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The impact of work on cognition and physical disability: Evidence from English women

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Abstract:

Delaying retirement has significant positive effects on the average cognition and physical mobility of women in England, at least in the short run. Exploiting the increase in employment of 60-63 year old women resulting from the increase in the female State Pension Age, we show that working substantially boosts performance on two cognitive tests, particularly for singles. We also find large improvements in measures of physical disability as a result of working: substantial increases in walking speed, and lower reports of mobility problems. However, for women in sedentary occupations, work reduces walking speed, due to lower levels of exercise.

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1. Introduction

Faced with increasing longevity in populations across the developed world, many governments are responding to the public finance pressures of an ageing population by encouraging individuals to work longer. For example, many countries have increased the eligibility age for public pensions. However, the full consequences of increased labour force participation at older ages on wellbeing, health and time use at older ages are not fully understood. The extent to which governments should continue to encourage individuals to extend their working lives should be based not only on the financial consequences of such policies, but also any knock on effects of a later retirement in other dimensions. One consequence of a longer working life may be altered levels of health, disability, and cognition, with direct consequences for individuals' wellbeing, and indirect consequences for their subsequent need for services, including those provided publicly.

There are a number of challenges when assessing the effects of retirement or work at older ages on health and cognition and there is no clear agreement from previous studies (see Banks, Chandola and Matthews 2015). This is in part because there are a wide range of health outcomes that may be affected by work at older ages (see Atalay and Barrett 2014). Some may be affected quickly and others (such as mortality – see Fitzpatrick and Moore 2018) may only occur a considerable time after retirement. Second, there can be substantial heterogeneity in the effect of retirement on health (Mazzonna and Perrachi 2012, 2016). While some jobs may negatively affect certain types of health, others may improve it, and while some retirement lifestyles may be good for health or cognition, others may be very poor. Finally, identifying causation from correlation can also be a challenge where health and labour supply have the potential to affect each other simultaneously.

Given the challenge of identifying causal impacts in general studies of retirement on many different health outcomes, which may vary for different types of people, jobs and lifestyles,

there is an important role for studies that examine specific mechanisms and outcomes. Our study is one of these and looks at the impact on cognitive function and physical disability of additional years of work? Our chosen health outcomes are measures of health that could plausibly react in the short term to a longer working life for people in their early 60s. To answer this question, we exploit the recent increase in the UK's "State Pension Age" for women (the earliest age at which they can claim a public pension), which increased the employment rate of 60-63 year old women by 11 percentage points between 2010 and 2017.

We build upon the previous literature in two key ways. First, by exploiting the gradual increase in the State Pension Age – this reform led to women born only a few months apart having different State Pension Ages – we can avoid the concerns arising from use of cross-country variation in pension eligibility as used in Rohwedder and Willis (2010), Bingley and Martinello (2013) and Coe and Zamarro (2011).[1]

Second, using rich data from the English Longitudinal Study of Ageing (ELSA), we observe multiple measures of individual's health and cognition. Our analysis combines the memory recall tests used in Rohwedder and Willis (2010), Bonsang et al (2012) and others, with the verbal fluency test of executive function, as used by Coe and Zammaro (2011) and Mazzonna and Perrachi (2012). We also exploit multiple measures of physical disability that are objective but self-reported (questions on problems undertaking certain physical activities) and one that is objective and also independently measured (an individual's walking speed) and therefore not subject to, for example, justification bias.

The substantial effects that we find imply that women who continue to work between 60 and their new – higher – State Pension Age as a result of the reform have on average significantly

[1] Fonseca et al (2017) find that results on retirement and cognitive function are sensitive to inclusion of country fixed effects, suggesting there are important unobserved differences across countries.

better cognition and fewer signs of physical disability than if they had retired at age 60. For women aged 60-63, being in paid work is found to increase cognition as measured by a delayed recall test (by around 1.5 words), though there is only a small impact on the immediate recall test. Being in employment also increases verbal fluency by around 6 words (in a minute) – compared to a pre-reform average of 23. One contributing factor to these cognition results could be that retirees lose the social participation and engagement with their colleagues when they retire, but that social participation and engagement outside of work (such as membership of clubs or societies, and seeing friends, family or children) do not rise upon retirement, which is what we find. And this is likely to be particularly relevant for single women, 63% of whom live alone, and therefore have no social engagement within their own home. Indeed, it is for this group that we see larger positive effects of work on cognition, compared to smaller (but still positive effects) on married people.

