

RESEARCH

Open Access

# Transition to retirement impact on health and lifestyle habits: analysis from a nationwide Italian cohort



Giacomo Pietro Vigezzi<sup>1</sup>, Giovanni Gaetti<sup>1</sup>, Vincenza Gianfredi<sup>1</sup>, Beatrice Frascella<sup>1</sup>, Leandro Gentile<sup>2</sup>, Angelo d'Errico<sup>3</sup>, David Stuckler<sup>4</sup>, Fulvio Ricceri<sup>5</sup>, Giuseppe Costa<sup>5</sup>, Anna Odone<sup>6\*</sup>, on behalf of the Italian Working Group on Retirement and Health

## Abstract

**Background:** Retirement is a life-course transition likely to affect, through different mechanisms, behavioural risk factors' patterns and, ultimately, health outcomes. We assessed the impact of transitioning to retirement on lifestyle habits and perceived health status in a nationwide cohort of Italian adults.

**Methods:** We analysed data from a large cohort of Italian adults aged 55–70, derived from linking six waves of the Participation, Labour, Unemployment Survey (PLUS), a national survey representative of the Italian workforce population, conducted between 2010 and 2018. We estimated relative-risk ratios (RRR) of transition to retirement and their corresponding 95% confidence intervals (CIs) for selected behavioural risk factors and health outcomes using multivariable logistic regression models. We used propensity score matching (PSM) to account for potential confounders.

**Results:** We included 5169 subjects in the study population, of which 1653 retired between 2010 and 2018 (exposed, 32%). Transition to retirement was associated with a 36% increased probability of practising sports (RRR 1.36, 95% CI 1.12–1.64). No statistically significant changes were reported for smoking habit (current smoker RRR: 1.18, 95% CI 0.94–1.46) and BMI (overweight/obese RRR: 0.96, 95% CI 0.81–1.15). Overall, retiring was associated with improved self-rated health status (RRR 1.26, 95% CI 1.02–1.58).

**Conclusion:** Individual data-linkage of multiple waves of the PLUS can offer great insight to inform healthy ageing policies in Italy and Europe. Transition to retirement has an independent effect on perceived health status, physical activity and selected behavioural risk factors. It should be identified as a target moment for preventive interventions, with particular reference to primary prevention so as to promote health and wellbeing in older ages.

**Keywords:** Ageing, Retirement, Physical activity, Self-rated health, Cohort study, Health behaviour

\* Correspondence: [anna.odone@unipv.it](mailto:anna.odone@unipv.it)

<sup>6</sup>Department of Public Health, Experimental and Forensic Medicine, University of Pavia, via Forlanini, 2, Pavia, Italy

Full list of author information is available at the end of the article



© The Author(s). 2021 **Open Access** This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by/4.0/>. The Creative Commons Public Domain Dedication waiver (<http://creativecommons.org/publicdomain/zero/1.0/>) applies to the data made available in this article, unless otherwise stated in a credit line to the data.

## Introduction

The world population is rapidly ageing as a result of increasing life expectancy and low fertility, with a faster pace in high-income countries and massive societal impact. It is estimated that by 2050, older people (> 60 years) will account for more than one-fourth of the population in all continents apart from Africa, with peaks at 35% in Europe [1].

As pension reforms across the world attempt to adapt to the ongoing demographic transition and research aims to evaluate their impact on health and welfare, a key fact is that people live long years after retirement compared to the past. Retirement itself is a life-course transition likely to affect behavioural risk factors' patterns and ultimately health after retirement. Previous research has explored how the transition to retirement modifies selected lifestyle habits, including social networks, smoking [2], alcohol consumption [2], dietary patterns and physical activity [3–5], as well as physical and mental health parameters [6–8]; nonetheless, the available evidence is not conclusive [9, 10]. Indeed, the mechanisms, pull and push factors, of the association between retirement, health and their determinants are complex, while individual, work-related and contextual elements could act as mediators or moderators [11, 12]. It is well known that health and retirement are bidirectionally linked [13]; on one side, retirement (i.e., retirement age and type of retirement) is influenced by health, and, on the other hand, retirement might differentially impact health, depending on different sociodemographic, socioeconomic and psychological factors [10]. After retirement, health and lifestyle may change due to loss of daily routines, physical and mental activity, social interactions and reduction in income. At the same time, moving out from demanding or stressful jobs and having more free time can be beneficial for psychological wellbeing. A negative balance between healthy and unhealthy behavioural patterns associated with retirement might add to the burden of late-life chronic conditions, with ultimate consequences on disability, mortality [14] and high direct and indirect costs.

Retirement is a turning point in people's life, making the passage into the long last stages of adult life. It cannot be seen as a mere single event, but rather a critical status transition with risks of both positive and negative effects on health, and thus also as a window of opportunity to intervene enabling and supporting healthy behaviours and, more in general, health promotion with preventive purposes [15].

With the general aim of contributing to fill the gaps in knowledge on the changes in health and lifestyles when transitioning to retirement, we investigated the impact of retirement on behavioural risk factors and perceived health in a large cohort of Italian adults.

## Methods

We analysed and critically interpreted data from a large cohort of Italian adults aged 55–70, derived from linking six waves of a national survey representative of the Italian workforce population, conducted between 2010 and 2018. The current study is part of a broader multidisciplinary project on healthy ageing research, the “Pension reforms and spatial-temporal patterns in healthy ageing: quasi-natural experimental analysis of linked health and pension data in comparative Italian and European perspective” (Pe\_hA) project, funded by a competitive grant from the Fondazione Cariplo programme on Aging and Social Research [16].

### Data sources

We used data from the Participation, Labour, Unemployment Survey (PLUS) conducted by the Italian National Institute for Public Politics Analysis (INAPP) and included in the Italian National Statistical Program.

