlement or on reforms that have led to changes in retirement incentives. Literature renders possible to make several observations on the average effect estimation. Retirement leads to better self-reported health, less depression, a decrease in healthcare consumption, a decline in cognition and an ambiguous effect on physical health. Later retirement has no effect on mortality, decreases healthcare consumption, and has a negative or non-significant impact on self-reported health. Studies on the impact of earlier retirement are scarce due to few natural experiments exploiting such a variation. Lastly, some studies find evidence of heterogeneous effects by gender and occupational status. As there are relatively few studies on this aspect, the question should be seriously explored in future research.

KEYWORDS

health, pension reform, retirement

JEL CLASSIFICATION

I1, J14, J26

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1 | INTRODUCTION

Numerous papers focus on the impact of retirement on health. In order to build a consensus, it is necessary to repeat the empirical analysis over different periods and different countries. The empirical evidence-gathering process is the only way to converge toward more general results (Angrist & Pischke, 2010). Previous studies often point out an absence of consensus. It prompted researchers to build solid identification strategies, highlighting heterogeneous mechanisms and effects which can explain the average effect estimation. Ultimately, a consensus emerges and the differences in results can be explained by both the diversity of methods and the indicators used.

The impact of retirement on health is also a public policy concern. In most European countries, the number of retirees increases faster than the number of workers. In a pay-as-you-go pension system, this raises sustainability issues. Consequently, the number of pension reforms in European countries has been increasing since the end of the 1990s. Carone et al. (2016) show the average yearly number of pension measures in Europe was multiplied by five, that is, it has risen from 9 between 1990 and 1999 to 44 between 2009 and 2014. These reforms affect both public and private pensions and changes eligibility criteria like the retirement age, the required contribution length; the pension calculation scheme; the indexation criterion for pension payments; the resources like social contributions, taxes, and the schemes, that is, merge or closure of pension schemes. A substantial part of these reforms leads to an increase in claiming age.

Three questions emerge from the previous literature. First, the researchers investigate the health impact of the switch from employment to retirement. This is of interest since retirement is a social construction and thus, can evolve through public policy changes. From this perspective, the underlying mechanisms are important to grasp. Health deterioration may be observed at retirement. If the reason for this deterioration is the sharp increase in leisure time, one could imagine that progressive retirement should be favored. However, the latter public policy would probably be unsuccessful if the real reason for health deterioration is the reduced income at retirement. Second, the researchers investigate whether later retirement affects health. From a public policy perspective, this question is of interest because policy makers want to ensure that the reforms have no detrimental effect on health. Moreover, they want to ensure these pension reforms improve the public finance, which is debatable if healthcare expenditure increases following health deterioration due to the reforms. Third, researchers investigate whether earlier retirement affects health.¹

In this paper, we try to reconcile the literature results on the health consequences of retirement which are often presented as inconclusive. Nishimura et al. (2018) investigate which factors can explain the differences in the literature results. For each study, the authors' replications show that the retirement definition plays no role in the results obtained. However, the method plays a definite role, especially concerning health measures and identification strategy. We adopt a complementary approach, as we try to find a consensus between studies. We select all the papers published from 2000 onward, in peer-reviewed academic journals, on the causal impact of retirement on health.² We end up with 51 papers on mortality, healthcare consumption, self-reported health, depression, cognitive abilities, physical health, pathologies, health index, and health-related behavior. We compare the literature results through a given health outcome that is comparable from one study to another. We also review the previous literature in the light of the following three causal effects on health: the transition from employment to retirement, later retirement, and earlier retirement.

We show that consensual results can be obtained. Retirement leads to a decrease in healthcare consumption, better self-reported health, less depression, a decline in cognition, an increase in mortality. Later retirement has no effect on mortality, decreases healthcare consumption, and has negative or non-significant impact on self-reported health. Studies on the impact of earlier retirement are scarce due to few natural experiments exploiting such a variation. Some studies find evidence of heterogeneous effects by gender and occupational status. The effects are rarely significant for women, and retirement would be beneficial for the self-rated health and cognitive functions of blue-collar workers.

The first section presents the potential mechanisms explaining the effect of retirement on health, the second section presents the empirical method used, and the last section compares the results obtained.

2 | POTENTIAL MECHANISMS

The first part of this section focuses on potential mechanisms that explain the health consequences of the switch from employment to retirement. The second one describes potential mechanisms that explain the health consequences of a change in retirement age. Distinguishing between these two mechanisms is essential. First, the health impact and potential underlying mechanisms are not necessarily the same. Second, studying discontinuity at retirement does not lead to the same public policy adjustments as the impact of a reform on retirement age. In both cases, we will distinguish between several health outcomes since there is no reason for retirement to affect all the health dimensions in the same way. Some mechanisms are thought to vary in different directions, according to individual characteristics such as gender, education, or income. In a third section, we focus on the income effects and health insurance effects, which may explain health variations at retirement. The explanation of the theoretical mechanisms relies on an adaptation of Grossman's model to take into account retirement, proposed by Galama et al. (2013).

In Grossman's framework, health is viewed as a durable capital stock that produces healthy time (Grossman, 1972). Individuals need medical care for the consumption and production benefits that good health provides. Health, in turn, improves work productivity, and therefore indirectly influences their utility through higher consumption. Health also directly influences utility as people enjoy spending time in good health.

Relying on the Grossman's theoretical framework and the Galama extension, we identify three potential underlying mechanisms explaining health changes: (i) the change in the budget constraint (including income and cost of health investment); (ii) the change in the marginal benefit of health investment; (iii) the changes in the efficiency³ and the depreciation rate of health investment.⁴

2.1 | Transition from employment to retirement

In a first strand of the literature, papers have documented the health impact of the switch from employment to retirement. Retirement is a sudden shift in daily life due to changes in schedule, leisure time, income, and social status. For all the above reasons, health may be impacted.

First, the change in the budget constraint is due to a reduced income at retirement. The pension amount is generally lower than the pre-retirement earnings. Moreover, the change in the budget constraint can also be due to an increase in healthcare costs, through changes in health insurance.

A decrease in the generosity of health insurance could change medical prices, and, in turn, the healthcare access. The income drop at retirement could decrease health through changes in food consumption, healthy habits, living conditions and healthcare access. As income is not linked to the time spent working, the opportunity cost of time is supposed to be nil at retirement.

Second, changes in the marginal benefit of health may arise if there are changes in utility associated with good health. Galama et al. (2013) explicitly describe a utility function before and after retirement. This is motivated by potential changes in self-perceived utility. Moreover, Grossman considers health utility as a function of work productivity. Following his model, marginal benefits of health will decrease at retirement. A set of studies explore the properties of corner solutions (Galama & Kapteyn, 2011; Wolfe, 1985). Wolfe's analysis suggests that the health of older people has improved because of early retirement.⁵ Workers are taking greater advantage of a potentially more rewarding retirement by beginning it earlier. Health utility also depends on leisure productivity, meaning that the marginal benefit of health at retirement would increase. The leisure productivity could be the ability to be efficient in activities during the leisure time; sport, family interactions, volunteer activities, etc. This can have different impacts according to individual characteristics, perceptions of their health utility and of their occupation, both during working life and retirement. Thus, it could explain heterogeneous impact by occupational group, gender, education, hobbies, family structure, geographical area, country.

Lastly, changes in the depreciation rate and efficiency rate may change health. However, these parameters are not expected to change suddenly at retirement. They could change following a modification in retirement age (see the section below).

These mechanisms are not mutually exclusive. They are applicable together and could lead to ambiguous results. Moreover, all the health dimensions can interact. The effect of retirement on one of the health outcomes can impact the others. For example, an increase in cognitive impairment may impact abilities to walk and, consequently, deteriorate physical health.

2.2 | Modification in the retirement age

In the literature, the effect of retirement transition on health is measured using the discontinuity that exists at the threshold of retirement entitlement, whereas the reforms enable to identify the causal effect of retiring later or earlier on health. The pension reform increases or decreases the legal retirement age for a part of the population, independent of their health. Thus, it is possible to conclude that the remaining health differences between those who are affected and those not, are imputable to the modification in the retirement age.

The timing of retirement does not imply direct changes in the marginal cost and benefit of health investment. However, the duration spent in employment and in retirement changes the number of periods of time exposed to the marginal cost and benefit during the working life, respectively, during the retirement span. Thus, the inter-temporal health investment may change due to inter-temporal changes in the marginal cost and benefit.

A variation in health could be explained by the changes (i) in the efficiency of the health investment and (ii) in the depreciation rate of health both linked to the retirement timing modification.⁶ This could be the consequence of a variation in duration spent in employment and in retirement.

A change in retirement timing can change the depreciation rate of health, due to the variation in career length and the retirement duration. Two opposing mechanisms are involved. The first is related to the so-called physiological reserve hypothesis, that is, the idea that working requires

drawing on the physiological reserves. Thus, the longer an individual works, the worse their health gets (increase in depreciation rate and decrease of efficiency of investment). The second relies on the use-it-or-lose-it hypothesis, that is, the longer an individual works, the better their health is (decrease in depreciation rate and increase of efficiency of investment).

Moreover, a change in retirement timing changes, at a given age, the duration an individual spends in retirement. Previous studies documented changes in health-related behavior at retirement, that could change depreciation rate and the efficiency of the health investment. For example, Zins et al. (2011) show significant changes in alcohol consumption at retirement, Eibich (2015) shows a decrease in cigarette consumption, Barnett et al. (2012) show changes in physical activities, and, consequently, Godard (2016) shows changes in body mass index. There are changes in behavior at retirement (dietary, alcohol intake, cigarette consumption, and physical activities), but also changes in self-perceived age and utility. The expected direction of such variations is unclear and may vary with individuals. In the model of Galama, workers with higher human capital invest more in health, because they stay healthier, retire later than those with lower human capital whose health deteriorates faster.