In terms of measures of physical disability, being in paid work at older ages is found to increase average walking speed by around 0.2 metres per second (m/s, compared to a pre-reform average of 1.0 m/s), results which are corroborated by substantial falls in the probability that individuals report having (moderate) mobility problems. We find evidence that one mechanism consistent with this effect is that older women do not increase the levels of other exercise (e.g. in sports or activities) and hence do not offset the loss of physical activity associated with their work. Looking further into this relationship, we find additional supportive evidence from the heterogeneity in effects across occupational groups. The overall positive effect of work on physical mobility is only a result of positive effects amongst those in more physically active occupations. But for women who work in the most sedentary occupations, being in paid work is found to have a significant negative impact on walking speed ‑ by around 0.3 m/s. For this group we also find that being in employment leads to a

reduced likelihood of reporting high levels of total exercise and an increased likelihood of reporting little or no exercise.

Taken together, these results suggest that, on average, there may be additional benefits of extending working lives beyond the financial benefits that accrue through retirement savings margins and such positive spillovers might should be factored into policy analysis of changing retirement incentives. But any such calculations should be nuanced. Perhaps most importantly, any such effects are going to be differentially distributed across the population, and not present at all for some subgroups. Our evidence suggests work is particularly good for the health of older single women and those who do not work in sedentary occupations. But the effects for married women in sedentary occupations (which is a relatively large group) are less strong. In addition, any longer run effects of work on more distant health outcomes such as cardiovascular disease or other chronic conditions, or mortality, may exhibit different patterns. Further research might profitably identify the key health or cognitive risks and protective factors inherent in different types of jobs and in different types of retirement lifestyles, and then study the distribution of transitions between the two in the older population, in order to generate a more detailed picture.

The rest of this paper proceeds as follows. Section 2 discusses the data we use. Section 3 sets out details of the policy reform that we exploit and the empirical methodology that we employ. Section 4 sets out our results and Section 5 concludes.

2. Data

We use data from the English Longitudinal Study of Aging (ELSA; see Steptoe et al 2013). This is a longitudinal study of people living in England who are aged 50 and over, with interviews occurring biennially. The first "wave" of ELSA was in 2002–03, and we use data from the third wave in 2006–07, through to the eighth (and most recent) wave in 2016–17.

ELSA is similar to related studies in other countries, including the Health and Retirement Study (HRS) in the United States, and Survey of Health, Ageing and Retirement in Europe (SHARE). It contains detailed information on a variety of measures of health, disability and cognitive function, as well as household demographics, economic activity, income, wealth, labour market histories and a range of other information on participation in different activities in society. Importantly, the data contain each individual's precise date of birth. This allows us to calculate the exact date at which they reached their State Pension Age – and the date that they would have reached State Pension Age in absence of reform.

The particular advantages of ELSA – relative to other survey datasets – are the relatively large sample size (for longitudinal household survey data) for individuals around retirement, and the detailed repeat information on measures of cognitive function and physical disability, which are measured in every wave (or nearly every wave) of the data.

As part of the ELSA interviews, the interviewer undertakes a number of tests of the individual's cognitive function. The tests used are carefully chosen such that they are relevant to older people's everyday functioning, sensitive to age-related decline, and that not many people get either the minimum or the maximum score (Huppert et al 2006). The first test is a "verbal learning and recall" test, in which individuals are read a list of ten words to memorise. They are then immediately asked to repeat as many of the words back to the interviewer, and five minutes later they are asked again to repeat the same ten words. This is a test of retrospective memory and is the same measure of cognition used in Rohwedder and Willis (2010) and Bonsang et al (2012), though we examine separately the effects on the immediate and delayed measures.

Steel et al (2003) provide more detailed information on these measures, and show that, on average, women, younger people, and more educated people perform better on them. They

also show that as people age, their performance on the delayed recall tests declines at a faster rate than on the immediate recall test. Celidoni et al (2017) find that decline in verbal recall tests in SHARE data are highly predictive of the onset of dementia.