PLUS is a national-level survey conducted periodically since 2005 to investigate different aspects of the Italian labour force, focusing on selected subgroups, including workers aged 50 years or more. PLUS waves recruited each year through stratified random sampling from 34,000 to 55,000 subjects, who gave consent to participate and were administered Computer-Assisted Telephonic Interviews (CATI). PLUS includes a classic panel design, as from the second wave in 2006 a relevant sample of the participants (around 60%) was included in the sample of the subsequent year and reinterviewed two or more times in consecutive waves, with a maximum length of the panel from 2005 to 2018. Details on survey design and sampling are available elsewhere [17].

### Study design and outcomes of interest

We linked individual-level data of subjects aged 55–70 across different PLUS waves to build a large cohort study, identifying “transition to retirement” as our exposure of interest. We distinguished between exposed subjects who retired over the study period (i.e., shifted from “employed” to “retired” at two different time points) and subjects who did not (i.e., remained “employed” at two different time points). We considered two subsequent observation time points for both exposed and unexposed subjects (Time0 and Time1).

We focused on the following primary outcomes, related to perceived health and behavioural risk factors' distribution at Time1, as compared to Time0: rate of change in self-rated health status and physical functioning (no change/improvement/worsening), Body Mass Index (BMI) (overweight-obesity/underweight-normal), smoking habit (yes/no), and physical activity (yes/no). In detail, health status was derived from the self-reported health assessment of the World Health Survey [18],

while the reduction in physical functioning was reported as temporary, permanent reduction or none. BMI was calculated from anthropometric data, and behavioural habits (smoking and physical activity) were assessed by dichotomous questions (yes or no) [19].

### Statistical analysis

The characteristics of the study population were explored through descriptive analysis and reported as proportions by exposure status. Since cohort study participants were not randomly allocated to the exposure, we used propensity score matching (PSM) to account for possible selection biases [20]. PSM was conducted separately for men and women. Propensity score (PS) was estimated matching for the following baseline (Time0) covariates, selected on the basis of evidence from the literature and experts' consultations: age, area of residence, education, type of job and job satisfaction, perceived health status and physical functioning, rate of overweight, smoking habits and physical activity. Details on the questionnaire's items and categorisation used are provided in Supplementary Table S1. Thus, based on the PS, the distribution of observed baseline covariates resulted homogeneous between exposed and unexposed subjects. Subjects were matched with a calliper width of 0.2 [21]. We compared baseline characteristics of the study population before and after PSM (prevalence and 95% confidence intervals, CIs). Group comparisons were performed using t-test for continuous variables and chi-square for categorical variables.

We estimated relative-risk ratios (RRR) of transition to retirement and their corresponding 95% CIs for various health outcomes comparing Time1 to Time0, using multinomial logistic regression models.

Statistical analyses were conducted using Stata software version 16.0 (Stata Corporation, College Station, Texas, USA).

### Results

After record linkage across different PLUS waves, 5169 subjects were included in the study population, of which 1653 retired between 2010 and 2018 (exposed, 32%) and 3516 did not retire over the study period (unexposed, 68%). In particular, among subjects who retired, 344 (21%) retired between 2010 and 2011, 532 (32%) retired between 2011 and 2014, 419 (25%) retired between 2014 and 2016, and 367 (22%) between 2016 and 2018.

Table 1 shows study population baseline characteristics, by exposure status, before and after PSM. Prior to PSM, the mean age was 60.37 years in the exposed group and 58.15 years in the unexposed group. There were 976 males (59%) and 677 females (41%) in the exposed group, and 2043 males (58.1%) and 1473 females (41.9%) among the unexposed. In the exposed group, before

retirement, 73.7% of subjects ( $n = 1218$ ) were white-collar workers and 26.3% ( $n = 435$ ) blue-collar workers; in the unexposed group 78.2% were white-collar, 21.8% blue-collar ( $p < 0.01$ ). Job satisfaction was mainly medium-high in both groups (around 59%): the exposed group was more frequently highly satisfied, and the unexposed group was more frequently medium-low and low satisfied ( $p = 0.05$ ). Education level was mostly medium in both groups (46% vs 47.2%): the exposed group was less educated, and the unexposed group had higher educational levels ( $p < 0.01$ ). Self-reported health was mostly good-excellent in both groups (65.2% vs 66.3%). Self-reported BMI was overweight-obese in 52.6% in the exposed group and 50.5% in the unexposed group. Smoking habit was reported by around 20% and sports habit by around 30% in both groups. Limitations to physical functioning reduction (partial or total) were reported by around 7% of the sample, both in the exposed and unexposed groups.

Figure 1 shows a relatively homogeneous distribution of the PS between the two groups (blue bars for unexposed), thus guaranteeing the accuracy of matching methods; t-test for continuous variables and chi-square test for categorical ones suggest that the balancing property is met.

Figure 2 shows a significant bias correction from the unmatched to the matched sample. After PSM, the sample size was reduced from 5169 to 3270 subjects, with 1635 subjects in each group (retired and still at work, respectively). As shown in Table 1, no more significant statistical differences can be found between exposed and unexposed groups except tobacco smoking ( $p = 0.04$ ).

Results from logistic regression models are reported in Table 2 and are referred to a weighted individual follow-up time mean of 2.11 years between retirement and Time1 (follow-up time was 1 year for 20.7% of the subjects, 2 years for 47.3% of them and 3 years for 32.0% of the total). Transitioning to retirement was associated with a 26% increase in the probability of reporting improved health status (RRR 1.26, 95% CI 1.02–1.58). Subjects who retired had a 36% greater probability of practising sport activities than subjects who did not exit the workforce (RRR 1.36, 95% CI 1.12–1.64). The risk of being overweight or obese did not change between exposed and non-exposed subjects (RRR 0.96, 95% CI 0.81–1.15). Subjects who transitioned to retirement reported a greater probability of smoking, although the difference was not statistically significant (RRR 1.18, 95% CI 0.94–1.46). Retired subjects also reported a RRR of 1.62 (95% CI 1.09–2.40) for physical functioning reduction after retirement, as compared to non-retired ones.

