The Effect of Retirement on Cardiovascular Disease: Evidence from Survey of Health, Ageing, and Retirement in Europe (SHARE)

Jiaru Liu

October 31, 2023

1 Introduction

Many countries in the world are experiencing a serious aging issue and they are trying to produce sustainable pension systems and reduce potential risks caused by aging populations. As a major life-course transition, it is believed that retirement could affect old people both physically and mentally. Also, more attention nowadays is turn to the effect of retirement on chronic diseases that accompanied by longer-lasting suffering. As the global leading cause of death, cardiovascular diseases (CVD) accounted for nearly one-third of deaths in 2019 (WHO, 2021). In Europe, it accounts to 45% of total deaths, which is higher than the international average level (European Heart Network, 2017). Also, it costs 210 billion euros annually in EU and 50% of it is spent on the health care. However, it could be prevented by reducing relevant risks including smoking frequency, alcohol consumption, and obesity (WHO, 2021). Thus, studying the causality between retirement and CVD could be vital to decrease overall high-risk population for CVD. Also, figuring out potential mechanisms behind it could be beneficial to not only reducing the related national medical burden but also designing retirement policies.

There is a growing discussion about how retirement influences people in their later life, different health conditions investigated include mental health (Butterworth et al., 2006; N. B. Coe & Zamarro, 2011; Eibich, 2015; Heller-Sahlgren, 2017; Picchio & Van Ours, 2020), subjective health (N. Coe & Lindeboom, 2008; N. B. Coe & Zamarro, 2011; Eibich, 2015; Insler, 2014; Johnston & Lee, 2009), chronic diseases (Behncke, 2012; N. B. Coe & Zamarro, 2011; Westerlund et al., 2010), health behaviours(Eibich, 2015; Müller & Shaikh, 2018) and healthcare utilization (N. B. Coe & Zamarro, 2011; Eibich, 2015). Mixed effects of retirement on CVD were discovered in previous paper, studies in Unites States found no effects while most European studies discovered negative impact of the retirement (Xue, Head, & McMunn, 2020). However, almost all previous paper only focus on short-term effect of the retirement on CVD outcome or related risk factors (Behncke, 2012; Börsch-Supan, Brugiavini, & Croda, 2009; Pedron et al., 2020; Sato, Noguchi, Inoue, Kawachi, & Kondo, 2023; Sousa-Uva et al., 2022; Yu et al., 2023). Studies often consider one single country (Behncke, 2012; Xue, Head, & McMunn, 2017; Yu et al., 2023) and ignore the potential differences in mechanisms across countries, which leaves important research gap to my study.

This study aims to investigate the causal relationship between retirement and CVD, which offers contributions to existing literature by addressing three critical gaps in current research. First, to the best of my knowledge, this paper might be one of the first to explore the long-term effect of retirement on CVD. Secondly, this study seeks to redress this imbalance by utilizing a cross-country data set to explore the distinct mechanisms within each nation and further compare them, thereby enriching the understanding of international differences in these mechanisms. Finally, the relationship between changes in mental health following retirement and CVD remains ambiguous, with previous research predominantly concentrating on how retirement influences conventional risk factors such as hypertension, obesity, diabetes, smoking, alcohol consumption, and physical activity (Pedron et al., 2020; Sato et al., 2023; Xue et al., 2017). This study breaks new ground by investigating the effects of retirement on individuals' depression levels and analyzing how these alterations might influence CVD. By estimating the the Survey of Health, Ageing, and Retirement in Europe (SHARE), it turns out retirement does not have significant effect on CVD in short-term. However, negative effects on heart attack are discovered in the long-run.

2 Conceptual Framework

The foundational premise of this paper is rooted in Grossman's health capital model, which posits that health is a durable capital stock (Grossman, 1972). Within this model, health is a dynamic asset that further depreciated over time and can be enhanced through the consumption of health-related products and services, like medical treatment. As Dave, Rashad, and Spasojevic (2008) mentions, retirement could be both detrimental and protective as the net impact of retirement on health depends on both marginal cost of health decline and marginal benefits of improvement in health. Specifically, the increase of leisure time post-retirement reduces the opportunity cost for medication and enabling engagement in health-promoting activities, thereby exerting a beneficial influence on

CVD. Concomitantly, the diminished opportunity cost of hospital visits may inversely correlate with the incidence of metabolic risk factors, including hypertension, high cholesterol, obesity, and diabetes. Furthermore, augmented leisure time may bolster physical activity, thereby reduce the probability of obesity. Alternatively, the incentives to invest in personal health drops with the decrease of income after retirement. The shifting incentives could extend to the bad management of other risk factors such as hypertension, high cholesterol and diabetes, where lack of control could exacerbate heart disease risks. It is hypothesized that the key mechanisms for retirement to impact the CVD is through the change of health behaviours, leisure activity and consumption of related medical treatment.

