Physical Functioning in work and retirement: commentary on age-related trajectories of physical functioning in work and retirement –the role of sociodemographic factors, lifestyle and disease by Stenholm *et al*

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INTRODUCTION

Stenholm *et al*[1]–henceforth, SW—look into the physical functioning of participants aged between 65 to 85 years in the Health and Retirement Study (a representative longitudinal survey of people aged 50 years or older in the USA). The authors report that physical functioning declined faster among the retired than among those individuals in full-time work, after controlling for age, sex, race, education, total wealth, body mass index, smoking, physical activity and chronic diseases.

This note does not review SW nor presents a systematic review of the literature on the topic. (For a recent systematic review of longitudinal research of the effects of retirement on health, see refs.[2 3].) (For a comprehensive review of the literature, see ref.[4].) The objective is more modest: to highlight some of the central tenets of the existing and conflicting literature to put SW into the context of its wider research programme.

After a brief description of the causal mechanisms as propounded by competing social theories, this paper discusses some methodological differences found in the literature, which are to a large extent at the bottom of the diversity in findings, concerning

- the indicators of retirement
- the influence of the jobs before retirement
- pathways to retirement, including early retirement
- the indicators of health status
- the focus on overall health or particular health conditions and diseases
- the choice of the time horizon
- the age cohorts
- the statistical approaches.

THEORETICAL CAUSAL MECHANISMS

Koopmans characterised empirical work with no theoretical foundation as an inquiry 'groping for guidance'.[5] When it comes to the effects of retirement on health, there is no dearth of theoretical underpinnings. However, none of the economic and social gerontological theories provide conclusive guidance about what to expect a priori regarding the sign of the direction.

The human capital model developed by Grossman predicts that retirement reduces individual investment on health given that in retirement the need to improve job productivity and earnings is absent by definition.[6] However, investment efforts in health in retirement are dependent on the marginal value of time: if perceived marginal benefits exceed the perceived marginal costs, individuals will invest more.[7] In turn, the marginal value of time may increase or decrease after retirement depending on whether individuals place a higher or a lower value on remaining or getting healthy as they age (in this context, health has an instrumental value depending on how much retired people enjoy their leisure time and how much they relate this enjoyment with their health status).

The microeconomic approach to social capital[i] equates social capital to an individual investment with many positive complementarities, including better health outcomes that would present a midlife peak—in old age the returns would not justify the costs.[8] However, retirement may reduce the opportunity cost of time, which would induce retirees to increase their social connectedness compared with pre-retirement, thus counterbalancing any negative incentives for individual investment decisions in health.[9]

Closely related to the social capital theory, the social network perspective sees retirement as causing an initial shrinkage in an individual's networks (by way of a loss of contact with former work colleagues) and therefore having a negative health impact; however, retirement may also open up opportunities for engaging in social activities other than paid employment, thus partially or fully offsetting or even reverting the negative effects.

Social gerontological theories similarly cast inconclusive predictions on the effects of retirement on health.

Disengagement or role theory, for example, asserts that retirement entails the disappearance of the work role—a central tenet of social identity in advanced societies—which may lead to a general decline in well-being. However, the fact that working is no longer necessary to procure a living may be experienced as a relief and thus the loss of the work role may be associated with a positive health effect. (For a systematic review of social role interventions in retirement, see ref.[10]).

Activity theory, in turn, predicts that retired people can actively pursue their hobbies and take part in social and physical activities, with beneficial effects on their mental and physical health.

Continuity theory purports that people largely retain most of their lifestyle, self-image and preferences also after the transition to life as a retiree, so people feel neither better nor worse when they retire.

Stress and coping theory, in this area, is associated with the notion of adaptation to retirement.[11–13] Retirement—depending on traits such as whether it is voluntary or not, and whether it is preceded by a transitional process or partial retirement or not—can be highly disruptive of the daily routines, lifestyles and established patterns of behaviour and social interaction of individuals, and such disruption is associated with increased levels of stress.[14 15] On the other hand, similarly to role theory, retirement can reduce stress and be felt as a relief if the previous job involved highly stressful activities.[16]

Given these inconclusive theoretical developments, it is to be expected that much of the research effort—including SW—is empirical, geared towards detecting the existence and direction of the causality.