### Discussion

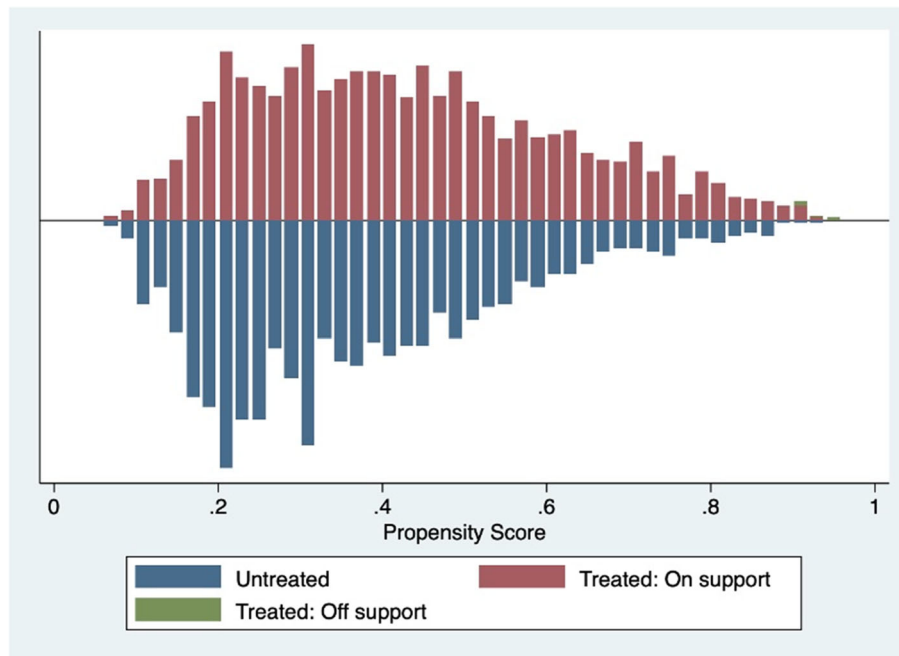
Analysing data from a large cohort of Italian adults, we observed the transition to retirement to be associated

**Table 1** Baseline characteristics of the study population before and after propensity score matching by exposure status

	Before PSM		<i>p</i> -value <sup>a</sup>	After PSM		<i>p</i> -value <sup>a</sup>
	Transition to retirement n. (%)	Control n. (%)		Transition to retirement n. (%)	Control n. (%)	
<b>n.</b>	1653	3516		1635	1635	
<b>Age (mean, years)</b>	60.37	58.15	< 0.01*	60.36	60.39	0.78
<b>Gender</b>			0.52			1
Males	976 (59.0%)	2043 (58.1%)		968 (59.2%)	968 (59.2%)	
Females	677 (41.0%)	1473 (41.9%)		667 (40.8%)	667 (40.8%)	
<b>Job</b>			< 0.01*			1
White collar	1218 (73.7%)	2751 (78.2%)		1206 (73.8%)	1206 (73.8%)	
Blue collar	435 (26.3%)	765 (21.8%)		429 (26.2%)	429 (26.2%)	
<b>Job satisfaction<sup>b</sup></b>			0.05			0.71
High	338 (20.6%)	619 (17.8%)		336 (20.5%)	315 (19.3%)	
Medium-high	982 (59.8%)	2091 (60.2%)		977 (59.8%)	1008 (61.7%)	
Medium-low	251 (15.3%)	599 (17.2%)		250 (15.3%)	252 (15.4%)	
Low	72 (4.3%)	168 (4.8%)		72 (4.4%)	60 (3.6%)	
<b>Education level</b>			< 0.01*			0.47
High	475 (28.7%)	1268 (36.1%)		467 (28.6%)	440 (26.9%)	
Medium	760 (46.0%)	1661 (47.2%)		757 (46.3%)	802 (49.1%)	
Low	418 (25.3%)	587 (16.7%)		411 (25.1%)	393 (24.0%)	
<b>Area of residence<sup>c</sup></b>			0.01*			0.63
North West	389 (23.5%)	741 (21.1%)		382 (23.4%)	387 (23.7%)	
North East	360 (21.8%)	649 (18.4%)		353 (21.6%)	315 (19.3%)	
Center	337 (20.4%)	759 (21.6%)		336 (20.5%)	344 (21.0%)	
South and islands	567 (34.3%)	1367 (38.9%)		564 (34.5%)	589 (36.0%)	
<b>Self-reported health status</b>			0.75			0.78
Excellent	238 (14.4%)	493 (14.0%)		234 (14.3%)	212 (13.0%)	
Good	839 (50.8%)	1839 (52.3%)		832 (50.9%)	863 (52.8%)	
Satisfactory	392 (23.7%)	816 (23.2%)		386 (23.6%)	375 (22.9%)	
Poor-bad	184 (11.1%)	368 (10.5%)		183 (11.2%)	185 (11.3%)	
<b>BMI</b>			0.17			0.80
Underweight-normal	784 (47.4%)	1740 (49.5%)		776 (47.5%)	767 (46.9%)	
Overweight-obese	869 (52.6%)	1776 (50.5%)		859 (52.5%)	868 (53.1%)	
<b>Current smoker<sup>b</sup></b>			0.10			0.04*
Yes	378 (22.9%)	727 (20.9%)		374 (22.9%)	314 (19.2%)	
No	1271 (77.1%)	2751 (79.1%)		1261 (77.1%)	1321 (80.8%)	
<b>Sports habit<sup>b</sup></b>			0.32			0.36
Yes	541 (32.8%)	1092 (31.4%)		530 (32.4%)	499 (30.5%)	
No	1110 (67.2%)	2389 (68.6%)		1105 (67.6%)	1136 (69.5%)	
<b>Physical functioning</b>			0.29			0.79
Partial limitation	50 (3.0%)	121 (3.4%)		49 (3%)	41 (2,5%)	
Total limitation	61 (3.7%)	104 (3.0%)		59 (3,6%)	59 (3,6%)	
No limitation	1542 (93.3%)	3291 (93.6%)		1527 (93,4%)	1535 (93,9%)	