Based on the above model, recent research includes mental health as a critical factor (Heller-Sahlgren, 2017; Okamoto, Kobayashi, & Komamura, 2023), with an expanding body of evidence linking psychological well-being to heart disease (CDC, 2020). Long-term psychological distress, such as depression or anxiety, is associated with the increase of heart rate or blood pressure, which increases the incidence of stroke and hypertension. However, the effects of retirement on psychological health remain unclear as retirees can get new roles from the retirement with more social connections from friends and family while also lose some job-related networks (Okamoto et al., 2023). Retirement, while often symbolizing freedom from workplace stress, can simultaneously be a source of stress itself (Minkler, 1981). Additionally, retirement's effect on time allocation may lead to increased engagement in physical and social activities, which reduces the occurrence of mental disorders. The change of stress can engender behavioral modifications such as alterations in smoking, drinking and sleep patterns that all of which can affect health outcomes and ambiguously impact the potential risk for CVD (Brannon, Updegraff, & Feist, 2018). Consequently, this study believes that the relationship between retirement and CVD is likely mediated through these intermediary risk factors rather than being a direct causal link.

3 Data

This study uses the Survey of Health, Ageing, and Retirement in Europe (SHARE), which is a unique longitudinal dataset contains rich information of demography, health, socio-economic status and family networks for citizens aged 50 or above in 28 European countries and Israel. Between 2004 and 2020, researchers carried core interviews every two years using computer-assisted personal interviewing (CAPI). At this stage, 8 waves of data are released and this study uses 6 waves of data exclude wave 3 and 8. Wave 3 is an End-of-Life study, which has different questionnaires with rest of waves, is not included in the research. Wave 8 was interrupted by the outbreak of the Covid and it is believed individual behaviours, including physical activity level, might be largely affected by policy like quarantine. Thus, it is also excluded. The main sample of my research including participants appear at least 2 waves, and they come from countries including Austria, Belgium, Switzerland, Germany, Denmark, Spain, France, Italy, and Sweden.

In the main study, I set a 10-year bandwidth below and above the statutory pensionable age for every country. The selection of bandwidth relates the trade-off between consistency and unbiasedness. A small bandwidth may yield minimal bias but high variance, while a larger bandwidth can reduce variance but introduce bias. Therefore, 7-year and 13-year window surrounding the statutory pensionable age is employed for robustness. Samples that only appear in one waves or samples who are not permanent retired are dropped.

3.1 Dependent Variable

The outcome variable of CVD measures the occurrence of heart attacks and stroke that are acute events caused by the interruption of normal blood flow to the heart or brain (WHO, 2021). In the core questionnaire, participants are asked whether they are ever diagnosed or currently have heart attack or stroke.

3.2 Independent Variable

In this paper, a self-reported retirement status is be used to indicate the labor force status for the respondents. In the questionnaire, participants are asked to describe their current situation. Answers including employed or self-employed, unemployed, retired, homemaker and permanently sick or disables. Similar as Heller-Sahlgren (2017) and Sato et al. (2023), only employed, self-employed and retired samples are included in this case, individuals who are unemployed, homemaker and permanently sick or disabled are not considered for the regression. The indicator is 1 if the respondents report they are retired. Otherwise, this indicator variable is 0. However, (Heller-Sahlgren, 2017) stated non-retirees, who were not work for paid jobs can still receive pension benefits at the state pension age. This might stop their current work and regard themselves as retirees. This definition of retirement is applied for a further robustness check.

3.3 Risk factors

Considering potential mechanisms between retirement and CVD, this research considers both metabolic and behavior risk factors. Metabolic risk factors include high blood pressure, diabetes, obesity, high cholesterol and behavioral risk factors contain physical inactivity, smoking, and drinking behaviors (Sato et al., 2023; Xue et al., 2020). Moreover, WHO (2021) also states that mental health could be potential risk factors. Thus, this study uses Euro-D to measure depression level.