The second test is a test of "verbal fluency", in which individuals are asked to name as many animals as they can in one minute. This measure is studied in Coe and Zamarro (2011) among others. Verbal fluency is a measure of executive functions such as self-initiated activity, categorisation and mental flexibility, rather than memory (Huppert et al 2006). Whitley et al (2016) show average verbal fluency starts to decline rapidly after the age of 60. In addition, we create a "cognitive index" which combines the two memory tests and the verbal fluency test in an equally weighted index that takes values between 0 and 30.

There are also a set of questions in each wave of data relating to disability and physical mobility. We use an objective and independently measured assessment of physical capacity: individuals' walking speed. The interviewer measures this by timing two walks of 8 feet (2.4 metres), and we report walking speed in metres per second (m/s). This is an important outcome not only because it is objective and independently measured, but because it is known to be a measure of physical function that declines dramatically with age (Steel et al 2003).

In addition, there are a set of questions that ask individuals whether they have problems undertaking specific mobility activities, in particular assessing upper and lower limb functions (see Steel et al 2003). Three of these ("pushing or pulling large objects", "stooping, kneeling or crouching", or "climbing several flights of stairs") we categorise as "moderate" mobility problems. There are a further seven problems which we categorise as "severe" mobility problems ("walking 100 yards", "sitting for two hours", "getting up from a chair", "climbing one flight of stairs", "lifting weights", "picking up a 5p coin from a table", and

"reaching or extending arms"). We mainly focus on the effects on moderate mobility problems as the group of interest is women aged 60-63 rather than older populations more likely to suffer with more severe problems.

2.1 The sample of cohorts of women affected by the increase in the State Pension Age

We select data from waves 3 to 8 of ELSA on all women born between April 1948 and March 1957 which are the birth cohorts affected by the reform (a financial year in the UK runs from April to the following March). Our sample contains two birth years (1948–49 and 1949–50) whose State Pension Age was their 60th birthday and then seven years who face a higher State Pension Age (details of the reform which created this variation is provided in the next section). The youngest birth year chosen is 1956–57 as their cohort is the youngest in our sample period who are observed at ages 60 or older. There are approximately 200-250 women observed of each single year of age in each wave of the ELSA data. Overall this leaves a sample of 10,628 person-year for the set of 2,462 women.

Table 1 shows the average characteristics of our sample, and the standard deviations. 57% of the sample are in paid work. On average they are 58.7 years old (because we include two waves of pre-reform data), with average ages being slightly higher among those not in paid work than those still in paid work. Those in paid work are more likely to be under the state pension age than those not in paid work. 77% are married or cohabiting, a rate that does not differ across those in and out of paid work. 24% of them left school before 16, while only 45% left aged 17 or older and those in work are more educated on average. Table 1 also shows differences in our outcomes of interest, with those in paid work, on average, having higher cognitive test score, slightly higher walking speed and reporting fewer mobility problems. Controlling for differences in age, time, birth cohort, education, marital status, and partner's age and education, being in paid work is still significantly associated with having

better cognitive test scores, faster walking speed, and fewer mobility problems, as is shown in Appendix Table 1.

We supplement our analysis using the UK "Family Resources Survey" (FRS – see Department of Work and Pensions et al 2018), which is an annual cross-sectional household survey of around 20,000 households per year. We only use households living in England to be consistent with the ELSA sample. The FRS includes information on households' incomes, and the economic activity and demographics of all members of the household (but do not contain measures of health). Since 2008–09, the FRS contains date of birth for all individuals (needed to calculate State Pension Age) and it is available up until 2016–17. Using the same birth cohorts of women as in our ELSA sample, there are 17,858 unique women in our sample from the FRS.