<sup>a</sup>T-test was used for continuous variables, chi-square for categorical variables<sup>b</sup>missing data not reported (59 for job satisfaction, 42 for current smoker, 37 for sports habit)<sup>c</sup>within Italy

PSM Propensity score matching, BMI Body mass index

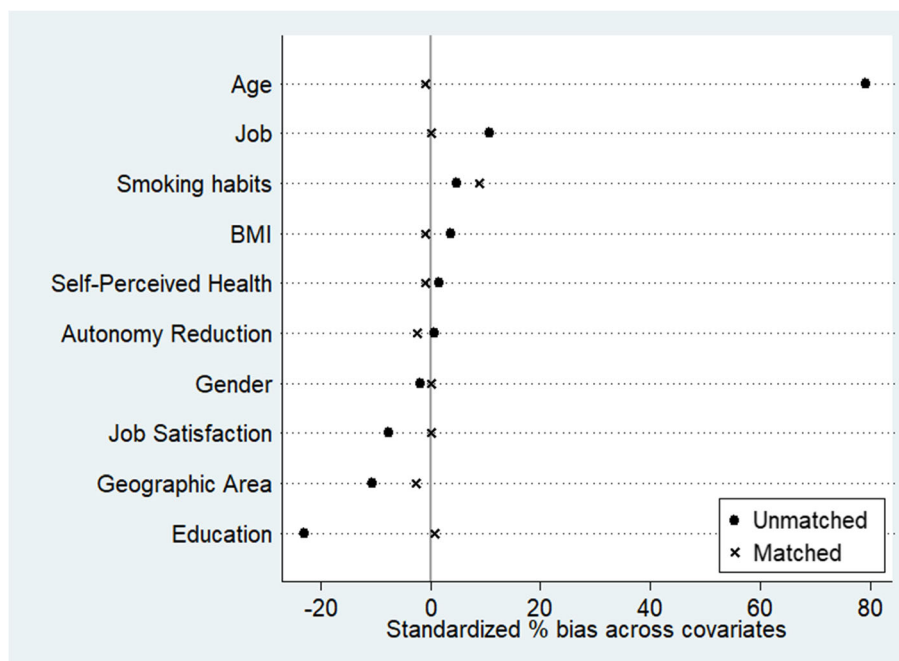


**Fig. 1** Distribution of propensity score matching into the two groups: unexposed (not transitioning, treated) and exposed group (transitioning, untreated)

with a greater probability of physical activity and perceived health status improvement, although also with worse physical functioning.

With regard to behavioural risk factors, our findings concerning physical activity are supported by studies

that have found that retirement has significant positive effects on voluntary physical activity [22–25]. Indeed, retirement results in a substantial reduction in hours worked and thus might provide retirees with the opportunity to devote more time to physical activity; increased



**Fig. 2** Percentage of bias reduction before and after propensity score matching

**Table 2** Relative-risk ratios and 95% confidence interval from logistic regression for the association between status and outcomes

Outcomes	Exposed <sup>a</sup> n. (%)	Unexposed n. (%)	RRR	95% CI	p-value
<b>Health status change</b>					
No change	773 (47.3%)	844 (51.6%)	1.00		
Worsening	465 (28.4%)	448 (27.4%)	1.13	0.92–1.40	0.25
Improvement	397 (24.3%)	343 (21.0%)	1.26	1.02–1.58	0.04*
<b>BMI</b>					
Underweight-normal (< 25)	762 (46.6%)	747 (45.7%)	1.00		
Overweight-obese (≥ 25)	873 (53.4%)	888 (54.3%)	0.96	0.81–1.15	0.68
<b>Current smoker</b>					
No	1284 (78.8%)	1317 (81.4%)	1.00		
Yes	345 (21.2%)	301 (18.6%)	1.18	0.94–1.46	0.15
<b>Sport habit</b>					
No	1022 (62.7%)	1124 (69.5%)	1.00		
Yes	608 (37.3%)	493 (30.5%)	1.36	1.12–1.64	< 0.01*
<b>Physical functioning change</b>					
No change	1464 (89.5%)	1501 (91.8%)	1.00		
Worsening	91 (5.6%)	58 (3.5%)	1.62	1.09–2.40	0.02*
Improvement	80 (4.9%)	76 (4.7%)	1.08	0.73–1.61	0.71

<sup>a</sup>transitioned to retirement

RRR Relative-risk ratio, BMI Body mass index

leisure-time physical activity consequent to retirement is identified as one of the major positive health-related changes in behaviour related to retirement [6, 25, 26]. However, differences are reported by type of physical activity: evidence suggests that transition to retirement is associated with exercise and leisure time, but not with total physical activity [4], for which no clear pattern seems to emerge [2].

Besides, such association is influenced by socioeconomic status (SES), which may act as an effect modifier, with lower SES decreasing the strength of the association [2, 4]. Among retirees of low SES, the decline in occupational activity after retirement is not replaced by an increase in other physical activity domains, while increased leisure-time physical activity is observed among people of high SES [4, 22, 26–28]. Our model accounted for SES with multidimensional proxies built as categorical variables, such as educational level and job type [29].

Systematic reviews on the topic [2, 3] reported various patterns of changes in sedentary time and physical activity across retirement, identified using different study's settings and methodologies (e.g., total sitting time vs specific leisure sedentary activities), reporting either a decline or an increase in duration, prevalence or frequency of physical activity. What is more, participation in physical activity varies by type of transition out of full-time employment [30, 31]: for instance, the case of disability retirement is quite a strong one [6]. On the

one hand, a decline in physical activity is observed among people exiting from paid work due to a disability [30]. On the other hand, midlife employees who increase their physical activity have a lower risk of subsequent disability retirement than those persistently low-active and vice versa [6], suggesting the importance of promoting vigorous physical activity among adult employees.