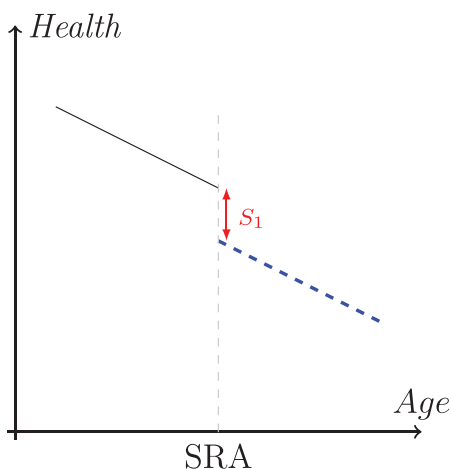
Finally, the switch from employment to retirement mostly affects health through a change in marginal cost and benefit, while a modification in retirement age mostly changes depreciation rate and efficiency of health investment. The modification in retirement timing could impact health through changes in inter-temporal marginal cost and benefit, consecutive to a change in the occurrence of the switch from employment to retirement.⁷

2.3 | Disentangling the monetary effects

The transition to retirement is generally accompanied by a decrease in income and shifting the retirement age leads to changes in inter-temporal income. It is therefore difficult to distinguish the effect of a decrease in income from the cessation of professional activity on health. When focusing on a modification of the career duration due to a reform, the income effect is difficult to isolate since the inter-temporal income is modified at the same time as the retirement age. Moreover, even when studying the same reform, according to data and empirical strategies, the measured effect is not always the same. For example, Bozio et al. (2021) measure the retirement effect of the 1993 French pension reform using the variation between cohorts and within cohort. The 1993 reform affects the income of each cohort in the same way but affects differently the claiming age (in the private sector). They isolate the impact of later retirement on mortality, purged from the income effect. Using the same reform but a different empirical strategy (a difference-in-differences [DiD] strategy between sectors and between cohorts), Blake and Garrouste (2019) find a negative effect of the reform on perceived health, imputable to both the effect of an increase in activity and an income effect.

The transition to retirement is sometimes accompanied by a change in healthcare coverage. In some cases, a reform affects several dimensions of the pension system simultaneously. Thus, it is often hard to differentiate from the impact of retirement and the impact of income or health insurance on health status. Moreover, this depends on the institutional framework of the country in question. Previous studies show the link between retirement decision and healthcare insurance (see French and Jones (2017) for a literature review). However, studies exploring the share of health consequences at retirement attributable to health insurance, to income drop, and other factors, are still scarce.

(a) Considering a decrease
at retirement



(b) Considering an
increase at retirement

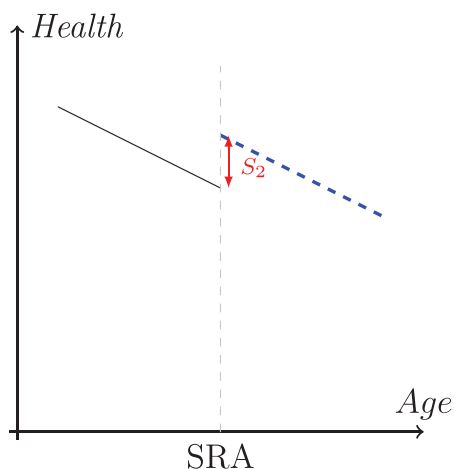


FIGURE 1 Impact of the switch from employment to retirement—reduced form. Figure 1(a) presents a decrease in health at the Statutory Retirement Age (SRA). Figure 1(b) presents an increase in health at the SRA [Colour figure can be viewed at wileyonlinelibrary.com]

Note: Blue dashed lines represent the health trend after retirement and black lines before retirement.

3 | METHODOLOGICAL CHOICES

3.1 | Institutional framework

The institutional framework is specific to each country and obviously affects the results. According to the country, people retire at different ages (see Figure B1), with different health insurance and with a pension which is more or less generous relative to the previous earnings. Thus, the conditions at retirement are not the same, and the differences relative to the working conditions are heterogeneous, leading to a heterogeneous magnitude of the shock. Differences in the replacement rate imply that the decrease in income due to retirement varies across countries. In fact, the replacement rate—measured in percentage of pre-retirement earnings—varies from 20% to 90% depending on the country (OECD, 2019).

3.2 | Choice of the identification strategy

The empirical strategy varies depending on the aim of the study.

3.2.1 | Instruments for studying the switch to retirement

Studies that focus on the health consequences of the switch to retirement compare individuals in the labour force, who are close to retirement, to those newly retired. This is represented in Figure 1 as the switch S . The usual econometric method to estimate S is an instrumental variable strategy.

Another method is the regression discontinuity design (RDD) or fuzzy regression discontinuity (FRDD). Among the papers selected, 25 use instrumental variable strategies and 12 use RDD or FRDD (see Figure B3 in Appendix B). Some studies use several thresholds, taking advantage of differences across countries or a change of threshold due to a reform, and measure the average switch. One could also be interested in how this switch varies with the legal age of retirement. One may think the drop can be lower or higher if the retirement age is 62 instead of 60. However, as far as we know, there is no study that documents this.

3.2.2 | Validity of age-relative incentives to retire as instrumental variables

Studies primarily use statutory retirement age as an instrumental variable. This enables the identification of the impact of the switch from employment to retirement on health, or very short-term effects of retirement on health. However, these strategies are not relevant to conduct a dynamic analysis (Coe et al., 2012), that is, studying mid-term and long-term effects of retirement on health.⁸ Moreover, the validity of this instrument is questionable as individuals may anticipate their retirement. It is possible that they disinvest in health before retiring and that studies underestimate the effect of retirement on health.⁹ To address this issue, it is possible to use the workers' retirement anticipation.¹⁰

In addition, the identification strategy of many papers leads to the estimation of a local average treatment effect among the compliers, those who switch from employment to retirement when they reach the legal retirement age. This excludes those who had to stop working earlier due to severe health problems and who used disability insurance or unemployment as a pathway to retirement (Inderbitzin et al., 2016; Staubli & Zweimüller, 2013). This means that the retirement effects on health may be underestimated.

3.2.3 | Instruments for studying the impact of later retirement

Researchers focusing on the impact of a change in retirement timing use reforms that change the retirement age threshold or variation of retirement age across countries. They measure the difference $\Delta_1 - \Delta_2$ (see Figure 2). It is the difference in health trends between those still working and affected by the reform and those retired and not affected. Some studies measure the difference between the blue and black lines at each age, instead of the difference in leading coefficient (Δ) of the blue and black lines. The most usual methods are instrumental variables (IV) strategy in a two-stage least square (2SLS) regression and DiD design. Among the papers on the impact of later or earlier retirement, 9 out of 17 use 2SLS and 5 use DiD (see Figure B3 in Appendix B). In a similar framework, one could also measure the impact of earlier retirement on health, as represented in Figure 3.

3.3 | Time horizon

The time horizon under consideration has also an influence on the choice of the estimation strategy. Studies using the discontinuity at retirement consider short-term effects (Fitzpatrick & Moore, 2018), while the use of pension reforms often enables to observe the effects of a change in the retirement age in the long run, that is, once there is enough perspective. Atchley (1976,

(a) Deteriorate the Trend

(b) Ameliorate the Trend

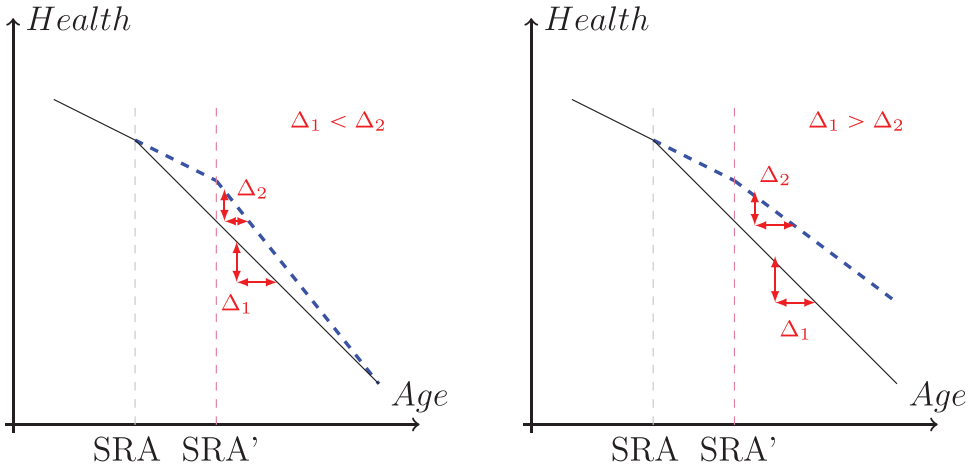


FIGURE 2 Impact of later retirement—reduced form. Figure 2(a) presents a higher health decline ($\Delta_2 > \Delta_1$) due to later retirement. Figure 2(b) presents a lower health decline due to retirement ($\Delta_2 < \Delta_1$) [Colour figure can be viewed at wileyonlinelibrary.com]

Notes: These figures represent the change in trend due to later retirement, assuming the absence of switch (*S*) in health at retirement. This assumption enables to simplify the graphical representation. Blue dotted lines illustrate health trends for those retiring at age *SRA'* and black lines illustrate health trends for those retiring at age *SRA*.

(a) Deteriorate the Trend

(b) Ameliorate the Trend

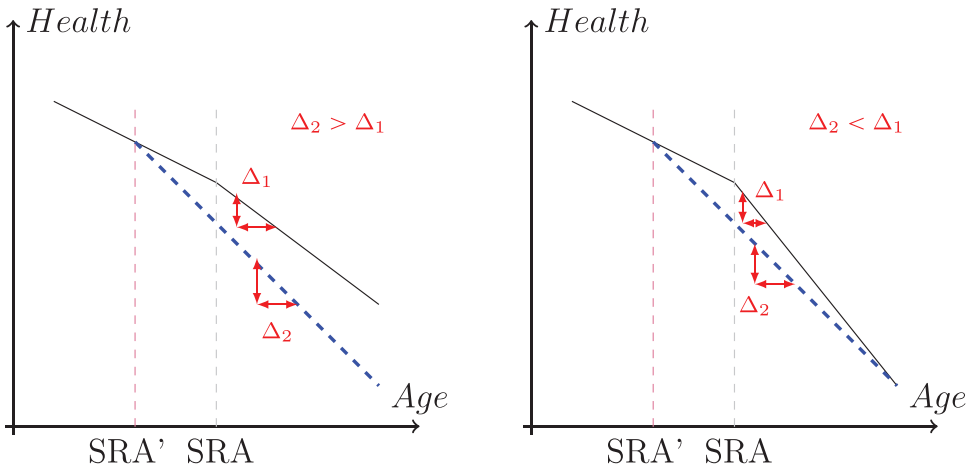


FIGURE 3 Impact of earlier retirement—reduced form. Figure 3(a) presents a higher health decline ($\Delta_2 > \Delta_1$) due to earlier retirement. Figure 3(b) presents a lower health decline due to earlier retirement ($\Delta_2 < \Delta_1$) [Colour figure can be viewed at wileyonlinelibrary.com]

Notes: These figures represent the change in trend due to earlier retirement, assuming the absence of change in health status at retirement. This assumption is chosen to simplify the graphical representation. Blue dotted lines illustrate health trends for those retiring at age *SRA'* and black lines for those retiring at age *SRA*.