INDICATORS OF RETIREMENT

There is a wide array of definitions of retirement.[17] Operationally, retirement is measured either subjectively or objectively.[18] Subjective measures of retirement are constructed from direct questions

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[i]Though not fully exchangeable, the literature refers to social networks, social connectedness or social capital.

about economic status.[19] Objective measures usually are derived from data on the number of hours worked in a paid job or receipt of pensions.

SW used the subjective economic status as asked in the US Health and Retirement Study, and excluded respondents working part time, unemployed, partly retired, retired, disabled or inactive for other reasons than retirement.

In contrast, Coe and Zamarro defined as retired everyone not in the labour force, so they included homemakers, the sick and disabled, respondents separated from the labour force (not temporarily) and the unemployed (not temporarily), as well as the retired.[20] These authors consider this to be a 'cleaner' measure of retirement behaviour when studying its effects on health because individuals "report that they are retired even when working full- or part-time, simply because they have left their 'career' job" (ref.[21], p. 81).

An alternative approach defines retirement operationally as working fewer than 1200 h a year (ie, roughly 3 days a week over 50 weeks).[22–25] In a similar vein, Llano Señarís *et al*[26] use the definition of retirement adopted in the European Community Household Panel—an individual who works fewer than 15 h a week and is in receipt of a pension.

Especially when investigating the retirement–health relationship among ethnic minorities, using one definition or the other may influence the results.[27]

An interesting comparative exercise is found in Kajitani *et al*[28 29] in the context of measuring the effects of retirement on cognitive functioning. The former paper estimated an instrumental variable model on retirement defined in terms of duration, while in the latter the authors ran the same models on the retirement variable defined in terms of economic activity. They obtained similar results. It would be worth replicating the second study with health outcomes other than cognitive functioning to test whether alternative definitions of retirement render different results and, if so, what it is that each definition would be measuring and which elements would be mediating in the retirement–health relation. SW adopted one commonly used definition—it is too early to conclude whether it is inherently weak or conceptually robust.

RETIREMENT FROM WHAT

Another consideration is the characteristics of the jobs from which individuals retire. Most studies (SW included) adopt a macro approach, which does not distinguish between the industry or type of job individuals either retired from or are still employed in.

However, some authors opine that restricting the analysis to working conditions or industry reduces heterogeneity among the population under study, thus increasing internal validity.[30] To mention but a few examples of more narrowly focused studies, Haynes *et al*[31] carried out an epidemiological study of early retirement and retirement at 65 years of age and mortality among workers in two rubber tyre manufacturing companies in the USA. Mein *et al*[32] investigated the effects of retirement on mental and physical health of civil servants in Britain, distinguishing between three occupational grades. Retirement was associated with an increase in weight and waist circumference among those with former active jobs, but not among those with former sedentary jobs.[33] Tsai *et al*[34] considered the effects of early retirement on mortality among employees of a US petroleum company—individuals who retired earlier presented a higher HR of death. Neuman finds that retirees from jobs with worse working conditions benefit less from retirement than those who retire from jobs with better working conditions.[35] Hult *et al*[36] studied the effects of early retirement due to disability among construction workers in Sweden. Brandl and Smith find that retired police officers die significantly younger than retired civil servants.[37] Both papers by Kajitani *et al* already cited use a three-digit occupation code and distinguish between 288 occupations. Finally, a study just published as a working paper by Mazzonna and Peracchi found that even though retirement seems to be associated with negative health outcomes across Europe, these adverse consequences disappear and even become positive for those working in very physically demanding jobs.[38]

There are certain professions in which the retirement process would be associated with higher physical or mental health problems than average, for example, the study on policy officers mentioned earlier or those on retirement from professional sports, such as footballers or female tennis players.[39 40] (See Park *et al*[41] for a recent systematic review.).

Therefore, there is merit in looking into the health consequences of retirement from specific professions, not the least because it can help tailor specific interventions to address issues arising from the transition. Concerning the analyses of the general population, a careful statistical design can control for this potential source of heterogeneity—whether its exclusion affects the results is an empirical open question worth posing in any study. Nevertheless, the effect may depend, in part, on the economic structure of the geographical unit or units under study: a services-based economy has a greater proportion of jobs demanding low physical effort than a manufacturing-based or agricultural economy, for example. Therefore, it can be argued that confining the study to one country (as SW did) somehow reduces the impact of not controlling for job type.