Moreover, recent studies suggested that the observed increase in leisure-time physical activity after retirement is temporary and diminishes over time. The transient positive effect, which is greater among those retiring at older ages, from higher status occupation and with fewer chronic diseases, may be short-termed and not persist in post-retirement years [23, 24]. Our results refer to a follow-up from transition to retirement of 3 years, maximum, so they cannot be exploited to evaluate effects over a longer term.

Secondly and directly linked to physical activity and possibly acting as mediators, smoking habit and a high BMI can cause a decline in the levels of physical health [32, 33] and should be considered in examining retirement-related changes in physical activity [6].

In detail, retirement could affect tobacco consumption, albeit results are still inconclusive as Xue et al. [2] systematically observed a decrease or no effect on smoking habit.

Studies report contrasting evidence concerning BMI: BMI seemed to increase in lower socioeconomic groups

or have no change in higher ones [34], but no clear pattern emerged. Previous work types may affect the physical practice, also through BMI. The loss of work-related physical activity from physically demanding jobs is not compensated by leisure-time physical activity, which would require substantial lifestyle adaptations, with a consequent increase in BMI if eating patterns are not changed. Obesity and overweight moderate the benefit of retirement on health and, with changes in BMI, all subjects are likely to experience improvements in self-rated and mental health [5].

Concerning self-rated health outcomes, on the one hand, a positive effect of retirement on self-rated health status has also been described by other European studies based on prospective data, such as the French GAZEL cohort [35] and the Whitehall II study, where mental health functioning improved in retirees from high employment occupation [7]. Our findings are generally consistent with those reporting that retirement appears beneficial for mental [36, 37] and perceived health [35]. Self-rated health was proved to be associated with mortality and is a valid measure of wellbeing and morbidity [38]. The reasons for the increased benefit may be that the burden of perceived health problems is substantially relieved by retiring, when people are no longer exposed to physically or mentally stressful conditions and can spend more time engaged in healthy activities, such as physical practice. As far as we are aware, our findings about perceived health status after retirement are among the first ones based on an Italian nationwide cohort of individuals who experienced the transition to retirement in the last 10 years. A fair generalisation might be proposed to other settings with generous health and social security systems in developed countries, since we accounted for the main possible confounders with PS.

On the other hand, even though literature findings have not produced conclusive evidence regarding physical functioning after retirement, with some studies suggesting functional benefits to retirement living [12], physical function was observed as declining with no significant difference between still working and retired subjects [7]. The Health and Retirement Study data corroborate a greater increase in physical functioning difficulties during retirement than in full-time work, accounting for chronic diseases and lifestyle-related risks [8]. Besides, the physical functioning reduction can moderate the effect between former work-related behaviours and physical activity during retirement. Our results appraise a significant change in physical functioning reduction towards a worsening outcome after retirement. Nevertheless, we acknowledged that both before and after PSM, the sample of individuals who reported a partial or total limitation is scarce, and the confidence interval of RRR is quite broad.

Our work has both strengths and limitations. Within the study's strengths, first of all, PLUS offers an extensive national database in terms of data, stratification and representativeness of the Italian working population aged 50 years or more. To the best of our knowledge, at the national level, this is one of the very few studies with a longitudinal design performed in Italy on the topic and the first analysis to exploit these data in a public health perspective. Another work's related strength is that the information derived from the same periodically conducted survey through rigorous procedures that include reliable CATIs. Secondly, a specific strength is the final study design: starting from cross-sectional waves, we reconstructed a longitudinal cohort via the individual-level data linkage, allowing us to follow the same subjects through different panel waves in all the years they were included. Finally, this study used a PSM approach to address the lack of randomness in the exposure (i.e., retirement) and simulating an experimental design. Even if this method may still have some limits, PSM increases the level of evidence of a study and, in turn, increases the strength and generalisability of its results [39].

Our study has some limitations. Firstly, we relied on self-reported health measures and health proxies. Secondly, the outcomes we derived from the survey are mostly not quantitative measures but derived from validated questions, such as the self-reported health assessment of the World Health Survey [18]. Thirdly, the study design did not cover an extensive follow-up period but focused on the differences reported in two consecutive interviews, before and after retirement. Finally, since the statutory pension age is predictable, workers may adjust their health-related behaviours before retirement; hence the potential effect of retirement on health and lifestyle behaviours may not completely coincide with the timing of withdrawal from employment.

Transition to retirement is a major life event, followed by changes at social, psychological, and physical levels that profoundly affect health. The circumstances of the transition can influence health behaviours [9], which are fundamental to maintain an acceptable level of health. Retirement triggers a complex set of adjustments and leads retirees' priorities and way of life to change as well [3], with conflicting results presented in literature and possibly involving a wide range of domains [2–4, 9, 10].

Adopting new healthy lifestyles is not easy at an older age. Thus, health promotion at this stage is a public health priority; the transition to retirement has an independent effect in itself and, as such, could be identified as a target point for prevention [15]. As life-course transitions tend to bring along lifestyle changes, synchronising them with public health interventions might be a successful approach [40]. Although finding occasion for promoting the initiation and maintenance of healthy

lifestyles is needed across the life course to prevent short- and long-term risk of unhealthy changes, this study supports previous evidence that the process of retirement is a window of opportunities for primary prevention interventions which could be effectively directed towards transitioning subjects [15].

Physical activity is a critical component of healthy ageing [41] and a key to preserve and improve health at older ages. Suggesting that the transition to retirement is associated with an increase in a moderate level of physical activity probably linked to people's free time, our study focuses on the need for intervention studies to test whether retirement offers an optimal and favourable moment for boosting the natural increase in physical activity [42].