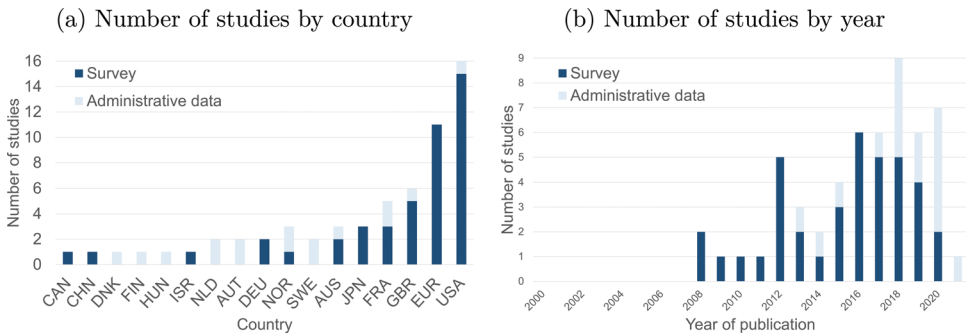


FIGURE 4 Description of data used in the selected studies. Figure 4(a) shows the distribution of the studies by country distinguishing the type of data used (administrative or survey data). Figure 4(b) shows the distribution by year of publication and type of data

[Colour figure can be viewed at wileyonlinelibrary.com]

Notes: Papers on the causal impact of retirement on health published in peer-reviewed journals between 2000 and 2021, working papers for mortality and healthcare consumption (51 papers). The total number of studies in both Figures exceed 51 papers because some papers (relying on the data of several countries or several kinds of data) are counted more than once.

1982) has suggested that retirees may experience a honeymoon phase after retirement, that is, a period in which the individuals engage in activities that they have put off for years because of work-related constraints.

Then, following this, retirees may experience a disenchantment stage, realizing that with a lower income, they have to adjust their lifestyle. The last step is a stability one. This theoretical framework is insightful to explore the dynamics of health effects of retirement. However, most of the available data does not allow to implement a convincing empirical strategy to identify the time horizon of retirement on health. Thus, the inter-temporal approach is most of the time left out in the empirical literature. One of the rare studies describing an age trend of health by work history is Kerkhofs and Lindeboom (1997). They describe the difference in trend for individuals (i) working from 44 to 65 and then retire; (ii) retire at an early retirement age (55 years old) and (iii) retire at age 65, but after experiencing unemployment from age 44. It emphasises differences in health level and trend, without information on the causality of retirement timing on these differences between individuals.

3.4 | Data and variables of interest

3.4.1 | Data

Data used are mostly time panel data (46 over the 51 papers included) instead of cross-section data. Data mostly derive from surveys, counting for 41 over 51 of the studies. For two decades, there has been a convergence in survey panel data on ageing, retirement, and health. Thus, similar studies emerge enabling to document the impact of retirement on health in various countries, as shown in Figure 4a. HRS in the United States is comparable to MHAS in Mexico; ELSA in the United Kingdom; SHARE in Europe; CRELES in Costa Rica; KLoSA in Korea; JSTAR in Japan; TILDA in Ireland; CHARLS in China, and LASI in India.¹¹ These surveys provide very rich information, including a large range of socio-economic variables. However, these data have three drawbacks. First, they have selection biases on who answers. Second, there is an attrition bias in the case of

panel surveys.¹² Third, answers are subject to declarative bias. Most of the time, the sample size is approximately 20,000 individuals in the raw data.¹³ Administrative data appears in many recent studies, as shown by Figure 4b. These studies are often presented as a solution to the previously mentioned drawbacks and especially the sample size limitation. However, there is a limited set of control variables available. Since control variables play a role in defining what is measured, the results from administrative data are rarely comparable to those of the survey data.

3.4.2 | Retirement definition and control variables

Claiming age and retirement age are different. Most of the time, studies using administrative data have information on claiming age while those using survey data have information on retirement age. Nishimura et al. (2018) explore how definitions and methods can explain differences in results. They replicate results from previous studies and change retirement definition (not work for pay vs. self-reported retired), method (fixed effect vs. instrumental variable), control variables (age, gender, and education vs. age and gender). They show that a change of retirement's definition does not affect the results. However, the impact of retirement on health might change with the age threshold. Studies focus on the impact of retirement at ages that vary from 53 to 67 (see Figure B2 in Appendix B).

Results are sensitive to the method and control variables. Most of the studies using administrative data use very few control variables (age, gender, marital status). Thus, the measured effect is an average effect along the population, without controls for confounding factor, or heterogeneity. Control variables are not only important to measure an effect *all other things being equal*. For example, Bingley and Martinello (2013) show the importance of schooling control in cross-country studies. They show that this control is necessary to insure the validity of the instrument.

3.4.3 | Choice of health measures

The main health outcomes studied in the literature can be classified into nine categories: mortality; healthcare utilization; self-reported health; depression and anxiety; cognitive abilities; physical health; pathologies; global health index; and health behavior. Tables 1 and 2 present health measures available and health outcomes used in the literature (see Appendix A for the health outcomes' definitions). It includes papers on the causal impact of retirement on health. For each of the nine health outcomes categories, there are differences between studies in health definition. These differences come from the available measure of health in the data, and the transformation of these measures researchers choose to exploit. While prior literature has usually considered the effects of retirement on specific outcomes, Rose (2020) examines the full range of health-related outcomes with administrative and survey data in a unified context. The author shows that the choice of health measure matters when looking at the effect of retirement on health.

4 | CONSENSUAL RESULTS

In this section, we present empirical results from studies examining the causal links. We distinguish three effects on health outcomes: the transition from employment to retirement; lengthening the retirement age; and reducing the retirement age. Then, studies are difficult to compare

TABLE 1 Health outcomes used (first part)

Authors	Health measure in the raw data	Variable used in the study
MORTALITY		
Coe and Lindeboom (2008), Hernaes et al. (2013), Hallberg et al. (2015), Bloemen et al. (2017), Hagen (2018), Zulkarnain and Rutledge (2018), Kuhn et al. (2020), Nielsen (2019), Bozio et al. (2021)	Death register	Death probability before a given age (see Table C1)
Fitzpatrick and Moore (2018), Rose (2020)	Death register	count of deaths
HEALTHCARE CONSUMPTION		
Coe and Zamarró (2015), Eibich (2015), Biró (2016), Gorry et al. (2018), Lucifora and Vigani (2018), Shai (2018), Zhang et al. (2018), Rose (2020)	Self-reported	Number of doctor visits, days in hospital, spendings for all care
Hallberg et al. (2015), Biró and Elek (2018), Hagen (2018), Nielsen (2019), Frimmel and Pruckner (2020), Grøtting and Lillebø (2020), Perdrix (2020)	Administrative register	Number of doctor visits, days in hospital, spendings for all care
SELF-REPORTED HEALTH		
Dave et al. (2006), Atalay and Barrett (2014)	US-Scale	= 1 if poor
Neuman (2008)	US-Scale	= 1 if improved or unchanged
Neuman (2008)	Self-reported	Health change $\in [1, 5]$
Johnston and Lee (2009), Coe and Zamarró (2011), Hessel (2016), Messe and Wolff (2019b), Rose (2020)	EU-Scale	= 1 if bad or very bad
Behncke (2012), Zhu (2016)	US-Scale	= 1 if fair or poor
Latif (2012), Calvo et al. (2013), Gorry et al. (2018)	US-Scale	Variable $\in [1, 5]$
Eibich (2015), Messe and Wolff (2019a)	EU-Scale	Variable $\in [1, 5]$
Blake and Garrouste (2019)	Duke index	$\in [0; 100]$
DEPRESSION		
Neuman (2008), Behncke (2012), Calvo et al. (2013), Rose (2020)	CES-D $\in [0, 8]$	Variable $\in [0, 8]$
Coe and Lindeboom (2008)	CES-D $\in [0, 8]$	= 1 if CES-D ≥ 4
Coe and Zamarró (2011), Heller-Sahlgren (2017)	EURO-D	Variable $\in [0, 12]$

(Continues)

TABLE 1 (Continued)

Authors	Health measure in the raw data	Variable used in the study
Coe and Zamarro (2011)	Self-reported	Feeling depressed last month.
Atalay and Barrett (2014)	Anxiety, mood disorders, high stress, depressive disorders.	
Fonseca et al. (2015)	CES-D $\in [0, 8]$	= 1 if CES-D ≥ 3
Zulkarnain and Rutledge (2018), Kuusi et al. (2020)	Antidepressant use	
Blake and Garrouste (2019)	Duke index	
COGNITIVE ABILITIES		
Rohwedder and Willis (2010), Coe and Zamarro (2011), Bonsang et al. (2012), Coe et al. (2012), Mazzonna and Peracchi (2012), Bingley and Martinello (2013), Atalay et al. (2019), Rose (2020)	Memory	Immediate and delay recall from 0 to 20
Behncke (2012)	Problem with cognitive function	
Coe et al. (2012)	Self-rated memory	
Celidoni et al. (2017)	Probability of having a decline higher than 20% at the memory test.	
Kajitani et al. (2017)	Respondent's address, date and day of the interview, respondent's mother's maiden name, name of the current and previous Prime Minister, respondent's date of birth and age, ability to continuously deduct 3 from 20.	
Mazzonna and Peracchi (2017)	Cognitive index based on a principal component analysis of memory, verbal fluency, and numeracy.	
Rose (2020)	Verbal fluency	72-score

Note: This Table includes all articles on causality between retirement and health published after 2000. The outcome name used in this survey is not always the one chosen in the original paper. For example, Rose (2020) defines as "recall score" the memory score because of another outcome called memory in his paper. In this paper, we define "memory" as the immediate and delayed recall.