Table 1: Descriptive Statistics of ELSA Sample, (waves 3-8, 2006/7 to 2016/17)

Women born between April 1948 and March 1957

	All		**In paid work**		**Not in paid work**	
Individual characteristics:						
In paid work	0.57	[0.49]	1.00	[0.00]	0.00	[0.00]
Age	58.7	[4.2]	57.3	[3.7]	60.4	[4.1]
Under state pension age	0.71	[0.45]	0.84	[0.36]	0.53	[0.50]
Married or cohabiting	0.77	[0.42]	0.78	[0.41]	0.75	[0.43]
Home owner	0.84	[0.36]	0.89	[0.32]	0.78	[0.41]
Left school before 16	0.24	[0.43]	0.19	[0.39]	0.31	[0.46]
Left school at 16	0.31	[0.46]	0.32	[0.47]	0.29	[0.45]
Left school 17+	0.45	[0.50]	0.49	[0.50]	0.39	[0.49]
Outcomes of interest:						
Verbal fluency test score	22.6	[6.7]	23.2	[6.5]	21.9	[7.0]
Memory test score – immediate	6.6	[1.6]	6.7	[1.6]	6.4	[1.7]
Memory test score – delayed	5.5	[2.0]	5.7	[1.9]	5.3	[2.1]
Cognitive index score	17.9	[5.2]	18.4	[4.9]	17.2	[5.5]
Walking speed (m/s)	0.95	[0.26]	0.99	[0.23]	0.93	[0.27]
Any moderate mobility problems	0.42	[0.49]	0.34	[0.47]	0.53	[0.50]

Note: Standard deviations presented in brackets.
Number of unique individuals: 2,462; Number of person-year observations: 10,628.

3. Empirical methodology

Estimating the effect of employment at older ages on physical and cognitive function is complicated by the potential simultaneity of the relationship between employment, and cognitive and physical function. While employment at older ages may affect these outcomes directly, better physical mobility and cognition may also affect when individuals retire. We therefore use an instrumental variables approach to estimate the causal effect of work at older ages on physical disability and cognitive function. We exploit the policy-induced increase in employment of women aged 60 to 63 between 2010–11 and 2016–17 that was caused by the gradual increase in the State Pension Age for women in the UK.

3.1 The increase in the state pension age for women

The State Pension Age is the earliest age at which an individual can receive a state pension in the UK.[2] Between 1948 and 2010, the state pension age for women was 60. At the State Pension Age, the state pension can be claimed, or it can be deferred in return for an increased pension payment, although this is rarely done for long. In 2015–16, a full basic state pension was £116 per week (£6,000 or $7,800 per year).[3] At around 27% of median weekly earnings this provides a relatively low replacement rate for most people. There is no earnings test on the state pension, but it is subject to income tax.

The 1995 Pensions Act legislated to increase the State Pension Age for women gradually from 60 to 65 between 2010 and 2020. The State Pension Age rose by one month for each

[2] In a US context, the State Pension Age can most easily be thought of as equivalent to the Early Retirement Age (ERA). Unlike in the US Social Security System the State Pension Age is the only focal age in the UK state pension system.

[3] Some qualify for an additional earnings-related state pension, worth up to £160 ($208) per week in addition to the basic state pension, but most employees opted out of this system in return for lower payroll taxes and accumulated a private pension instead.

month of birth after March 1950. The implication of this is that women born only a few months apart have discrete differences in the age that they can first claim a state pension. While those born in March 1950 had a State Pension Age of 60, for those born in April 1951, their State Pension Age was 61, and for those born in April 1952 it was 62. The 2011 Pensions Act accelerated the increase in the State Pension Age to 65 (for those born after 5th April 1953), and increased it to 66 (for those born after 5th October 1954). The resulting State Pension Ages for women born between 1950 and 1955 are shown in Appendix Figure 1.

3.2 Using the increase in State Pension Age as an instrument for employment

We estimate the effect of being in paid work at older ages on disability and cognition using (two-sample) two stage least squares, using an indicator for being under or over her State Pension Age as an instrument for employment. Our first stage is set out in equation 1, and our second stage in equation 2. In the first stage, we regress an indicator of being in paid work *W*, for individual *i* in period *t*, on an indicator for whether she is under or over her State Pension Age (*underSPA)*, controlling flexibly for age using 18 single-year-of-age dummy variables ($\sum_a \delta_a[age_{it} = a]$), 46 dummy variables for time measured in years and quarters, ($\sum_t \mu_t[time_{it} = t]$), a variable that controls linearly for individuals year of birth (their "cohort" *C*), and a vector of other control variables.[4] We present results with and without the cohort variable; but it does not make a substantive difference to the results.