Overall, gaps in knowledge persist. More extended longitudinal studies might help disentangle the different elements that mediate the effects of retirement on risk factors and health outcomes and analyse the temporal evolution, possibly differentiating contextual and individual characteristics. This effort would contribute to the implementation of prevention measures to promote healthy ageing. Finally, the role of health inequalities must be researched in depth to design public health policies targeting disadvantaged groups.

## Conclusion

Retirement effects on health and health-related behaviours are crucial for the future sustainability of healthcare and pension systems in most Western countries. The varied and long-term impacting consequences of retirement show that an economic perspective might be narrow-minded to guide future reforms [43]. The public health implications of retirement might be considered in a multidimensional and multiprofessional way to address the demographic and epidemiologic transition.

Even if there may be some functional benefits to retirement living, new prevention strategies to encourage healthy lifestyles in later life and maintain daily physical activity in the long term are needed across all SESs. Future research should focus on the determinants and pathways of behavioural changes after retirement to inform this development. Linking multiple and future further waves of national surveys may offer great insight to direct healthy ageing policies in Italy and Europe, possibly allowing a more extensive follow-up record linkage.

## Abbreviations

PLUS: Participation, Labour, Unemployment Survey; INAPP: Italian National Institute for Public Politics Analysis; CATI: Computer-Assisted Telephonic Interview; BMI: Body Mass Index; PSM: Propensity score matching; PS: Propensity score; RRR: Relative-risk ratios; SES: Socioeconomic status

## Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s12889-021-11670-3>.

### Additional file 1.

## Acknowledgements

For his conceptual insights and helpful discussion, we especially would like to thank former Minister of Labour and social security, Professor Tiziano Treu.

**\*Italian Working Group on Retirement and Health (in alphabetical order):** Andrea Amerio<sup>7</sup>, Chiara Ardito<sup>8</sup>, Greta Carioli<sup>9</sup>, Giuseppe Costa<sup>5</sup>, Angelo d'Errico<sup>3</sup>, Dario Fontana<sup>3</sup>, Beatrice Frascella<sup>1</sup>, Giovanni Gaetti<sup>1</sup>, Leandro Gentile<sup>2</sup>, Vincenza Gianfredi<sup>1</sup>, Roberto Leombruni<sup>8</sup>, Anna Odone<sup>6</sup>, Fulvio Ricceri<sup>5</sup>, Carlotta Sacerdote<sup>10</sup>, David Stuckler<sup>4</sup>, Giacomo Pietro Vigezzi<sup>1</sup>, Nicolas Zengarini<sup>3</sup>.

**Affiliations:** <sup>1</sup>School of Medicine, University Vita-Salute San Raffaele, Milan, Italy; <sup>2</sup>IRCCS Fondazione San Matteo, Pavia, Italy; <sup>3</sup>Department of Epidemiology, ASL TO3, Piedmont Region, Grugliasco, Turin, Italy; <sup>4</sup>Department of Social and Political Sciences, Bocconi University, Milan, Italy; <sup>5</sup>Department of Clinical and Biological Sciences, University of Turin, Turin, Italy; <sup>6</sup>Department of Public Health, Experimental and Forensic Medicine, University of Pavia, Pavia, Italy; <sup>7</sup>Department of Neuroscience, Rehabilitation, Ophthalmology, Genetics, Maternal and Child Health, Section of Psychiatry, University of Genoa, Genoa, Italy; <sup>8</sup>Department of Economics and Statistics "Cognetti De Martiis", University of Turin, Turin, Italy; <sup>9</sup>Department of Clinical Sciences and Community Health, Laboratory of Medical Statistics, Biometry and Epidemiology "G.A. Maccacaro", University of Milan, Milan, Italy; <sup>10</sup>Unit of Cancer Epidemiology, Città della Salute e della Scienza University-Hospital and Center for Cancer Prevention (CPO), Turin, Italy;

## Authors' contributions

AO, together with VG, GPV, BF, GG designed the study. AO, together with VG, GPV, BF, GG contributed to the implementation of the research and the analysis of the results. GPV, together with BF, GG VG and AO, wrote the first draft of the manuscript. All authors contributed to the final version of the manuscript. All authors read and approved the final version of the manuscript.

## Funding

The present study is funded by i) Fondazione Caripto, Grant: Aging and social research 2018: people, places and relations. Project: Pension reforms and spatial-temporal patterns in healthy ageing in Lombardy: quasi-natural experimental analysis of linked health and pension data in comparative Italian and European perspective (project n. 2018-0863), and ii) by the Italian Ministry of Health (project n. RF-2016-02364270).

## Availability of data and materials

The datasets supporting the conclusions of this study are publicly available from INAPP (<https://inapp.org/it/dati/plus>) upon request.

## Declarations

### Ethics approval and consent to participate

The need for ethics approval and consent to participate in this non-interventional study derived from a secondary analysis of anonymised data was waived.

### Consent for publication

Not applicable.

### Competing interests

The authors declare that they have no competing interests.

## Author details

<sup>1</sup>School of Medicine, University Vita-Salute San Raffaele, Milan, Italy. <sup>2</sup>IRCCS Fondazione San Matteo, Pavia, Italy. <sup>3</sup>Department of Epidemiology, ASL TO3, Piedmont Region, Grugliasco, Turin, Italy. <sup>4</sup>Department of Social and Political Sciences, Bocconi University, Milan, Italy. <sup>5</sup>Department of Clinical and Biological Sciences, University of Turin, Turin, Italy. <sup>6</sup>Department of Public



Health, Experimental and Forensic Medicine, University of Pavia, via Forlanini, 2, Pavia, Italy.