4 Identification Method

4.1 Endogeneity

The largest obstacle to estimate the causal effect of retirement on CVD is to address the endogeneity issue. There are two main sources of endogeneity in this case. First, the omitted variable bias (OVB) arises from variables that are difficult to observe and control. For instance, older individuals may consider factors such as preference for leisure, grandparenting behaviors, or informal care provision to spouses when making retirement decisions. Those who provide care to family members may be more inclined to retire (positive correlation), and might be less likely to perceive early symptoms of CVD, potentially exacerbating the disease (positive correlation). This leads to a positive bias in the estimated effect. Secondly, reverse causality poses a challenge, whereby individuals with heart problems may opt for early retirement.

4.2 Research Design

To circumvent these challenges, this paper employs the same IV-FE (instrumental variable-fixed effects) method as Heller-Sahlgren (2017) to estimate both short and long term effects. This method is very close to the fuzzy regression discontinuity (RD) design, which utilized in previous studies(N. B. Coe & Zamarro, 2011; Eibich, 2015; Georganas, Laliotis, & Velias, 2022; Johnston & Lee, 2009; Müller & Shaikh, 2018).

In short run, Two-Stage Least Squares (2SLS) is applied here and it shown as

$$\begin{aligned} R_{it} = \delta_0 + \delta_1 X_{it} + \delta_2 {X_{it}}^2 + \delta_3 I(X_{it} \geq SP_{it}) + \delta_4 X_{it} I(X_{it} \geq SP_{it}) \\ + \delta_5 {X_{it}}^2 I(X_{it} \geq SP_{it}) + \delta_6 Marital_{it} + \gamma_t + \lambda_i + \mu_{it} \end{aligned} \tag{1}$$

$$\begin{aligned} CVD_{it} = &\beta_0 + \beta_1 \hat{R_{it}} + \beta_2 X_{it} + \beta_3 {X_{it}}^2 + \beta_4 X_{it} I(X_{it} \geq SP_{it}) + \\ &\beta_5 {X_{it}}^2 I(X_{it} \geq SP_{it}) + \beta_6 Marital_{it} + \sigma_t + \eta_i + \varepsilon_{it} \end{aligned} \tag{2}$$

where R_{it} indicates the retirement status for participant i in time t and X_{it} is the age difference between the responders' age and the country-specific retirement age. Using the centered age could solve the issue that different countries have different statutory pensionable age and pension reforms at given periods. $I(X_{it} \geq c_0)$ is an indicator variable to show whether the age of participant is above the country-specific statutory retirement age or not. $X_{it} I(X_{it} \geq c_0)$ is an interaction term of X_{it} and $I(X_{it} \geq c_0)$, which allows the different slope of age on both sides of the cutoff. $Marital_{it}$ is the marital status for responders and (Sato et al., 2023) also consider this to the model. It indicates 1 if the individual is either married or partnered. CVD_{it} is the outcome variable for the older people and equals to 1 if the responder ever or currently has the disease. γ_t and σ_t are time fixed effect while λ_i and η_i are country fixed effect. Both μ_{it} and ε_{it} capture idiosyncratic error terms. The endogenous variable, R_{it} is just identified by the IV and $\hat{R_{it}}$, is the estimated result from the first stage.

For long-term effect, a lagged retirement variable R_{it-1} is applied here, the estimation reads as:

$$\begin{aligned} R_{it-1} = \delta_0 + \delta_1 X_{it-1} + \delta_2 {X_{it-1}}^2 + \delta_3 I(X_{it-1} \geq SP_{it-1}) + \delta_4 X_{it-1} I(X_{it-1} \geq SP_{it-1}) + \\ \delta_5 {X_{it-1}}^2 I(X_{it-1} \geq SP_{it-1}) + \delta_6 Marital_{it-1} + \gamma_t + \lambda_i + \mu_{it} \end{aligned} \tag{3}$$

$$\begin{aligned} CVD_{it} = \beta_0 + \beta_1 \hat{R_{it-1}} + \beta_2 X_{it-1} + \beta_3 {X_{it-1}}^2 + \beta_4 X_{it-1} I(X_{it-1} \geq SP_{it-1}) \\ + \beta_5 {X_{it-1}}^2 I(X_{it-1} \geq SP_{it-1}) + \beta_6 Marital_{it-1} + \sigma_t + \eta_i + \varepsilon_{it} \end{aligned} \tag{4}$$

This model is very similar with previous paper (N. B. Coe & Zamarro, 2011; Eibich, 2015; Heller-Sahlgren, 2017; Müller & Shaikh, 2018; Yu et al., 2023), while my model also considers age polynomials. In my setting, I consider second order polynomials of the centred age and use the first order as robustness check. As any IV setting, the estimated effect is a Local average treatment effect (LATE). In this paper, LATE captures the average effect of retirement for compliers, who retired after reaching the official retirement age.