We use a two-sample 2SLS estimator as we use ELSA and FRS data pooled together in the first stage and only ELSA data in the second stage. We estimate our standard errors clustering

[4] This comprises five dummies for relationship status (married, cohabiting, widowed, divorced, separated) with baseline of single (never married), a dummy for leaving education at age 16 or later, 10 dummies for region, a dummy for partner's education, a quadratic in partners' age, a dummy for partner being aged 60-64, and a dummy for partner being over his SPA.

at the individual level, using the method set out by Pacini and Windmeijer (2016) for robust inference for the two-sample 2SLS estimator.

$$W_{it} = \alpha(underSPA)_{it} + \sum_a \delta_a[age_{it} = a] + \sum_t \mu_t[time_{it} = t] + \pi_1 C_i + \gamma_1 X_{it} + \varepsilon_{it} \quad (1)$$

$$y_{it} = \beta \widehat{W}_{it} + \sum_a \varphi_a[age_{it} = a] + \sum_t \mu_t[time_{it} = t] + \pi_2 C_i + \gamma_2 X_{it} + v_{it} \quad (2)$$

Equation (1) identifies the effect of being under State Pension Age on employment using difference-in-difference estimation. Being under the State Pension Age is an interaction between a woman's age and the time at which she is observed. We therefore must assume the common trends assumption that – in absence of the reform, the employment rate of women of different ages would have changed in the same way over time. This assumption rules out spillovers of the reform onto otherwise unaffected women, and that no other shocks hit those groups who were affected by the increased pension age but not those whose pension age was unaffected.[5]

The second stage of the instrumental variables methodology is shown in equation (2), where the outcome *y* (e.g. cognitive test score) is regressed on the predicted probability in being in work from equation (1) ($\widehat{W}$), and the same controls for age, time, cohort and other control variables as in the first stage. Our key assumption is that being under the State Pension Age only affects cognition and physical disability through its effects on employment, and through no other channel: we discuss the implications of any violation of this assumption alongside the relevant results.

[5] This assumption is untestable in period of the reform. However, to test for common trends prior to the reform, Appendix Table 4 presents "placebo tests" which imagine that the reform had occurred 4, 6, or 8 years earlier, and tests whether there was an impact on employment of this "placebo reform". We find no effect, suggesting that there are indeed common trends in employment prior to the reform. Pre-reform common trends in employment rates of older women were found in Cribb et al (2016) using a different UK dataset.

4. Results

4.1 The effect of the increase in the state pension on the employment of women

Table 2 shows our first stage estimates, i.e. the effects of being under the State Pension Age on the probability of being in paid work, as set out in equation (1). Columns (1) and (2) show that, using ELSA data only, being under the State Pension Age increases the probability of 60-63 year old women being in paid work by around 10 percentage points, with a standard error of 2.4 percentage points.[6] This compares to a pre-reform (2009–10) employment rate of around 40% for 60-62 year old women. Columns (3) and (4) show that incorporating data from the Family Resources Survey makes little difference to the estimated size of the effect (which is 11 percentage points) but the substantial increase in the number of individuals in our estimation sample means that there is considerably better precision, with a standard error of 1.4 percentage points and F-stat of around 60. In addition whether or not a liner control for birth cohort is included in the model makes very little difference to the estimated size of the effect of being under the SPA on paid work (as shown by comparing column 1 to column 2, and column 3 to column 4).

Table 2 Effect of being under the State Pension Age on probability of being in paid work

	(1)	(2)	(3)	(4)
Effect of being under SPA	0.097***	0.095***	0.108***	0.106***
Standard error	[0.024]	[0.024]	[0.014]	[0.014]
F-stat	17.0	16.0	61.9	59.6
Observations	10,628	10,628	28,482	28,482
Controls for linear cohort (financial year of birth)	No	Yes	No	Yes
Datasets	ELSA only	ELSA only	ELSA and FRS	ELSA and FRS

[6] These are similar effects on labour supply to those found by Cribb and Emmerson (2019) and a little larger than those found by Cribb et al (2016).

Notes: Control variables included in regression as set out in section 3 (though specifications 1 and 3 do not include a linear control for financial year of birth). Estimated by Ordinary Least Squares. Standard errors, shown in brackets, are clustered at the individual level. *** denotes that the effect is significantly different from zero at the 1% level.
Source: Authors' calculations using the English Longitudinal Study of Ageing and Family Resources Survey.