PATHWAYS TO RETIREMENT

Retirement can imply an abrupt change in daily time-use patterns, from full-time work to full retirement. However, increasingly, full retirement is preceded by a transitional period that involves part-time work (sometimes after changing jobs—the so-called 'bridge jobs'). Furthermore, retirement can come as a result of a voluntary decision by the individual or they may be somehow forced into retirement. Part of the literature considered whether the differences in the pathways to retirement and the voluntariness of the decision are significantly associated with health status after retirement.

van Solinge finds that retirement has a positive effect on the health of older workers who were free to decide when they wanted to leave the labour force: people for whom retirement was a conscious, positive choice tend to feel better after retirement.[42] Similarly, Isaksson and Johansson found that the voluntariness in the retirement decision explained differences in physical health and psychological well-being over 1.5 years among 4000 individuals in Sweden who were working full time at the beginning of the study.[43] A sense of control over the timing and conditions of retirement has been found to have a positive effect on subsequent quality of life and well-being.[44]

Halleröd *et al* investigated the effects of different pathways to retirement on health and well-being. These authors failed to find any statistically significant effects of retirement on health conditional to a number of alternative exit patterns from employment into retirement.[45]

A literature review by Kuerbis and Sacco[46] of research on the effects of retirement on drinking patterns found that retirement per se is not associated with alcohol problems, but that some characteristics of the retirement transition process such as its voluntariness have a significant impact on adverse drinking

behaviour. This finding is confirmed by Zantinge *et al*.[47]

As mentioned, one pathway to full-time retirement increasingly more sought after by older workers is known as 'bridge employment', that is, transitional employment that takes place after leaving a full-time position but before exiting the workforce.[48 49] Around 60% of older workers in the USA are reported to have moved to a bridge job before fully retiring.[50] Using a longitudinal dataset from between 1992 and 1998 of over 12 000 people in the USA, Zhan *et al*[51] found positive effects of bridge employment on reducing the risks of major diseases, slowing down functional decline and better mental health outcomes. Kantarci[52] compared the retirement effects on health between part-time and full-time workers aged between 50 and 75, and full-time retirees of the same age group with US data between 1994 and 2008. They found that part-time and full-time workers report worse overall health and memory and a much lower body weight but they would be less prone to depression than full-time retirees.

The complexity of retirement pathways is reflected in Dingemans[53] and Dingemans and Henkens,[54] which explored whether bridge employment after involuntary retirement reversed the negative impact of the latter on subjective well-being among Dutch retirees—their main finding is that it does: forced retirees who took a bridge job after retiring did not present lower levels of well-being compared with workers still in their main career job.

What retirees do with their increased leisure time compared with those individuals in paid work is also important. Barnett *et al*[55] carried out a systematic review of the literature on effects of retirement on physical activity between 1980 and 2010 and concluded that retirement is associated with gains in leisure-time physical activity and exercise.[56] In turn, evidence suggests that sustained leisure-time physical activity improves overall health in later life.[57]

One of the few points on which the literature seems to be in accord with is that involuntary retirement (unmitigated by postretirement employment) has deleterious health effects.[58] The dataset used by SW neither distinguishes between voluntary and involuntary retirement nor provides information about pathways, which is a clear deficiency in their study.

EARLY RETIREMENT

The age of retirement can be—the literature is divided on this point—a relevant mediator in the effects of retirement on health.

Some papers find positive health effects of early retirement.[59–63] Negative consequences are also reported in many papers.[64–68] Recently, Calvo *et al*[69] found that early retirement has negative consequences for subjective physical and emotional health, but retiring later than at the culturally expected retirement age presents no health disadvantages. Still others failed to find any significant effects. For example, Hult *et al*[36] analysed the relationship between early retirement due to disability and mortality among over 20 000 construction workers in Sweden and failed to find any significant differences by timing of retirement.[42 70]

SW does not distinguish between retirees who took early retirement and those who did not given that they restricted the sample to individuals aged between 65 and 85—so, considerations about early retirement do not apply.

INDICATORS OF HEALTH STATUS

SW measure physical functioning by a composite unweighted additive index of 10 self-reported limitations in lower and upper limb mobility—such as walking one block, getting up from a chair after sitting for long periods, etc.—an index sometimes used in the literature. (Pearson[71] provides a useful description.) An alternative approach is to run factor analysis on different indicators to construct a weighted index with the resulting scores. Mein *et al*[32] applied this procedure to obtain a measure of mental and physical health.