TABLE 2 Health outcomes used (second part)

Authors	Outcome used
PHYSICAL HEALTH	
Bound et al. (1999), Neuman (2008), Behncke (2012) Neuman (2008)	Activity daily living (ADL) and instrumental activity daily living (IADL) limitations. Muscle functions
Neuman (2008)	Mobility index from 0 to 5
Coe and Lindeboom (2008), Rose (2020)	Number of ADL
Hessel (2016), Rose (2020)	Having limitations
Blake and Garrouste (2019)	Duke index
PATHOLOGIES	
Coe and Lindeboom (2008)	High blood pressure, diabetes, cancer, heart attack
Neuman (2008)	High blood pressure, diabetes, cancer, lung disease, heart problems, strokes, psychiatric problems, arthritis
Johnston and Lee (2009)	Hypertension, asthma, heart condition, diabetes, arthritis
Behncke (2012)	Angina, heart attack, stroke, diabetes, arthritis, cancer, high C-reactive protein, high fibrinogen, low hemoglobin
Atalay and Barrett (2014)	Hypertension, migraine, back pain, disc disorder, heart condition
Hessel (2016)	Dummy equal one if having at least one chronic condition
Rose (2020)	Blood test, cholesterol
Kuusi et al. (2020)	Cardiovascular and musculoskeletal conditions
HEALTH INDEX	
Johnston and Lee (2009)	GHQ-12 (12 questions about mental health)
Coe and Zamarro (2011)	Following Bound (1999): index from regression: $a+b*(L)+u$, with L = number of ADL, IADL, chronic diseases, mobility limitation, body mass index (BMI)

(Continues)

TABLE 2 (Continued)

Authors	Outcome used
Insler (2014)	High blood pressure, diabetes, cancer, lung and heart problems, stroke, psychological problem, arthritis, obese
Eibich (2015)	SF-12 physical health and SF-12 mental health
Zhu (2016)	SF-36 (22 questions about physical health and 14 about mental health)
Blake and Garrouste (2019)	Duke index
Rose (2020)	Number of health problems reported
HEALTH-RELATED BEHAVIOR	
Johnston and Lee (2009)	Body mass index
Lee and Smith (2009)	Smoking, regular exercise
Bonsang and Klein (2012)	Life satisfaction. From 0 “totally unhappy” to 10 “fully happy”. Computed from questions on satisfaction with health, household income, free time
Atalay and Barrett (2014)	Overweight, smoking, low exercise level
Eibich (2015)	Smoking, drinking, physical activities, health conscious diet, sleep duration, body mass index
Fonseca et al. (2015)	Life satisfaction on a scale from 1 to 5
Ayyagari (2016)	Smoking
Godard (2016)	Overweight and obesity (computed from body mass index)
Motegi et al. (2016)	Smoking, drinking, light and heavy exercise, walking, sleeping time
Zhao et al. (2017)	Smoking, drinking
Rose (2020)	Smoking, drinking, physical exercise

Note: This Table includes all articles on causality between retirement and health published after 2000.

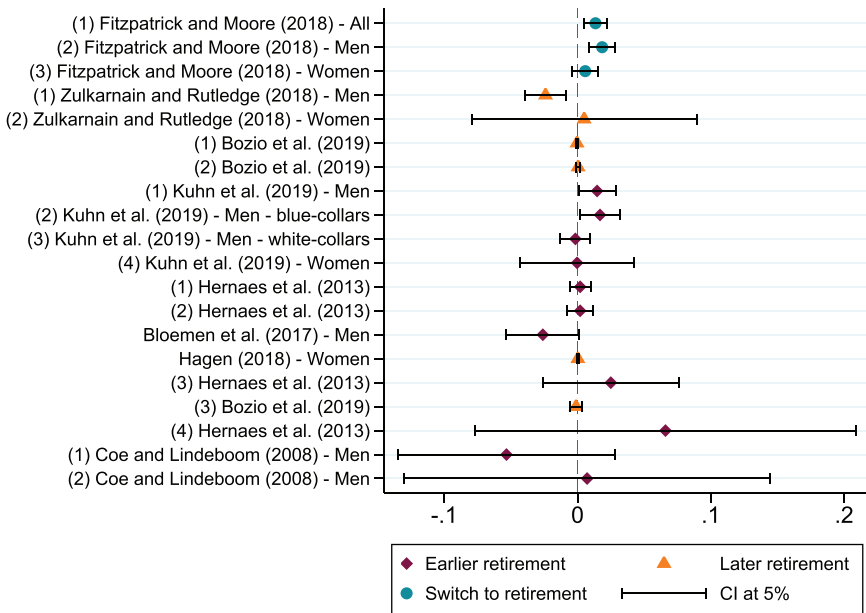


FIGURE 5 Impact of retirement on mortality

[Colour figure can be viewed at wileyonlinelibrary.com]

Notes: Bozio et al. (2021). Figure 5 shows the estimated effects of retirement on mortality, distinguishing estimates at the retirement age threshold (blue circles), a decrease in retirement age (red squares), and an increase in retirement age (orange triangles). They are classified according to the size of the sample, from the largest sample at the top, to the smallest at the bottom. We do not include Rose (2020) due to a different mortality rate computation. Bozio et al. (2021) measure the causal impact of later retirement and find a non-significant impact between ages 61 and 65—see row (3), between ages 65 and 72—see row (1), and between ages 72 and 79—see row (2). Coe and Lindeboom (2008) measure the effect of early retirement on the probability to die within 4 years—see row (1), within 6 years—see row (2). Hernaes et al. (2013) find a non-significant impact of early retirement by age 67—see row (1), by age 70—see row (2), by age 74—see row (3), and by age 77—see row (4). See Table C1 for more details.

because they do not define health in the same way, using measures of physical health, depression, health behavior, pathologies, or aggregate health indices. However, the following indicators seem comparable from one study to another: mortality, healthcare consumption, self-reported health, and cognitive functioning. We show the comparison between studies highlighting the three causal effects on health. We report the point estimates and the confidence intervals, and comparable measures of health (see Figures 5–8). However, the differences between studies should always be carefully interpreted.

4.1 | Non-significant effect on administrative measures of health

Mortality and pathologies are the two most usual administrative measures of health.¹⁴ The literature mainly shows that the switch from employment to retirement and delayed retirement have no significant impact neither on mortality nor on the likelihood to develop pathologies.

Figure 5 shows the point estimates of the studies on the causal impact of retirement on mortality.¹⁵ Coe and Lindeboom (2008), Hernaes et al. (2013), and Nielsen (2019) show no significant impact of an earlier retirement on mortality in the United States, in Norway, and in Denmark. Studies focusing on particular sub-populations, however, find different results. Thus, Hallberg

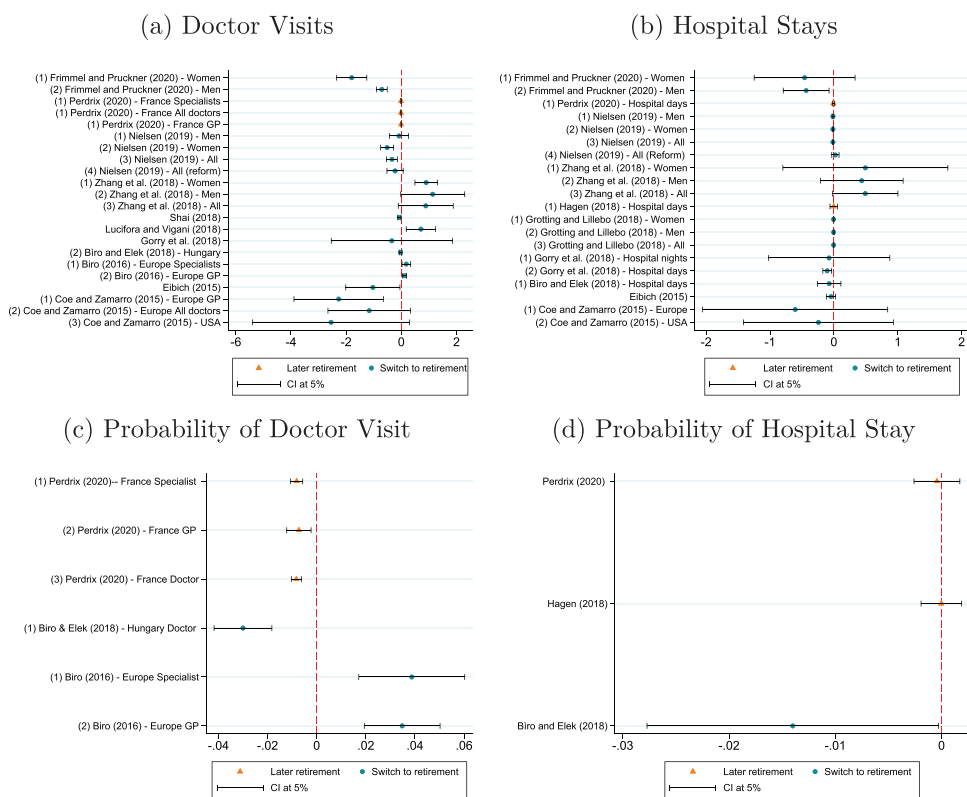


FIGURE 6 Impact of retirement on healthcare consumption

[Colour figure can be viewed at wileyonlinelibrary.com]

Notes: Figure 6 shows the estimated effects on medical visits - see Figure 6(a) - hospital stays - see Figure 6(b) - the probability of medical visits - see Figure 6(c) and the probability of hospitalization - see Figure 6(d), distinguishing between estimates at the retirement age threshold (blue circles) and an increase in retirement age (orange triangles). They are classified according to the size of the study sample, from the largest sample at the top, to the smallest at the bottom. Hallberg et al. (2015) is the only study on the impact of earlier retirement on healthcare consumption. They focus on hospital stays among women, and find a negative impact between -5 and -10 depending on specification, with large confidence interval (between -15 and -0.5).

et al. (2015) and Bloemen et al. (2017) show a decrease in mortality among military officers in Sweden and among the male civil servants in the Netherlands, respectively, and Kuhn et al. (2020) find an increase in mortality among blue-collar men in Austria.

Other studies focus on the impact of later retirement. Hagen (2018) and Bozio et al. (2021) find no significant impact, respectively, among women civil servants in Sweden and in the private sector in France. These effects are precisely estimated, thanks to exhaustive administrative data. Zulkarnain and Rutledge (2018) show a decrease in death probability in the Netherlands due to later retirement among men. Finally, Fitzpatrick and Moore (2018) show a discontinuity in the number of deaths at retirement in the United States for men but not for women. Rose (2020) finds a non-significant increase in mortality at retirement in the UK (see Table C1 in Appendix C).

Most of the studies on pathologies find a non-significant impact. Coe and Lindeboom (2008) find no significant effect of earlier retirement on high blood pressure, diabetes, cancer, and heart attacks in the United States. Analyzing men and women separately, Hessel (2016) and Neuman (2008) also find no significant effect on chronic conditions at retirement respectively in Europe and in the United States, controlling at least for gender, age, marital status, education, and income.