5 Preliminary Results

In the first step, I estimate both the short and long run impact of retirement on the primary CVD outcomes, drawing upon a comprehensive sample encompassing all nine countries with the control of both time and individual fixed effects. Table 1 presents the principal findings. Model (1) and (4) display the first-stage regression results for the model and it represents the probability of retirement significantly increases once the people are eligible to receive the full pension income. Also, all F-statistics are well above 600, which largely exceed 10, attesting to the relevance assumptions of the valid IV.

Model (2) and (3) conclude the short-term effect of retirement on both heart attack and stoke, yet they do not yield statistically significant results. Models (5) and (6) explicate the long-term consequences, revealing a detrimental effect of retirement on CVD. Specifically, the data suggests a 7% increase in the probability of heart attack occurrence after two years post-retirement.

Table 1: Retirement effects on CVD

	Short-run			Long-run		
	First-result	Second-result		First-result	Second-result	
	(1)	(2)	(3)	(4)	(5)	(6)
Variables	Retired	Heart Attack	Stroke	L.Retired	Heart Attack	Stroke
$I(X_{it} \geq c_0)$	0.120***					
	(0.008)					
L.$I(X_{it} \geq c_0)$				0.197***		
				(0.013)		
Retired		-0.013	0.0104			
		(0.030)	(0.020)			
L.Retired					0.0697**	0.013
					(0.031)	(0.020)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Individual FE	Yes	Yes	Yes	Yes	Yes	Yes
F statistics	1041.53			669.45		
Observations	80,756	80,759	80,756	41,124	41,102	41,099

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Secondly, this paper presents the regression analyses exploring the impact of retirement on potential risk factors for CVD. Consistent with the preceding model, both year and individual fixed effects are controlled. The results, presented in Tables 2 and 3, summarize the effects of retirement on related metabolic and behavioral risk factors across both short- and long-term horizons. The listed data reveal that retirement does not exert a statistically significant influence on the majority of the related risk factors, either in the immediate aftermath or over an extended period. However, a notable exception is observed of mental health, where retirement appears to show a negative impact. This finding suggests that an increased propensity for depression post-retirement could potentially serve as a mechanism through which retirement influences CVD outcomes.

Table 2: Retirement effects on Metabolic risk factors

Variables	Hypertension		Diabetes		Obesity		High cholesterol		Euro-D	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Retired	-0.049		-0.021		-0.017		-0.054		-0.203	
	(0.045)		(0.028)		(0.043)		(0.060)		(0.294)	
L.Retired		-0.013		0.002		0.019		-0.013		0.783***
		(0.039)		(0.025)		(0.044)		(0.062)		(0.282)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Individual FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	80,758	41,102	80,757	41,100	79,524	40,608	80,756	41,100	80,807	41,124

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 3: Retirement effects on Behavioural risk factors

Variables	Moderate PA		Vigorous PA		Smoking		Drinking		Binge Drinking	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Retired	-0.001		0.088		-0.021		0.049		0.198	
	(0.054)		(0.085)		(0.054)		(0.068)		(0.151)	
L.Retired		-0.019		0.032		0.032		-0.076		0.145
		(0.051)		(0.082)		(0.088)		(0.067)		(0.132))
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Individual FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	80,788	41,113	80,781	41,114	61,409	22,607	80,786	41,118	60,551	34,099

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

References

Behncke, S. (2012). Does retirement trigger ill health? *Health economics*, *21*(3), 282–300.

Börsch-Supan, A., Brugiavini, A., & Croda, E. (2009). The role of institutions and health in european patterns of work and retirement. *Journal of European social policy*, *19*(4), 341–358.

Brannon, L., Updegraff, J. A., & Feist, J. (2018). *Health psychology: An introduction to behavior and health*. Cengage Learning.

Butterworth, P., Gill, S. C., Rodgers, B., Anstey, K. J., Villamil, E., & Melzer, D. (2006). Retirement and mental health: analysis of the australian national survey of mental health and well-being. *Social science & medicine*, *62*(5), 1179–1191.