Notwithstanding, it is worth noting that some authors find performance-based measures of physical mobility superior to, and poorly correlated with, subjective measures.[72] For a discussion of the limitations of using self-reported data to assess the impact of retirement on health, see refs.[73–76]

Therefore, it is not surprising to find papers that use one type of measures or the other, or both. Among the papers that looked at both types of indicators, we can mention Neuman, who investigated the effects of retirement on both objective and subjective measures of health from the US Health and Retirement Study using an instrumental variables model.[25] He found that retirement preserved subjective health, but the effects on objective health indicators were not significant, which led to the conclusion that health preservation as a result of retirement would be more apparent than real. However, the evidence strongly rejected any deleterious health effects of retirement. Furthermore, Insler combines nine doctor-diagnosed health variables and one self-reported health status into a weighted health index.[77] (In this, he follows Bound *et al*.[78 79]) Insler reports that his results (namely, retirement is beneficial to health) are robust to the choice of health index "as long as it includes the more 'broadly based' subjective self-reported health" (p. 29).

FOCUS ON MORTALITY, OVERALL HEALTH OR PARTICULAR HEALTH CONDITIONS AND DISEASES

SW focused on an aggregate index made up of 10 indicators of physical limitations. In contrast, part of the literature deals with the effects of retirement on specific conditions such as depression or myocardial infarction, while others look into the impact of retirement on mortality.

Among the many papers focusing on specific conditions, we can mention the following. Charles reported positive effects of retirement on depression and loneliness.[80] Using data of over 600 000 Danish individuals, Olesen *et al*[81] find that retirement is associated with a small though statistically significant increase in the risk of myocardial infarction. Fe and Hollingsworth[82] investigated the effects of retirement on the consumption of primary care services and mental health using British longitudinal data between 1991 and 2006. The authors reported that retirement seems to reduce the demand for primary care services and is not associated with changes in mental health. Hernaes *et al*,[83] using administrative data for the full population of Norway, found no significant effects of retirement on mortality. In contrast, Blake and Garrouste[84] with French data report that delaying the retirement age by 1 year increases the chances of dying within 4 years. Vahtera *et al*[85] reported that retirement reduces sleep disturbances. Latif[86] finds a positive impact of retirement on psychological well-being. A longitudinal study of data from Finnish public sector workers between 1994 and 2001 found an increase in the risk of poor adherence to medication after retirement among people with diabetes and hypertension.[87]

A parallel growing literature focuses on the effects of retirement on cognitive functioning.[38 88–90] Cognitive functioning could be given more salience in studies on retirement and physical and mental health based on self-reported health measures on the account that there is some evidence that cognitive functioning would partially explain discrepancies between self-reported and objective health measures.[91]

Approaches that aggregate indicators for different health conditions or elements of, say, physical or cognitive functioning into one measure have advantages and disadvantages: they provide an answer to the question of whether retirement affects 'health' (or physical/cognitive condition), but in so doing, their results may mask positive, negative and insignificant effects depending on the particular condition or functioning. Studies such as SW that combine several indicators would benefit from presenting separately the results both for the chosen overall measure of health or functioning and for each of its individual components.

TIME HORIZON AND TRAJECTORY OF THE RELATIONSHIP BETWEEN RETIREMENT AND HEALTH

Another methodological aspect concerns the time horizon of the effects: whether the research focus is upon the short-term or the long-term impacts of retirement on health. Furthermore, it is also relevant to consider the trajectory over time of the relationship: in other words, whether the effects imply a step-change in health or a gradual change and whether they persist over time or not.

The importance of distinguishing between short-term and long-term effects of retirement is reflected in the 'honeymoon period' hypothesis first proposed by Atchley[92]: initially, retirees would experience relief from the pressures and burdens of working life, but after a transitional period of adjustment and accommodation, impoverished social status and reduced social networks may start affecting health and well-being negatively.

SW adopted a long-term view: they looked into the relationship between retirement and 10-year changes in physical functioning. In contrast, Johnston and Lee[93] focused on the short-term effects of retirement on three subjective and two objective measures of health and reported a positive impact on mental health and well-being and no significant effects on physical health. Sahlgren[94] investigated both short-term and long-term effects and concluded that there are no significant short-term effects but that retirement would present negative long-term consequences on self-reported overall, physical and mental health.