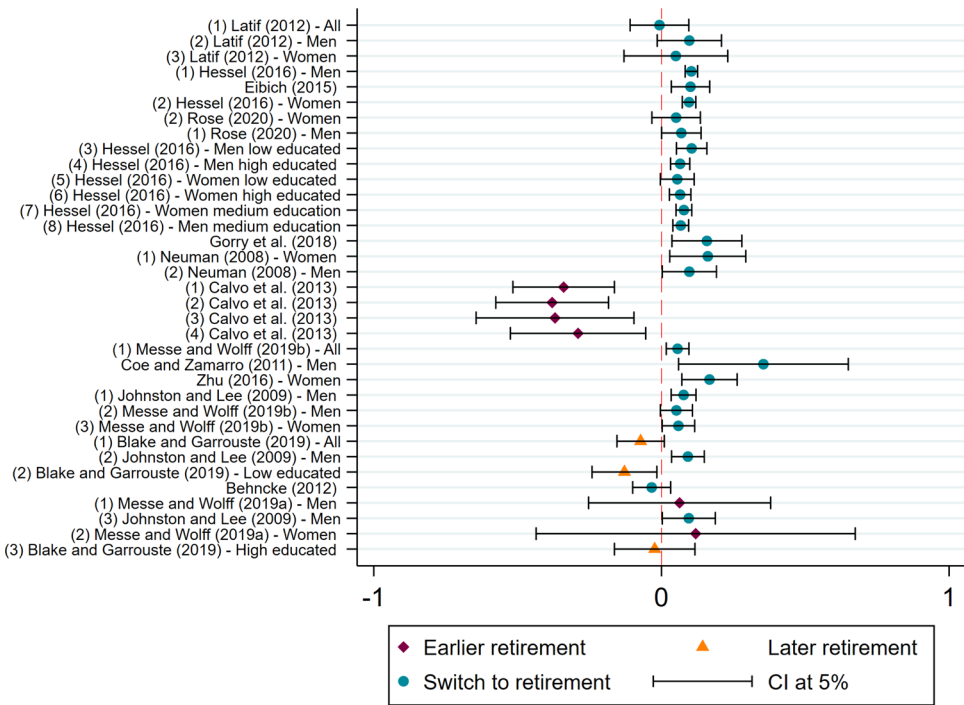


FIGURE 7 Impact of retirement on self-reported health

Notes: Figure 7 shows the estimated effects on self-reported health, distinguishing between estimates at the retirement age threshold (blue circles), a decrease in retirement age (red squares), and an increase in retirement age (orange triangles). They are classified according to the size of the study sample, from the largest sample at the top, to the smallest at the bottom. Studies of the impact of going from working to retirement show a positive or non-significant effect.

[Colour figure can be viewed at wileyonlinelibrary.com]

Atalay and Barrett (2014) find that later retirement decreases the probability of having migraines, hypertension, and back pain in Australia among women, but not among men.

4.2 | Decrease in healthcare consumption

Figure 6 shows results on healthcare consumption.¹⁶ Most of the studies on the impact of the switch from employment to retirement find a decrease in doctor visits (Bíró & Elek, 2018; Coe & Zamarro, 2015; Eibich, 2015; Frimmel & Pruckner, 2020; Nielsen, 2019; Shai, 2018). Few studies find a non-significant impact (Gorry et al., 2018; Nielsen, 2019; Rose, 2020). As far as we know, only three studies find an increase in doctor visits (Lucifora & Vigani, 2018; Zhang et al., 2018). They argue that this result is owing to a large opportunity cost of time. Most of the studies on the impact on hospital stays find either a decrease or a non-significant impact.

Since there is no change in the number of pathologies at retirement, one may question the origin of this decrease at retirement. Some argue that there is a health improvement; others think that it is due to administrative medical visits an employee has during the working life (Bíró & Elek, 2018; Nielsen, 2019). Others argue that doctor visits are not only a consequence of health status but may be a cause to declare a particular health status (e.g., if individuals are aware of their

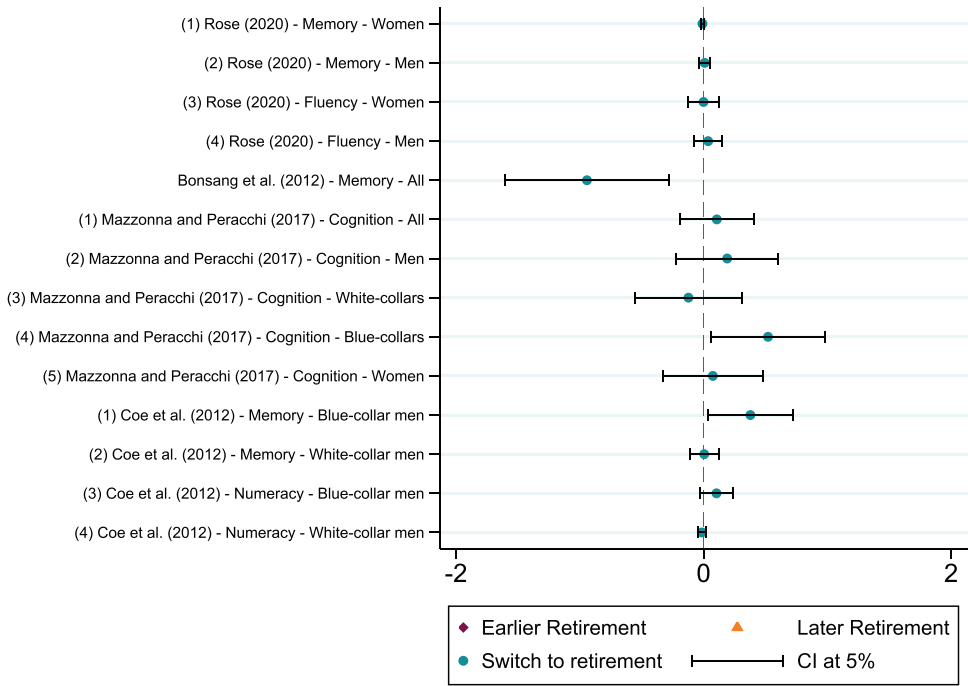


FIGURE 8 Impact of retirement on cognitive abilities
 [Colour figure can be viewed at wileyonlinelibrary.com]

Notes: Figure 8 shows the estimated effects on cognitive abilities, distinguishing between estimates at the retirement age threshold (blue circles), a decrease in retirement age (red squares), and an increase in retirement age (orange triangles). They are classified according to the size of the study sample, from the largest sample at the top, to the smallest at the bottom. Several studies are missing: Bingley and Martinello (2013) due to the different aim of their study (they find a significant negative impact on cognitive abilities); Coe and Zamarro (2011) due to large standard errors; Rohwedder and Willis (2010) due to their macro-economic framework (they find a negative effect); Behncke (2012) due to very different definition of the outcome (significant increase of problem with cognition). Mazzonna and Peracchi (2017) distinguish the individuals employed in highly demanding jobs (that we called “blue-collars”) from those employed in very low demanding jobs (that we called “white-collars”).

pathologies mainly through doctor visits). Finally, the decrease found in healthcare consumption needs to be resonated with studies on other health outcomes like self-reported health, physical and cognitive health.

4.3 | Improvement in self-reported health and decrease in depressive symptoms

Figure 7 presents the point estimates on self-reported health.¹⁷ All studies find that the switch to retirement increases self-reported health (Coe & Zamarro, 2011; Eibich, 2015; Hessel, 2016; Johnston & Lee, 2009; Messe & Wolff, 2019b; Zhu, 2016).¹⁸ Studies on the impact of later retirement on self-reported health show mainly non-significant impact (see Table C3 in Appendix C). This non-significant impact can dissimulate heterogeneous effects (Blake & Garrouste, 2019).

Some studies construct health index based on several health dimensions. Blake and Garrouste (2019) find that later retirement decreases the Duke index among the less educated.¹⁹ Coe and Zamarro (2015) find a decrease in the index of Bound et al. (1999). Johnston and Lee (2009) find

a decrease of GHQ12 among men without diploma. Zhu (2016) finds a decrease of SF-36 among women. There is only one study using a health index that does not conclude that there is a significant decrease. Eibich (2015) finds no significant effect at the retirement discontinuity on health measured through SF-12.

Studies on the causal impact of retirement on depression are consistent (see Table C4 in Appendix C). Thus, all studies show either that retirement causes significantly less depression (Atalay & Barrett, 2014; Calvo et al., 2013) or that there is a non-significant effect of retirement on depression (Atalay & Barrett, 2014; Behncke, 2012; Blake & Garrouste, 2019; Coe & Lindeboom, 2008; Coe & Zamarro, 2011; Fonseca et al., 2014; Heller-Sahlgren, 2017; Neuman, 2008; Zulkarnain & Rutledge, 2018). Rose (2020) finds a decrease among women but not among men.

4.4 | Heterogeneous impacts on cognitive abilities and physical health

Figure 8 presents the point estimates only for the most comparable studies (see also Table C5 in Appendix C). Almost all studies show a decrease in immediate and delayed memory due to retirement (Behncke, 2012; Bingley & Martinello, 2013; Bonsang et al., 2012; Kajitani et al., 2017; Rohwedder & Willis, 2010) or a non-significant impact (Coe et al., 2012; Mazzonna & Peracchi, 2017; Rose, 2020). Moreover, Mazzonna and Peracchi (2012, 2017) show a negative impact of the duration spent in retirement on cognitive abilities. Celidoni et al. (2017) find that retirement is beneficial, but can be detrimental to cognition later.

However, there are heterogeneous effects by occupational groups and gender. Coe et al. (2012) find an increase in memory at retirement for blue-collar men in the United States and a non-significant impact for white-collar men. Mazzonna and Peracchi (2017) find an increase in cognition for individuals employed in highly physically demanding jobs and non-significant effects for those employed in very low physically demanding jobs (see Figure 8, blue collars vs. white collars). All the same, Kajitani et al. (2017) show that the cognitive decline is slower for individuals who had jobs requiring complex interaction with data.

Comparison of studies on the causal impact of retirement on physical activities should be interpreted with caution since the measure of physical health diverges from one study to another. Behncke (2012) finds an increase in the number of difficulties with activity daily living (ADL), while Coe and Lindeboom (2008), Rose (2020) find no significant effect on the number of ADL, respectively, among American men and English men and women. Neuman (2008) finds a significant increase in ADL limitations among women but not among men. Using other measures of physical health, Behncke (2012) finds an increase in difficulties with walking and hearing, and of metabolic syndrome in the United Kingdom. However, Neuman (2008) finds no significant impact on major muscle functions and mobility. Hessel (2016) shows that retirement decreases the probability of reporting functional limitations among both men and women.

5 | CONCLUSION

This paper provides a comparison of studies on the impact of retirement on health. We detail previous studies per outcome making a distinction between switching to retirement and earlier or later retirement. We highlight that the results are not as contradictory as would seem. Studies show that retirement leads to a decrease in healthcare consumption, an increase in self-reported health and a cognitive decline. Most of the studies show that later retirement has no impact

neither on mortality nor on pathology. Considering this absence of effect, one may also expect a non-significant impact on healthcare consumption. However, studies on healthcare consumption show a decrease of doctor visits and drug consumption (for men but not for women). The reason for this decrease could be due to various channels, one of which is the frequently quoted health changes. Studies show no significant impact of later retirement on self-reported health. Studies find a decrease or a non-significant impact on depression, raising the question of whether this is due to a lack of statistical power or an absence of effect. Studies on the impact of an earlier retirement are scarce due to few natural experiments exploiting such a variation. The literature highlights the existence of heterogeneous effects, mainly according to occupation and gender. The effects are rarely significant for women, and retirement would be beneficial for physical and cognitive health of blue-collar workers and those less educated. However, there are still few studies focusing on the heterogeneity by education and working group, and more research on this question would be necessary to build conclusive statement. One other interesting aspect recently discussed in the health-retirement literature is to test the existence of spillover effects on the spouses' health (Bertoni & Brunello, 2017; Messe & Wolff, 2019b; Müller & Shaikh, 2018; Picchio & Ours, 2020). Assessing this effect matters to conduct a cost–benefit analysis of pension reforms.