Received: 12 May 2021 Accepted: 9 August 2021

Published online: 14 September 2021

## References

- WHO. World Population Ageing 2017.
- Xue B, Head J, McMunn A. The impact of retirement on cardiovascular disease and its risk factors: a systematic review of longitudinal studies. *The Gerontologist*. 2020;60(5):e367–77. <https://doi.org/10.1093/geront/gnz062>.
- Barnett I, Guell C, Ogilvie D. The experience of physical activity and the transition to retirement: a systematic review and integrative synthesis of qualitative and quantitative evidence. *Int J Behav Nutr Phys Act*. 2012;9(1):97. <https://doi.org/10.1186/1479-5868-9-97>.
- Barnett I, van Sluijs EMF, Ogilvie D. Physical activity and transitioning to retirement: a systematic review. *Am J Prev Med*. 2012;43(3):329–36. <https://doi.org/10.1016/j.amepre.2012.05.026>.
- Matta J, Carette C, Zins M, Goldberg M, Lemogne C, Czernichow S. Obesity moderates the benefit of retirement on health: a 21-year prospective study in the GAZEL cohort. *J Psychosom Res*. 2020;131:109938. <https://doi.org/10.1016/j.jpsychores.2020.109938>.
- Lahti J, Holstila A, Mänty M, Lahelma E, Rahkonen O. Changes in leisure time physical activity and subsequent disability retirement: A register-linked cohort study. *Int J Behav Nutr Phys Act*. 2016;13(1):99.
- Mein G, Martikainen P, Hemingway H, Stansfeld S, Marmot M. Is retirement good or bad for mental and physical health functioning? Whitehall II longitudinal study of civil servants. *J Epidemiol Community Health*. 2003;57(1):46–9. <https://doi.org/10.1136/jech.57.1.46>.
- Stenholm S, Westerlund H, Salo P, Hyde M, Pentti J, Head J, et al. Age-related trajectories of physical functioning in work and retirement: the role of sociodemographic factors, lifestyle and disease. *J Epidemiol Community Health*. 2014;68(6):503–9. <https://doi.org/10.1136/jech-2013-203555>.
- Van Der Heide I, Van Rijn RM, Robroek SJW, Burdorf A, Proper KI. Is retirement good for your health? A systematic review of longitudinal studies. *BMC Public Health*. 2013;13(1):1–11.
- Schaap R, de Wind A, Coenen P, Proper K, Boot C. The effects of exit from work on health across different socioeconomic groups: a systematic literature review. *Soc Sci Med*. 2018;198(June 2017):36–45. <https://doi.org/10.1016/j.socscimed.2017.12.015>.
- Eibich P. Understanding the effect of retirement on health: mechanisms and heterogeneity. *J Health Econ*. 2015;43:1–12. <https://doi.org/10.1016/j.jhealeco.2015.05.001>.
- Jokela M, Head J, Vahtera J, Westerlund H, Marmot MG, Ferrie JE, et al. From midlife to early old age: health trajectories associated with retirement. *Epidemiology*. 2010;21(3):284–90. <https://doi.org/10.1097/EDE.0b013e3181d61f53>.
- Oksanen T, Virtanen M. Health and retirement: a complex relationship. *Eur J Ageing*. 2012;9(3):221–5. <https://doi.org/10.1007/s10433-012-0243-7>.
- Hernaes E, Markussen S, Piggott J, Vestad OL. Does retirement age impact mortality? *J Health Econ*. 2013;32(3):586–98. <https://doi.org/10.1016/j.jhealeco.2013.03.001>.
- Zantinge EM, van den Berg M, Smit HA, Picavet HSJ. Retirement and a healthy lifestyle: opportunity or pitfall? A narrative review of the literature. *Eur J Pub Health*. 2014;24(3):433–9. <https://doi.org/10.1093/eurpub/ckt157>.
- AREA Ricerca Scientifica e TT Bando con scadenza 'Ricerca Sociale' Contributi deliberati dal CdA del 18 dicembre 2018 [Internet]. [www.fondazionecariplo.it](http://www.fondazionecariplo.it). 2020 [cited 2020 Nov 17]. Available from: [https://www.fondazionecariplo.it/static/upload/ric/ricerca-sociale\\_cda\\_18dicembre20181.pdf](https://www.fondazionecariplo.it/static/upload/ric/ricerca-sociale_cda_18dicembre20181.pdf)
- Mandrone E. L'INDAGINE ISFOL PLUS. *Riv Ital Econ Demogr E Stat*. 2014;3:8.
- Subramanian SV, Huijts T, Avendano M. Self-reported health assessments in the 2002 world health survey: how do they correlate with education? *Bull World Health Organ*. 2010;88(2):131–8. <https://doi.org/10.2471/BLT.09.067058>.
- Plus | INAPP [Internet]. [cited 2021 Jul 12]. Available from: <https://inapp.org/it/dati/plus>
- Ross ME, Kreider AR, Huang Y-S, Matone M, Rubin DM, Localio AR. Propensity score methods for analyzing observational data like randomized experiments: challenges and solutions for rare outcomes and exposures. *Am J Epidemiol*. 2015;181(12):989–95. <https://doi.org/10.1093/aje/kwu469>.
- Austin PC. Optimal caliper widths for propensity-score matching when estimating differences in means and differences in proportions in observational studies. *Pharm Stat*. 2011;10(2):150–61. <https://doi.org/10.1002/pst.433>.
- Kämpfen F, Maurer J. Time to burn (calories)? The impact of retirement on physical activity among mature Americans. *J Health Econ*. 2016;45:91–102. <https://doi.org/10.1016/j.jhealeco.2015.12.001>.
- Stenholm S, Pulakka A, Kawachi I, Oksanen T, Halonen JI, Aalto V, et al. Changes in physical activity during transition to retirement: a cohort study. *Int J Behav Nutr Phys Act*. 2016;13(1):51. <https://doi.org/10.1186/s12966-016-0375-9>.