With regards to the trajectory of the effects, in a longitudinal study using data of over 13 000 employees of the French national gas and electricity company from 7 years before to 7 years after retirement, Westerlund *et al* reported that retirement was not associated with the risk of major chronic diseases and that it was associated with a reduction in mental and physical fatigue and depressive symptoms. Retirement would have introduced a break in the trends of the prevalence of these conditions within the first year after retirement.[95]

Studies such as SW that incorporate medium-to-long-term effects should include results in the short run. The long-term effects are an important research topic, but short-term effects are more relevant for the design of targeted interventions during pre-retirement and the first months after retirement.

AGE COHORTS

Retirement age is a relevant mediator in the relationship between retirement and health, but the ages of the population under study are a key element of the research design—another methodological consideration that complicates the extraction of conclusions from the literature. Bamia *et al*[65] is one of many papers encompassing a wide range of ages, which have controlled for age at baseline or enrolment.

SW included individuals aged between 65 and 85 years of age from 1992 to 2010. When they comment on their results vis-à-vis those in Jokela *et al*, SW surmised that, to some extent, the discrepancies between both studies may arise from the age differences—Jokela *et al*[62] looked into individuals aged 39–64 at baseline and 54–76 at the last follow-up.

SW's upper age limit of 85 is much older than previous papers. In contrast, for example, Coe and Zamarro[20] and Sahlgren[94] studied individuals aged between 50 and 69 years. In turn, Kantarci and van Soest[96] restricted their sample to respondents aged between 50 and 75 years. For understandable reasons, research on the effects of early retirement on health restrict the age range even more, for example, Bloemen *et al*[4] studied individuals aged between 53 and 60 during the whole period under study.

Whenever the datasets and provided sample size and other statistical considerations (such as stratification procedures, etc.) allow it, if the research focus is upon retirement instead of early retirement alone, their upper age limit should be set at the oldest possible age. In this sense, SW is a welcome example.

STATISTICAL APPROACHES

The literature is unanimous in explaining the different results reported over time as a partial consequence of the various statistical strategies followed, some of which have been found not to control or adjust effectively for the inherent difficulties when analysing the effects of retirement on health. The main statistical problem stems from the fact that bad health or health deterioration has been consistently reported as a powerful trigger of the retirement decision.[97–99] Therefore, in order to measure the effects of retirement on health, simultaneous causality and unobserved individual endogeneity need be addressed. SW used one procedure to control for these. Fonseca *et al*,[100] in a recent paper, suggest that failure to control for endogeneity makes retirement appear to increase both the risk of poverty and of depression, but that once endogeneity is accounted for using instrumental variables, these negative effects disappear and in fact the models would indicate some weak evidence that retirement induced through eligibility for retirement pensions may be protective against poverty and depression.

The literature identifies two main sources of this endogeneity: the justification bias and the role bias.

Justification bias may likely occur considering that in Western societies there is a social expectation to be in paid employment below the stipulated age for receiving full pension benefit. This social pressure would lead retirees to state a given health condition is more serious than people with the same condition in employment—it is worth mentioning that Kapteyn *et al*[101] found evidence for this bias in the USA but not in Europe; the difference, incidentally, according to these authors, would be related to the different levels in social insurance generosity and employment protection between the USA and Europe.

Role bias may occur if the social roles taken up in retirement are less demanding and therefore retirees perceive their health improves despite any changes in their health condition. For example, Llano Señarís *et al*[26] comment on a discrepancy they found between improved self-reported health and use of healthcare services between and after retirement in a longitudinal study of over 10 000 people aged 60 or over in Spain spanning between 1994 and 2000. These authors conclude that subjective measures of health status would reflect lifestyle changes introduced by retirement rather than health conditions. Neuman presents a useful description of the potential effects of justification and role biases on the association between retirement and subjective indicators of health.[24]

The empirical developments studied longitudinal data (either from administrative records or surveys)—a few papers

only comparing two periods of time, but the majority spanning over three or more.