To conclude, the results are relatively consensual. However, at least three elements could complete the literature. First, studies on the impact of retirement on physical health being very hard to compare, the results need to be harmonized to fully understand the source of these differences (country, health measure, heterogeneity, etc.). Second, studies finding non-significant impact do not distinguish between the absence of effect and the inability to detect an effect, except for Bozio et al. (2021). It would be useful to provide computation of minimum detectable effects to determine at which point the lack of statistical power can be related to sample size limitation. Third, only a few recent studies point out the large heterogeneity in the effect. This question should be explored further.

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ENDNOTES

- ¹ We distinguish this effect from the previous one since it is not necessarily symmetrical.
- ² We added working papers for studies on mortality and healthcare consumption. These two outcomes have been of a very recent interest (partly due to the new availability of administrative data).
- ³ The efficiency of the health investment is not included in Grossman (1972) but in Galama et al. (2013). It is defined as the efficiency of health investment to improve health. It is assumed to decrease with age.
- ⁴ Grossman (1972) assumes that the last parameter is exogenous, whereas Ried (1998) relaxes this assumption and proposes a Grossman's model with endogenous depreciation rate of health.
- ⁵ The context of Wolfe's study is a bit different from the current one, since the retirement age was decreasing (between 1960 and 1980 in the United States).
- ⁶ Bíró and Elek (2018), for example, claim that the health consequences of behavioral changes at retirement may only appear after a while. Therefore, retirement cannot lead to a sudden health change through this channel.

- ⁷ Changing the retirement age can have an impact on the employment–retirement transition. Lengthening or shortening the career leads to changes in the occurrence of behavioral changes, such as smoking, alcohol consumption, or physical activity. These factors could explain the differences in health status (between those who are affected by the reform and those not) after a few years of retirement.
- ⁸ The identification of mid-term and long-term effects of retirement on health requires an instrumental variable that varies both within and between cohorts to disentangle the effect of the time spent at retirement from that of ageing.
- ⁹ Especially, the difference between the effective and the desired amount of work is detrimental to health (Bassanini & Caroli, 2015).
- ¹⁰ Haider and Stephens (2007) use workers' subjective beliefs about their retirement dates as an instrument for retirement. After demonstrating that subjective retirement expectations are strong predictors of subsequent retirement decisions, they find a consumption decline on retirement for workers who retire when anticipated. However, their estimates of this consumption decrease are about a third less than those who rely on the instrumental variables' strategy used in prior studies.
- ¹¹ A harmonized version of all these data is available on Gateway to Global Aging data.
- ¹² Selection bias of who stays from one wave to another in the sample.
- ¹³ See Table B1 in Appendix B for the exact number of observations from 2004 in the three largest aging surveys (SHARE, HRS, and ELSA).
- ¹⁴ Pathologies can come both from administrative data and survey data. In most of the studies, individuals report pathologies diagnosed by a medical practitioner. In this case, the self-report measure derives from an administrative measure.
- ¹⁵ Table C1 details the country, method, and results for each study.
- ¹⁶ Table C2 sums up studies on the impact of retirement on healthcare consumption (in particular, doctor visits, hospital stays, and drug consumption).
- ¹⁷ Table C3 sums up studies on the causal impact of retirement on self-reported health.
- ¹⁸ See also Apouey et al. (2019), Atalay and Barrett (2014), Behncke (2012), Coe and Lindeboom (2008), Latif (2012), Rose (2020) find no significant impact. Rose (2020) finds a significant increase only among women.
- ¹⁹ However, it is difficult to distinguish this effect from an income effect.
- ²⁰ Computation of the authors, using SHARE, wave 1, 2004/05.
- ²¹ Answer to "On a scale from 1- very good to 8- very poor, how do you rate your health?"
- ²² For example, "I have the feeling to be as good as the others."

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APPENDIX A: DEFINITION OF HEALTH OUTCOMES

A.1 | Mortality

Mortality is the most homogeneous health outcome since it is similar in all countries studied. However, this measure is not anymore perfectly comparable once considering death by cause. Indeed, the method used to fulfill death certificate changes from one country to another. It can affect the prevalence of cause of death. It also affects the share of unknown cause of death which differs from one country to another. Most of the studies use death probability at a given age. As far as we know, only two studies use a death count instead of the probability (Fitzpatrick & Moore, 2018; Rose, 2020).

A.2 | Healthcare consumption

Healthcare consumption includes two types of measures: self-reported healthcare consumption, and administrative record of healthcare consumption. The first one is subject to declarative and memory bias, while the second differs from one country to another due to differences in care covered by the health insurance system.

A.3 | Self-reported health

Self-reported health came from two main measures: the US scale and the European scale. Both are a five-scale answer to “how do you assess your health in general”. In the US scale, the possible answers are “excellent”, “very good”, “good”, “fair” and “bad” while the European one has the answers “very good”, “good”, “fair”, “poor” and “very poor”. The European survey SHARE is one of the rare surveys that ask both questions. It shows that 43% of individuals that answer “very good” in the EU scale report “excellent” in the US scale while 47% report “very good”.²⁰ However, 90% of those who answer “very bad” at the EU scale answer “poor” at the US scale and 9% answer “fair”. All the same, 94% of those who respond “bad” in the EU scale also respond “fair” or “bad” in the US scale. It highlights that the use of a discrete variable from 1 to 5 is probably not comparable between US and EU scales. However, a dichotomous variable equal to 1 if the individual declares the worse health status cannot be comparable to a dichotomous variable equal to 1 if the individual declares one of the two worse health status. Other studies sometimes used others measures like the Likert 8-scales,²¹ self-reported change in health, or Duke index.

A.4 | Depression

Depression relies on three types of measures. The first one is the CES-D scale from 0—no depressive symptom to 60—severe depression. The score is computed from the answer to 20 questions on self-confidence,²² confidence with past and future, well-being feelings, loneliness. The possible answers to all these questions are “never”, “rarely”, “sometime”, “often”, “very often”, “every time”. A simplified version of the CES-D scale, using eight questions with two possible answers per question also exists. The second one is the EURO-D scale, a 12 questions scales. It includes questions on happiness, depression, hope for future, suicidal feelings, guilty feelings, sleeping trouble, no interest in things, fatigue, concentration, fearfulness. The third one relies on administrative measures like antidepressant use.

A.5 | Cognition

Depression and cognitive abilities are sometimes called “mental health”. It is a misnomer that may create confusion between different measures. Studies on cognitive abilities used four measures: memory, verbal fluency, numeracy, and orientation. Most of the time, memory is measured through the number of words over a list of 10 words that an individual has to repeat just after (immediate memory) and after 10 min (delayed memory). Verbal fluency is measured through the number of animals an individual can list in one minute. Numeracy is measured through the ability an individual has to compute from 100 to 0 subtracting 7 by 7. Orientation in time is measured through the answer to questions on the actual year, month, day, season.

A.6 | Physical health, pathologies, health index, and health behavior

Measures of physical health, pathology, health index, and health behavior are not standardized. Table 2 shows there is almost one definition per paper. **Physical health** includes functional limitation, activity daily living (ADL) and instrumental activity daily living limitation (IADL), grip

strength. Functional limitations include difficulties to reach its arm above shoulders, difficulties with stairs climbing, and with carrying a bag over 5 kg. ADL includes difficulties with eating, dressing, bathing, getting in and out of bed, going to the toilet. Instrumental activity living (IADL) includes difficulties with taking its drugs, dealing with administrative tasks, going shopping, giving a phone call, taking by its own transports, cleaning the house, preparing a meal. **Health index** relies on SF-12, SF-36, GQH, or computation of several health measures by the authors. Syse et al. (2017) show that retirement is associated with a higher probability to report a physical health improvement (using SF-12 as health measure) between ages 57 and 66. However, Mein et al. (2003) show no significant differences in health at retirement using SF-36. **Health behavior** includes studies on the body mass index (as a proxy of food behavior), on smoking and drinking, physical exercises, well-being, and on questions about satisfaction with health. Lastly, studies on **pathology** include either a list of pathologies, or the study of one particular pathology.

APPENDIX B: QUANTITATIVE DESCRIPTION OF SELECTED STUDIES ON THE CAUSAL IMPACT OF RETIREMENT ON HEALTH

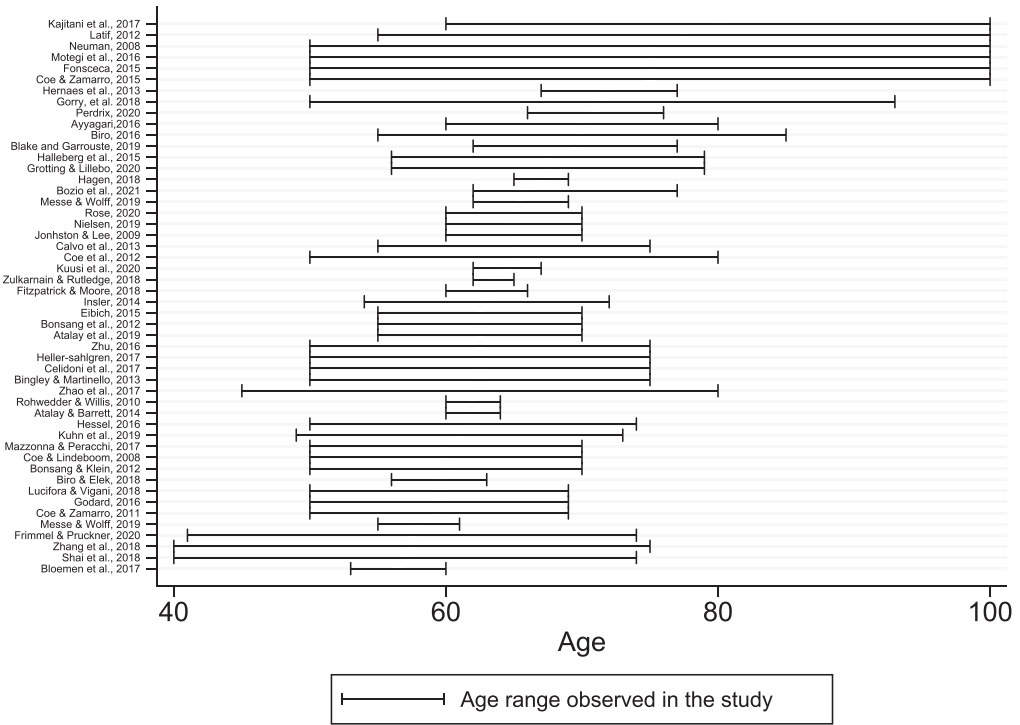


FIGURE B1 Number of studies on the causal impact of retirement on health by age

Notes: This figure summarizes the age range at which individuals are observed in all studies included in this literature review. Behncke (2012) is missing because this information is not available in the paper.