4.2 The effect of work on cognition and physical disability

Table 3 shows the estimated effect of being in paid work on cognition and physical disability. The results for cognition suggest that there are large and positive effects of being in employment on cognition for those who continue in paid work as a result of a higher State Pension Age. While there is some evidence of positive effects of employment on immediate memory test (0.5 to 0.7 additional words), there are large and significant effects of being in work on the delayed memory test – of around 1.5 to 1.8 additional words. This effect is larger than the effect of work on memory tests found by Bonsang et al (2012) – who found an effect of around 1 extra word recalled when the immediate and delayed tests were combined, but substantially smaller than the effects in Rohwedder and Willis (2010) who found an effect of employment of around 4.7 additional words.

Being in paid work also increases the verbal fluency score (number of animals mentioned) by around 6 animals, compared to a pre-reform average of around 23 animals (and a standard deviation of around 7). This is in contrast to Coe and Zamarro (2011) who do not find a significant effect of retirement on verbal fluency. Overall, the combined cognitive index score increase by around 5.5 points, around a one-standard deviation effect, and compared to a pre-reform average of 18. This large effect is statistically significant at the 1% level.

This effect on the cognitive index is considerable compared to the pre-reform distribution, and larger than the naïve OLS estimate (shown in Appendix Table 1). Appendix Tables 2 and 3 show that the effect is larger than the difference in average cognitive index between the average score for the top and bottom income decile for women in our sample, and similar to

the difference between the average score for the top and bottom (non-pension) wealth decile. Although the standard errors show there is some uncertainty around these estimates, the lower 95% confidence interval for the effect on the combined cognitive index is around 3 – meaning that we can rule out not only negative effects on cognition, but also small and even moderate positive impacts on cognition. Of course, these effects are Local Average Treatment Effects, and therefore one interpretation of these large effects are that women who would be better off in paid work (in terms of their cognition at least) may be those who continue to work in response to the higher State Pension Age.

Table 3 also shows that – for those women who work longer as a result of a higher State Pension Age – staying in paid work decreases physical disability. Staying in employment increases walking speed by around 0.2 m/s – compared to a pre-reform average of around 1.0 m/s. This objective and independently measured indicator of physical capacity is corroborated by a substantial decrease in the probability of women reporting having any of the three moderate mobility problems – by around 50 percentage points. These increases in mobility are driven by reductions in people reporting two of the three specific moderate mobility problems: difficulties stooping, kneeling and crouching, and difficulties climbing several flights of stairs. We also look at the effect on the probability of reporting the more severe mobility problems, but find no significant evidence of any effects.

The precision of the results suggests that we can rule out not only negative impacts of work on disability, but we can also rule out small and even moderate improvements in physical disability. Appendix Tables 2 and 3 suggest that the effects on walking speed are similar to the average difference in walking speed between those in the highest income decile and those in the lowest income decile (0.2 m/s), though smaller than the difference between the top and bottom wealth distribution (0.3 m/s).

Table 3: Effect of being in paid work on measures of cognition and physical disability

Outcome	(1)	(2)	Pre-reform averages for 60-63 year old women	Number of observations
Verbal fluency test score	6.24***	6.23***	23.19	8,490
	[1.86]	[1.89]	[7.38]	
Memory test – immediate	0.50	0.74**	6.61	10,296
	[0.34]	[0.35]	[1.57]	
Memory test – delayed	1.47***	1.76***	5.52	10,309
	[0.43]	[0.45]	[1.95]	
Cognitive index	5.35***	5.78***	18.15	8,480
	[1.38]	[1.43]	[5.40]	
Walking speed (m/s)	0.19***	0.21***	0.98	3,991
	[0.06]	[0.07]	[0.27]	
Probability of any moderate mobility problems	–0.50***	–0.52***	0.49	10,628
	[0.12]	[0.12]	[0.50]	
Controls for linear cohort	No	Yes		

Notes: Exogenous control variables as set out in section 3 (though specification 1 does not include a control for financial year of birth). Estimated by Two Sample Two Stage Least Squares. Standard errors, reported in brackets, are clustered at the individual level. *** denotes that the effect is significantly different from zero at the 1% level and ** at the 5% level.