- Holstila A, Mänty M, Rahkonen O, Lahelma E, Lahti J. Statutory retirement and changes in self-reported leisure-time physical activity: a follow-up study with three time-points. *BMC Public Health*. 2017;17(1):528.
- Sjösten N, Kivimäki M, Singh-Manoux A, Ferrie JE, Goldberg M, Zins M, et al. Change in physical activity and weight in relation to retirement: the French GAZEL cohort study. *BMJ Open*. 2012;2(1):e000522. <https://doi.org/10.1136/bmjopen-2011-000522>.
- Mein GK, Shipley MJ, Hillsdon M, Ellison GTH, Marmot MG. Work, retirement and physical activity: cross-sectional analyses from the Whitehall II study. *Eur J Pub Health*. 2005;15(3):317–22. <https://doi.org/10.1093/eurpub/cki087>.
- Odone A, Landriscina T, Amerio A, Costa G. The impact of the current economic crisis on mental health in Italy: evidence from two representative national surveys. *Eur J Pub Health*. 2018;28(3):490–5. <https://doi.org/10.1093/eurpub/ckx220>.
- Chung S, Domino ME, Stearns SC, Popkin BM. Retirement and physical activity: analyses by occupation and wealth. *Am J Prev Med*. 2009;36(5):422–8. <https://doi.org/10.1016/j.amepre.2009.01.026>.
- Oakes JM, Rossi PH. The measurement of SES in health research: current practice and steps toward a new approach. *Soc Sci Med*. 2003;56(4):769–84.
- Feng X, Croteau K, Kolt GS, Astell-Burt T. Does retirement mean more physical activity? A longitudinal study. *BMC Public Health*. 2016;16:605.
- Henkens K, van Solinge H, Gallo WT. Effects of retirement voluntariness on changes in smoking, drinking and physical activity among Dutch older workers. *Eur J Pub Health*. 2008;18(6):644–9. <https://doi.org/10.1093/eurpub/ckn095>.
- Laaksonen M, Rahkonen O, Martikainen P, Karvonen S, Lahelma E. Smoking and SF-36 health functioning. *Prev Med*. 2006;42(3):206–9. <https://doi.org/10.1016/j.jypmed.2005.12.003>.
- Woo J, Leung J, Kwok T. BMI, body composition, and physical functioning in older adults. *Obes Silver Spring Md*. 2007;15(7):1886–94. <https://doi.org/10.1038/oby.2007.223>.
- Chung S, Domino ME, Stearns SC. The effect of retirement on weight. *J Gerontol Ser B*. 2009;64B(5):656–65. <https://doi.org/10.1093/geronb/gbn044>.
- Westerlund H, Kivimäki M, Singh-Manoux A, Melchior M, Ferrie JE, Pentti J, et al. Self-rated health before and after retirement in France (GAZEL): a cohort study. *Lancet Lond Engl*. 2009;374(9705):1889–96. [https://doi.org/10.1016/S0140-6736\(09\)61570-1](https://doi.org/10.1016/S0140-6736(09)61570-1).
- Oksanen T, Vahtera J, Westerlund H, Pentti J, Sjösten N, Virtanen M, et al. Is retirement beneficial for mental health? Antidepressant use before and after retirement. *Epidemiol Camb Mass*. 2011;22(4):553–9. <https://doi.org/10.1097/EDE.0b013e31821c41bd>.
- Mänty M, Kouvonen A, Lallukka T, Lahti J, Lahelma E, Rahkonen O. Changes in physical and mental health functioning during retirement transition: a register-linkage follow-up study. *Eur J Pub Health*. 2018;28(5):805–9. <https://doi.org/10.1093/eurpub/cky013>.
- DeSalvo KB, Bloser N, Reynolds K, He J, Muntner P. Mortality prediction with a single general self-rated health question. A meta-analysis. *J Gen Intern Med*. 2006;21(3):267–75. <https://doi.org/10.1111/j.1525-1497.2005.00291.x>.
- Lallukka T, Shiri R. Use of pseudo-trials in public health research: a case for propensity score matching. *Eur J Public Health*. 2020;30(3):393–4.
- Heaven B, O'Brien N, Evans EH, White M, Meyer TD, Mathers JC, et al. Mobilizing resources for well-being: implications for developing interventions in the retirement transition. *The Gerontologist*. 2016;56(4):615–29. <https://doi.org/10.1093/geront/gnu159>.
- Hupin D, Roche F, Gremeaux V, Chatard J-C, Oriol M, Gaspoz J-M, et al. Even a low-dose of moderate-to-vigorous physical activity reduces mortality by 22% in adults aged ≥60 years: a systematic review and meta-analysis. *Br J Sports Med*. 2015;49(19):1262–7. <https://doi.org/10.1136/bjsports-2014-094306>.

42. Baxter S, Johnson M, Payne N, Buckley-Woods H, Blank L, Hock E, et al. Promoting and maintaining physical activity in the transition to retirement: a systematic review of interventions for adults around retirement age. *Int J Behav Nutr Phys Act.* 2016;13(1):12. <https://doi.org/10.1186/s12966-016-0336-3>.
43. Signorelli C, Odone A, Gozzini A, Petrelli F, Tirani M, Zangrandi A, Zoni R, Florindo N. The missed Constitutional Reform and its possible impact on the sustainability of the Italian National Health Service. *Acta Biomed.* 2017 Apr 28;88(1):91–4. <https://doi.org/10.23750/abm.v88i1.6408>.

### Publisher's Note

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

**Ready to submit your research? Choose BMC and benefit from:**

- fast, convenient online submission
- thorough peer review by experienced researchers in your field
- rapid publication on acceptance
- support for research data, including large and complex data types
- gold Open Access which fosters wider collaboration and increased citations
- maximum visibility for your research: over 100M website views per year

**At BMC, research is always in progress.**

Learn more [biomedcentral.com/submissions](https://biomedcentral.com/submissions)