The most common approach to deal with unobserved individual-specific heterogeneity is a fixed-effects specification with instrumental variables.[67 85 89 102]

However, fixed-effects models do not control for changes in endogenous factors affecting economic activity—and the retirement decision in particular—over time. Therefore, these studies could suffer from a potential uncontrolled endogeneity bias. With regards to the choice of instrumental variables, most authors have chosen key institutional elements such as default retirement age or entitlement age to state-funded medical care (eg, as in the USA), while others have also included indicators for spousal work histories, private pensions, the number of years between eligibility and current age, etc.

Other statistical approaches have used Cox regression models. For example, Bamia *et al*[65] used this strategy to estimate the effect of retirement on all-cause and cause-specific mortality risk. Similarly, Hult *et al*[36] used Cox regression to study differences in mortality risk among workers in the construction industry in Sweden and found that the difference in mortality risk between those who continued working and those who retired due to musculoskeletal conditions was statistically indistinguishable, once adjusted for cohort effects and other covariates.

In turn, Fe and Hollingsworth[82] and Coe and Zamarro[20] used a regression discontinuity approach within a panel model. The regression discontinuity models incorporate a threshold variable for the level at which the conditional distribution of the proportion of retirees by age and the age of the individuals and another discontinuity in the statistical relationship between their rates of change (ie, a discontinuity in the first derivative) –default retirement age would explain both this kink and jump.[103]

A different approach was used by Isaksson and Johansson,[43] who applied analysis of covariance and tests for cluster stability over time.

A number of studies based in Finland and France recurred to the generalised estimating equations method with an autoregressive correlation structure within a repeated responses logistic regression specification to measure the effects of retirement on sleep disturbances, non-adherence to medication or antidepressant use.[85 87 104 105]

A study on changes in consumption of psychotropic drugs before and after retirement in Finland used growth curve models, that is, multilevel random-coefficient models with repeated measurements nested within individuals. These models account for the within-person clustering.[106]

One rigorous empirical strategy increasingly of choice is the estimation of average and local average treatment effects. Following Wooldridge, in this context, ATE can be defined as the expected effect of retirement on the health status of an individual randomly drawn from the population (ie, from both the retirees and those who continue working).[107] In turn, ATET refers to the mean effect of retirement on the health of those who actually retired. Finally, LATE is the average effect of retirement on the health status of those individuals who would be induced to retire by reaching state pension age.

Some papers have used this approach under different statistical specifications. For example, in their study of retirement effects on health among men in England between 1997 and 2005, Johnston and Lee[93] estimated the LATE either side of a discontinuity at age 65 (ie, the then default retirement age for men) and a two-stage least-square estimator. Behncke applied a modified propensity score matching estimator based on the comparison between health outcomes of retired and those employed individuals with a similar probability to retire conditional on a number of confounders.[108] In this way, the author attempted to control for all variables that jointly affect retirement and health outcomes such that conditional on these variables the decision to retire would be independent of factors also related to health outcomes. Bloemen *et al*[4] estimated the LATE using a two-stage individual fixed-effects specification but within a difference-in-difference model to estimate the effects of retirement on mortality of civil servants in the Netherlands and a difference-in-difference-in-difference model (to distinguish between civil servants and workers employed outside the public sector) that control for year fixed effects, (non-linear) age effects and the differences in year effects and non-linear age effects.

SW adopted a different approach: a linear regression with generalised estimation equations controlling for the intraindividual correlation between repeated measurements using an exchangeable correlation structure, incorporating several interactions and a number of time-varying covariates.

It would be useful to carry out a comparative exercise of the statistical properties of the different empirical approaches in vogue and of the results obtained by each on one same dataset.

FINAL REMARKS

The policy implications of eliciting whether retirement has any health consequences, either negative or positive, are highly relevant and topical given the objective to maintain workers in the labour force until later in life than currently.

SW is a welcome contribution to the burgeoning literature of the retirement effects on health.

As ever in scientific research, results are provisional—even more so in this case, considering the crucial methodological differences in the literature that to a large extent explain the conflicting reported results. Stenholm *et al* add some evidence in one direction, but their effort needs be understood within the larger empirical quest to provide answers to whether retirement from paid employment has any effects on health.

The mixed results of this research programme so far are a consequence of a series of alternative methodological choices—some have been proved to be better than others, but in many cases they respond to different research questions. Whether retirement affects health embraces, in fact, a multitude of questions rather than one single interrogation.

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