Source: Authors' calculations using the English Longitudinal Study of Ageing and Family Resources Survey.

These results, which use an instrumental variables methodology, are identified on the base of our assumption that a higher State Pension Age only affects cognition and disability through its effect on employment. There are two potential threats to this assumption. The first is that the higher State Pension Age involves a reduction in state pension income paid to women who are no longer eligible for the state pension at age 60 and it is this income loss that is the cause of the effects observed. Cribb and Emmerson (2019) estimate that state benefit income (including the state pension) falls by an average of £82 ($107) per week for 60-62 year old women for the period before they reached their higher State Pension Age as a result of the reform. Although this is significant, it is very unlikely that this magnitude of income change to have a material impact on either cognition or disability. A £82 per week fall in benefit

income is a little smaller than the £100 per week difference between average income in the 4th and 6th deciles of the income distribution.

In contrast, the health measures we focus on differ only modestly between these deciles of the income distribution. This suggests that the effect of income on health is very small relative to the size of our estimated effect of retirement on health. This is shown in Appendix Table 2, there the average cognitive index rises by about 0.1 in this income range compared to an average index of 17.9. There is also only a 0.04 m/s rise in average walking speeds between these two deciles, compared to an average of 1.0 m/s and essentially no change in reports of moderate mobility problems.[7] Therefore, the fall in state pension incomes because of the reform are very unlikely to affect our results. Moreover, if they did, the falls in state pension income would be likely to worsen cognition and disability, but we find substantial *positive* impacts of employment (driven by the reform) on cognition and disability.

A second possible threat is that there could be an unpleasant surprise among some women that they face a State Pension Age higher than 60, and that there may be a sense of "injustice" at facing a higher State Pension Age than those women who were born a few years earlier (see De Grip et al 2012). This channel may well be relevant for some health outcomes, such as mental health or subjective general health; Carrino et al (2018) find worse mental health as a result of the higher State Pension Age. But it is unlikely that this channel would affect cognition or independently measured physical performance. Again, if it did bias our results, then this would imply that that true effect would be an even larger positive impact of work on cognition and physical disability than we estimate.

[7] An alternative calculation is that there is decrease in wealth resulting from a three year increase in the State Pension Age, of around £12,800 (3x52x£82). If people are not credit constrained, it is their wealth that will drive behaviour (Grossman 1972). Appendix Table 3 shows that differences in (non-pension) wealth which are much larger than this across the wealth distribution are associated with only small differences in – with the exception of the very lowest wealth quintile, who have much worse cognition and disability than the rest of the distribution.

In order to check the robustness of these results, we conduct some placebo tests. To do this, we imagine that the reform – the increase in the State Pension Age for women – was implemented either 4, 6 or 8 years previously. We do this by estimating the effect of the instrument (being under the State Pension Age) on the outcomes of interest, where the instrument is defined as if the reform was introduced earlier. The results of these placebo tests – shown in Appendix Table 4 – find that, while there are positive effects of being under the State Pension Age on cognition and physical disability when the pension age was actually increased, there is no evidence that these outcomes are changing in response to the placebo reforms 4, 6 or 8 years earlier. This helps support our conclusion that our results are not the result of variation in outcomes that happens to correlate with the increase in the State Pension Age.

4.3 Mechanisms for paid work improving cognition and physical disability

One reason for the increases in physical mobility could be if paid work involves a degree of physical activity that is not replaced when people move out of work and retire. Table 4 provides evidence that is consistent with this. Using the same IV method, it estimates the effect of being in paid work on the probability that individuals report undertaking various levels of exercise (none/low, medium or high). The question in ELSA asks: "*We would like to know the type and amount of physical activity involved in your daily life. Do you take part in sports or activities that are vigorous/moderately energetic/mildly energetic."* It subsequently asks about the frequency of undertaking of such exercise.

We use these questions on intensity and frequency to categorise people into three groups depending on whether they undertake no/low amounts of exercise, medium, or high amounts. The exact coding of these variables, and the specific activities that are prompted are listed in Appendix Table 5. The prompting highlights sports (such as swimming or running) or

activities (such as gardening or vacuuming) that are usually thought of as leisure activities, or activities of home production, rather than picking up physical activity undertaken at work. We find no statistically significant evidence of changes in the amount exercise as a result of staying in work longer due to the higher State Pension Age, implying that a failure upon retirement to replace physical activity at (or going to) work with physical activity in sports, activities or housework may be one reason that being in employment on average improves walking speed and mobility compared to being retired.