CDC. (2020). *Binge drinking.* Retrieved october 9, 2023, from https://www.cdc.gov/alcohol/fact-sheets/binge-drinking.htm#:~:text=Binge%20drinking%20is%20defined%20as,is%20harmful%20on%20its%20own.

Coe, N., & Lindeboom, M. (2008). Does retirement kill you? evidence from early retirement windows.

Coe, N. B., & Zamarro, G. (2011). Retirement effects on health in europe. *Journal of health economics*, *30*(1), 77–86.

Dave, D., Rashad, I., & Spasojevic, J. (2008). The effects of retirement on physical and mental health outcomes. *Southern Economic Journal*, *75*(2), 497–523.

Eibich, P. (2015). Understanding the effect of retirement on health: Mechanisms and heterogeneity. *Journal of health economics*, *43*, 1–12.

Georganas, S., Laliotis, I., & Velias, A. (2022). The best is yet to come: The impact of retirement on prosocial behavior. *Journal of Economic Behavior & Organization*, *196*, 589–615.

Grossman, M. (1972). On the concept of health capital and the demand for health. *Journal of Political Economy*, *80*(2), 223–255. Retrieved 2023-10-30, from http://www.jstor.org/stable/1830580

Heller-Sahlgren, G. (2017). Retirement blues. *Journal of health economics*, *54*, 66–78.

Insler, M. (2014). The health consequences of retirement. *Journal of Human Resources*, *49*(1), 195–233.

Johnston, D. W., & Lee, W.-S. (2009). Retiring to the good life? the short-term effects of retirement on health. *Economics Letters*, *103*(1), 8–11.

Minkler, M. (1981). Research on the health effects of retirement: an uncertain legacy. *Journal of health and social behavior*, 117–130.

Müller, T., & Shaikh, M. (2018). Your retirement and my health behavior: Evidence on retirement externalities from a fuzzy regression discontinuity design. *Journal of health economics*, *57*, 45–59.

Okamoto, S., Kobayashi, E., & Komamura, K. (2023). The retirement–health puzzle: A sigh of relief at retirement? *The Journals of Gerontology: Series B*, *78*(1), 167–178.

Pedron, S., Maier, W., Peters, A., Linkohr, B., Meisinger, C., Rathmann, W., ... Schwettmann, L. (2020). The effect of retirement on biomedical and behavioral risk factors for cardiovascular and metabolic disease. *Economics & Human Biology*, *38*, 100893.

Picchio, M., & Van Ours, J. (2020). Mental Health Effects of Retirement. *De Economist*, *168*(3), 419–452. Retrieved from https://doi.org/10.1007/s10645-020-09369-8 doi: 10.1007/s10645-020-09369-8

Sato, K., Noguchi, H., Inoue, K., Kawachi, I., & Kondo, N. (2023). Retirement and cardiovascular disease: a longitudinal study in 35 countries. *International Journal of Epidemiology*, dyad058.

Sousa-Uva, M., Fonseca, A. M., Nunes, B., Sousa-Uva, A., Rodrigues, A. P., & Matias-Dias, C. (2022). The modifying role of major cardiovascular risk factors in the association between retirement and cardiovascular disease: Results from share portugal. *Work*, *72*(2), 577–586.

Westerlund, H., Vahtera, J., Ferrie, J. E., Singh-Manoux, A., Pentti, J., Melchior, M., ... others (2010). Effect of retirement on major chronic conditions and fatigue: French gazel occupational cohort study. *Bmj*, *341*.

WHO. (2021). *Cardiovascular diseases (cvds).* Retrieved october 9, 2023, from https://www.who.int/news-room/fact-sheets/detail/cardiovascular-diseases-(cvds)

Xue, B., Head, J., & McMunn, A. (2017). The associations between retirement and cardiovascular disease risk factors in china: a 20-year prospective study. *American journal of epidemiology*, *185*(8), 688–696.

Xue, B., Head, J., & McMunn, A. (2020). The impact of retirement on cardiovascular disease and its risk factors: a systematic review of longitudinal studies. *The Gerontologist*, *60*(5), e367–e377.

Yu, W., Yang, Y., Liu, X., Gao, X., Lv, Y., Zhou, L., ... others (2023). Heterogeneous effects of retirement on the biomedical risk factors for cardiovascular and metabolic diseases: New evidence based on the physical examination database in shanghai, china. *SSM-Population Health*, *21*, 101333.