FIGURE B2 Number of studies by legal retirement age
[Colour figure can be viewed at wileyonlinelibrary.com]

Notes: This summary does not include the 13 studies using cross-country variation in early and statutory retirement age in Europe and in the United States. For studies using as an instrumental variable a progressive increase in retirement age from age SRA to age SRA', we consider the average between SRA and SRA'.

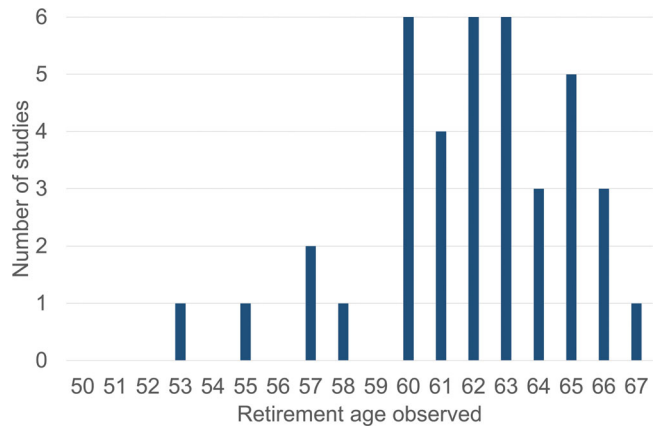


FIGURE B3 Number of studies on the causal impact of retirement on health by method
[Colour figure can be viewed at wileyonlinelibrary.com]

Note: The method associated with each study is the one described as so by the authors in the paper.

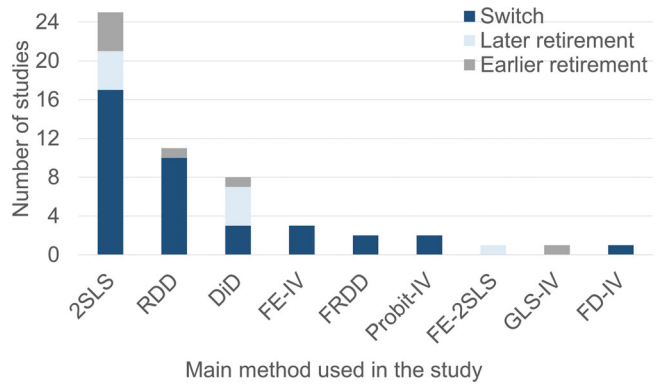


TABLE B1 Number of observations in the three biggest aging surveys

	SHARE	HRS	ELSA
2004	30,424	20,129	9,432
2006	13,377	18,469	9,771
2008	n.a.	17,217	11,050
2010	36,840	22,034	10,274
2012	21,370	20,554	10,601
2014	10,774	18,747	9666
2016	18,158	20,912	8445

APPENDIX C: TABLES OF RESULTS BY OUTCOME

TABLE C1 Studies on the causal impact of retirement on mortality

Authors	Country	Sample	Method	IV	Controls	Result	Death age
Impact of the switch from employment to retirement on mortality							
Fitzpatrick and Moore (2018)	USA	Men	RDD	ERA: 62	Age	Increase	62
Fitzpatrick and Moore (2018)	USA	Women	RDD	ERA: 62	Age	NS	62
Rose (2020)	GBR	Men	RDD	SRA: 65	Age	NS	65
Rose (2020)	GBR	Women	RDD	SRA: 60	Age	NS	60
Impact of earlier retirement on mortality							
Coe and Lindeboom (2008)	USA		RDD	ERA offer	Age, marital status, education, income, NS white/blue-collar, race, US-born, children, wave FE	NS	Within 4 and 6 years
Hernaes et al. (2013)	NOR	n.a.	DiD	ERA: 67 to 62	Gender, marital status, education, income, industry, previous paid sick leave, pension histories, public sector worker, treatment and cohort FE	NS	By age 67, 70, 74, 77
Hallberg et al. (2015)	SWE	Military officers	2SLS	ERA 60 to 55	Cohort, income, income interacted with cohort, education	Decrease	Age ≤ 71
Bloemen et al. (2017)	NLD	Male civil servants	2SLS	ERA decrease	Age, individual and year FE	Decrease	Within 5 years (Continues)

TABLE C1 (Continued)

Authors	Country	Sample	Method	IV	Controls	Result	Death age
Kuhn et al. (2020)	AUT	Blue-collar men	2SLS	Decrease in SRA	Age, income, sick-leave, industry, living area	Increase	Age ≤ 73
Nielsen (2019)	DNK	Exclusion of disability and early pension beneficiaries	2SLS	SRA 67 to 65	Gender, marital status, education, income, average hospital utilization	NS	Before 2012
Nielsen (2019)	DNK	Exclusion of disability and early pension beneficiaries	RDD	ERA:60	Gender, marital status, education, income, average hospital utilization	NS	Before 2012
Impact of later retirement on mortality							
Hagen (2018)	SWE	Women civil servants	DiD	SRA from 63 to 65	School, cohort FE, income, sick-leave	NS	65–69
Zulkarnain and Rutledge (2018)	NLD	Men born between 1943 and 1954	2SLS	Delayed retirement Age FE	marital status, income, year	FE Decrease	62–65
Zulkarnain and Rutledge (2018)	NLD	Women born between 1943 and 1954	2SLS	Delayed retirement Age FE	marital status, income, year	FENS	62–65
Bozio et al. (2021)	FRA	Private sector	2SLS	SRA increase	Age, cohort, income, disability	NS	65–74

Notes: This table includes only studies on the causal impact on mortality.

Abbreviations: n.a. in column “sample” is for no particular restriction in the sample, except “answer the survey”, and other practical exclusion restriction. Countries abbreviations are the 3-letter codes from the United Nations. Method abbreviations are: DiD, Difference in Difference; 2SLS, two stage least square; RDD, Regression Discontinuity Design. Instrumental variable (IV) abbreviations are: ERA, Early Retirement Age; SRA, Statutory Retirement Age; LRA, Late Retirement Age. Controls abbreviation is: FE, Fixed-effect. Result's column contains “NS” for non significant results at the 5% level.

TABLE C2 Studies on the impact of retirement on healthcare consumption

Authors	Country	Sample	Method	IV	Controls	Results on Doctor visits	Hospital	Drugs	Age
Impact of the switch from employment to retirement									
Coe and Zamarro (2015)	EU + USA	Men, workers at age 50	RDD	SRA	Age, income, education, marital status, ethnic group, race	Decrease	NS	n.a.	50+
Eibich (2015)	DEU	Civil servants & self-employed	RDD	ERA: 60 65	Age, individual, year and month fixed-effect	Decrease	NS	n.a.	55–70
Bíró (2016)	EU	–	IV-Probit	ERA and SRA	Age, gender, marital status, education, employment category, income, living area, SRH, number of illness, ADL, wave, country	Increase	n.a.	n.a.	50+

(Continues)

TABLE C2 (Continued)

Authors	Country	Sample	Method	IV	Controls	Results on Doctor visits	Hospital	Drugs	Age
Bíró (2016)	HRS	-	IV-Probit	ERA:62 SRA: 65	Age, gender, marital status, education, employment category, income, living area, SRH, number of illness, ADL, wave, coun- try	Increase	n.a.	n.a.	50+
Bíró and Elek (2018)	HUN	Women	2SLS (TPM)	ERA: 57 ⇒ 69	Age, individual fixed-effect	Decrease	Decrease	Decrease	56–60
Bíró and Elek (2018)	HUN	Men	2SLS (TPM)	ERA: 60 ⇒ 69	Age, individual fixed-effect	Decrease	Decrease	Decrease	57–63
Gorry et al. (2018)	USA	Workers at age 50	2SLS	SS threshold	Age, healthcare coverage	NS	Decrease	Decrease	50–93
Lucifora and Vigani (2018)	EU	-	RDD	ERA and SRA	Age, education, marital status, household size, children, industry, occupational group, income, SRH	Increase	n.a.	n.a.	50–69

(Continues)

TABLE C2 (Continued)

Authors	Country	Sample	Method	IV	Controls	Results on	Drugs	Age
						Doctor visits	Hospital	
Shai (2018)	ISR	Men	DiD	2004: SRA 65 ⇒ 67 and 2003: ERA 61.5 ⇒ 65 (resp. 56.5 ⇒ 60)	Age, year fixed-effect, marital status, living area, health fund, household size, education	NS	n.a.	40–74
Zhang et al. (2018)	CHN	n.a.	RDD	SRA: 60 (men) 50 (women)	Age, gender, marital status, education	Increase	Increase	40–75
Nielsen (2019)	DNK	–	RDD	ERA: 60	Gender, marital status, education, income	Decrease	Decrease	60–70
Nielsen (2019)	DNK	–	2SLS	SRA: 67 ⇒ 65	Gender, marital status, education, income	NS	NS	60–70
Frimmel and Pruckner (2020)	AUT	Private sector	FRDD	2000: ERA 60 ⇒ 61.5 (men) 55 ⇒ 56.5 (women)	Age, year and individual fixed-effect	Decrease	Decrease	41–74
Grøtting and Lillebø (2020)	NOR	–	RDD	SRA: 67	Age	NS	n.a.	56–79
Kuusi et al. (2020)	FIN	Workers before ERA	2SLS	SRA: 63	Age, year, individual fixed-effect	n.a.	Decrease	62–67

(Continues)

TABLE C2 (Continued)

Authors	Country	Sample	Method	IV	Controls	Results on Doctor visits	Hospital	Drugs	Age
Rose (2020)	GBR	Men	RDD	SRA: 65	Age	n.s.	n.a.	n.a.	60–70
Rose (2020)	GBR	Women	RDD	SRA: 60	Age	Decrease	n.a.	n.a.	55–65
Impact of earlier retirement									
Hallberg et al. (2015)	SWE	Men from the army	2SLS	SRA of military officers: 60 ⇒ 55	Dummy for military officer, county dummies, income, education, interaction terms	n.a.	Decrease	n.a.	56–79
Impact of later retirement									
Hagen (2018)	SWE	Women, civil servants	DiD	SRA: 63 ⇒ 65	Education, income, cohort FE, sick-leave	NS	NS	NS	65–69
Perdrix (2020)	FRA	Men, private sector	2SLS	SRA Increase	Age, income, sick-leave, chronic condition, living area	Decrease	NS	Decrease	66–76

Notes: This Table includes only studies on the causal impact on healthcare consumption.

Abbreviations: n.a. in column “sample” is for no particular restriction in the sample, except “answer the survey”, and other practical exclusion restriction. Countries abbreviations are the 3-letters codes from the United Nation. Method abbreviations are: LATE, Local Average Treatment Effect; 2SLS, two stage least square; DiD, Difference in Difference; RDD, Regression Discontinuity Design; FRDD, Fuzzy Regression Discontinuity Design. Instrumental variable (IV) abbreviations are: ERA, Early Retirement Age; SRA, Statutory Retirement Age. Controls abbreviations are: SRH, Self-Reported Health. Result’s columns contains “NS” for non significant results at the 5% level.

TABLE C3 Studies on the causal impact of retirement on self-reported health

Authors	Country	Sample	Method	IV	Controls	SRH	Result	Age
Impact of the switch from employment to retirement								
Coe and Lindeboom (2008)	USA	Men	2SLS	ERA window	Age, education, marital status, income, white/blue-collar, race, US-born, children, wave FE	Dummy	NS	50–70
Neuman (2008)	USA	In employment in wave 1	2SLS	ERA window	Gender, socio-economic status, living area, type of employer, long term sick-leave	Dummy no deterioration	Increase	50+
Johnston and Lee (2009)	GBR	Men without university diploma	RDD	SRA	Age, marital status, education, income, tenant, living area	Dummy	Increase	60–70
Behncke (2012)	GBR	In employment in wave 1	LATE	Reform	Age, gender, marital status, education, household size, children, grandchildren, birth country, occupational group, physical activities at work, living area, SRH, cognitive function, number of ADL	Dummy	NS	n.a.
Latif (2012)	CAN	n.a.	2SLS	Age specific incentive to retire	Age, gender, marital status, income, education, living area	0-bad to 5-good	NS	55+
Eibich (2015)	DEU	Civil servants and self-employed	FRDD	SRA: 60 LRA: 65	Age, individual FE, year and month FE	0-bad to 5-good	Increase	55–70
Hessel (2016)	EU	Men and women separately	2SLS	SRA by country	Age, gender, marital status, education, assets, debt, race	Dummy	Increase	50–74
Zhu (2016)	AUS	Woman	2SLS	SRA changes	Age, gender, marital status, education, public vs private sector employment, number of hours worked per week, stressful situation at work, sick-leave	Dummy	Increase	50–75

(Continues)

TABLE C3 (Continued)

Authors	Country	Sample	Method	IV	Controls	SRH	Result	Age
Gorry et al. (2018)	USA	Workers at age 50	2SLS	SS threshold	Age, health insurance coverage	1-bad to 5-good	Increase	50–93
Messe and Wolff (2019b)	FRA	In employment in wave 1	DiD	Retirement age	Gender, education socio-economic status, type of employer, working condition	Dummy bad health	Decrease	50–69
Rose (2020)	GBR	Men	RDD	SRA: 65	Age	Dummy	Decrease	60–70
Rose (2020)	GBR	Women	RDD	SRA: 60	Age	Dummy	NS	55–65
Impact of earlier retirement								
Calvo et al. (2013)	USA	In employment before retirement	GLS IV	Reform	Age, wealth, income, spouse, gender, race, education, blue-collar	1-bad to 5-good	Decrease	55–75
Messe and Wolff (2019a)	FRA	Private sector	2SLS	Reform ERA	Age, living in a couple, number of children, education, unemployment spell during career, working condition	Dummy	NS	62–69
Impact of later retirement								
Atalay and Barrett (2014)	AUS	n.a.	LATE	1993 reform	Married, living alone, education, income	Dummy	NS	60–64
Blake and Garrouste (2019)	FRA	Men and women	DiD	1993 pension reform	Age, gender, education, household size, children, marital status, income, living area	Duke Health Profile (100)	Decrease	62–77

Notes: This Table includes only studies on the causal impact on self-reported health.

Abbreviations: n.a. in column “sample” is for no particular restriction in the sample, except “answer the survey”; and other practical exclusion restriction. Countries abbreviations are the 3-letters codes from the United Nation. Method abbreviations are: LATE, Local Average Treatment Effect; 2SLS, two stage least square; RDD, Regression Discontinuity Design; FRDD, Fuzzy Regression Discontinuity Design. Instrumental variable (IV) abbreviations are: ERA, Early Retirement Age; SRA, Statutory Retirement Age; LRA, Late Retirement Age. Controls abbreviations are: SRH, Self-Reported Health; ADL, Activity Daily Living limitations; FE, Fixed-effect. Result’s columns contains “NS” for non significant results at the 5% level.

TABLE C4 Studies on the causal impact of retirement on depression

Author	Country	Sample	Method	IV	Controls	Outcome	Depression	Age
Switch from employment to retirement								
Neuman (2008)	USA	In employment in wave 1	2SLS	ERA window	Gender, socio-economic status, living area, type of employer, long term sick-leave	CES-D	NS	50+
Coe and Zamarro (2011)	EU	Men, working before age 50	2SLS	SRA by country	Age, gender, marital status, education, income, occupational group, race, drinking, smoking, wealth, health insurance, employment status	Euro-D + self-report	NS	50–69
Behncke (2012)	GBR	In employment in wave 1	LATE	Incentive by age	Age, gender, marital status, education, household size, children, grandchildren, birth country, occupational group, physical activities at work, living area, SRH, cognitive function, ADL	CES-D	NS	n.a.
Fonseca et al. (2014)	EU + USA	n.a.	2SLS	SRA by country	Age, gender, marital status, education, income, country, living area, ADL	CES-D	NS	50+
Heller-Sahlgren (2017)	EU	n.a.	FRDD	SRA by country	Age, gender, education, individual and country FE, lagged mental health	Euro-D	NS	50–75

(Continues)

TABLE C 4 (Continued)

Author	Country	Sample	Method	IV	Controls	Outcome	Depression	Age
Rose (2020)	GBR	Men	RDD	SRA	Age	CES-D	NS	60–70
Rose (2020)	GBR	Women	RDD	SRA	Age	CES-D	Decrease	55–65
Later retirement								
Calvo et al. (2013)	USA	Born between 1931 and 1941	2SLS	ERA window	Age, gender, education, practice effect, SRH	CES-D	Decrease	55–75
Atalay and Barrett (2014)	AUS	Women	2SLS	1993 reform	Marital status, education, income		Decrease	60–64
Atalay and Barrett (2014)	AUS	Men	2SLS	1993 reform	Marital status, living alone, education, income	Self-report	NS	60–64
Zulkarnain and Rutledge (2018)	NLD	Men and Women separately, born between 1943 and 1954	2SLS	2009 reform	Age, wave, marital status, income	Prescribed antidepressant drugs	NS	62–65
Blake and Garrouste (2019)	FRA	–	DiD	SRA increase	Age, gender, education, household size, children, marital status, income, living area	Duke Health Profile (100)	NS	62–77

Notes: This Table includes only studies on the causal impact on depression.

Abbreviations: n.a. in column “sample” is for no particular restriction in the sample, except “answer the survey”; and other practical exclusion restriction. Countries abbreviations are the 3-letters codes from the United Nation. Method abbreviations are: LATE, Local Average Treatment Effect; 2SLS, two stage least square; FRDD, Fuzzy Regression Discontinuity Design. Instrumental variable (IV) abbreviations are: ERA, Early Retirement Age; SRA, Statutory Retirement Age. Controls abbreviations are: SRH, Self-Reported Health; ADL, Activity Daily Living limitations; FE, Fixed-Effect. Result’s column contains “NS” for non significant results at the 5% level.

TABLE C5 Studies on the impact of retirement on cognitive abilities

Authors	Country	Sample	Method	IV	Controls	Results on Memory	Verbal fluency	Numeracy	Age
Switch from employment to retirement									
Rohwedder and Willis (2010)	USA, GBR, EU	n.a.	2SLS	SRA by country	Age, country	Decrease	n.a.	n.a.	60–64
Bonsang et al. (2012)	USA	Retired after age 50, and stop working at retirement	2SLS	SS incentive	Age, individual fixed effect	Decrease	n.a.	n.a.	55–70
Behnecke (2012)	GBR	In employment in wave 1	LATE	Reform	Age, gender, marital status, education, household size, children, grandchildren, birth country, occupational group, physical activities at work, living area, SRH, cognitive function, number of ADL	Increase in problem with cognition			n.a.
Coe et al. (2012)	EU	Men worker before age 50	2SLS	SRA by country	Age, gender, marital status, education, income, wealth, occupational group, race, drinking, smoking, health insurance, employment status	NS	n.a.	n.a.	50+
Coe et al. (2012)	USA	Men blue collar born in 1931 and later, working after age 50	2SLS	ERA window	Age, education, race, ethnicity, wave	Increase	n.a.	n.a.	50–80

(Continues)

TABLE C 5 (Continued)

Authors	Country	Sample	Method	IV	Controls	Results on		Age
						Memory	Verbal fluency Numeracy	
Coe et al. (2012)	USA	Men white collar born in 1931 and later, working after age 50	2SLS	ERA window	Age, education, race, ethnicity, wave	NS	n.a.	50–80
Bingley and Martinello (2013)	USA, GBR, EU	Retired after age 50. Men and women separately, and both together	2SLS	ERA and SRA by country	Age, gender, country, education	Decrease	n.a.	50–75
Mazzonna and Peracchi (2017)	EU	working after age 50	2SLS	SRA and ERA	Age, education, country, age interacted with country	NS	NS	50–70
Rose (2020)	GBR	men	RDD	SRA	Age	NS	NS	60–70
Rose (2020)	GBR	women	RDD	SRA	Age	NS	NS	55–65

Notes: This Table includes only studies on the causal impact on cognitive abilities.

Abbreviations: n.a. in column “sample” is for no particular restriction in the sample, except “answer the survey”, and other practical exclusion restriction. Countries abbreviations are the 3-letters codes from the United Nation. Method abbreviations are: LATE, Local Average Treatment Effect; 2SLS, two stage least square. Instrumental variable (IV) abbreviations are: ERA, Early Retirement Age; SRA, Statutory Retirement Age; SS, Social Security. Controls abbreviations are: SRH, Self-Reported Health; ADL, Activity Daily Living limitations. Result’s columns contains “NS” for non significant results at the 5% level.