Table 4: Effect of being in paid work on probability of undertaking different levels of exercise

Amount of exercise:	(1)	(2)	Pre-reform averages for 60-63 year old women
None or low	0.05	0.10	0.27
	[0.09]	[0.09]	[0.44]
Medium	–0.11	–0.11	0.44
	[0.11]	[0.11]	[0.50]
High	0.06	0.01	0.29
	[0.10]	[0.10]	[0.46]
Controls for linear cohort (financial year of birth)	No	Yes	

Notes: Number of observations: 10,621. Exogenous control variables as set out section 3 (though specification 1 does not include a control for financial year of birth). Estimated by Two Sample Two Stage Least Squares. Standard errors, reported in brackets, are clustered at the individual level. *** denotes that the effect is significantly different from zero at the 1% level, ** at the 5% level and * at the 10% level.
Source: Authors' calculations using the English Longitudinal Study of Ageing and Family Resources Survey.

In addition, when many people leave work they lose the social engagement with colleagues who they would previously interact with on a regular basis. Higher levels of social isolation, and lower levels of social participation in societies or clubs, are associated with worse cognitive function in older age (Donovan et al 2015; Bourassa et al 2017). One reason for work maintaining cognitive function might be that when people retire they do not substitute engagement with colleagues for engagement with other people or participation in other activities. This story is consistent with the results of Table 5 which shows that we do not find any statistically significant effect on being in work on seeing children, friends or family, or

on the number of clubs or societies (such as social clubs, churches or other religious organisations, sports clubs etc). In addition, we create a "social isolation index", which is a count variable (of between 0 and 4), which the sum of the three dummy variables recording whether they see children, family and friends at least weekly, and a dummy variable for being in a member of at least one society). We find no evidence of an effect of being in paid work on this social isolation index.

Table 5: Effect of being in paid work on measures of social participation and isolation

Outcome	(1)	(2)	Pre reform average for 60-63 year old women	Number of observations
See children at least weekly	0.083 [0.103]	0.126 [0.106]	0.533 [0.501]	8,644
See family at least weekly	–0.052 [0.101]	–0.112 [0.105]	0.388 [0.489]	9,144
See friends at least weekly	–0.075 [0.110]	–0.111 [0.113]	0.543 [0.500]	9,203
Number of societies or clubs individual is a member of	–0.198 [0.281]	–0.258 [0.285]	1.33 [1.38]	8,942
Social isolation index	–0.028 [0.235]	0.057 [0.238]	1.91 [1.03]	8,130
Linear controls for cohort	No	Yes		

Notes: Estimated by Two Sample Two Stage Least Squares. Exogenous control variables as set out in the note to table 2 (including control for financial year of birth). Standard errors, reported in brackets, are clustered at the individual level. *** denotes that the effect is significantly different from zero at the 1% level, ** at the 5% level and * at the 10% level.
Source: Authors' calculations using the English Longitudinal Study of Ageing and Family Resources Survey.

4.4 Heterogeneity in the effect of work on cognition and physical disability

All the results so far have shown *average* effects for women aged 60-63 who remained in paid work as the results of a higher State Pension Age. However, as is emphasised by Eibich (2015), Mazzonna and Peracchi (2016) and Muller and Shaikh (2018), there is potentially significant variation in the effect of work or retirement on measures of health at older ages.

We therefore investigate the extent to which the effect of paid work on cognition and disability vary by two key characteristics: marital status and the physicality of their occupation (in their current or last job).

To use our Two Sample 2SLS methodology we are restricted to examining heterogeneity that can be measured in both the FRS and ELSA. Given that there is no direct measure of physicality of job in the FRS, we measure the physicality at the 1 digit Standard Occupational Classification level for women in our ELSA sample – as shown in Appendix Table 6. We class one occupational group (administrative occupations) as "sedentary", with 85% of working women in this group reporting that they have a sedentary job. We class three occupational groups (managerial, professional and associate professional) as "partly sedentary" as between 40% and 60% of working women in each occupational groups report being in sedentary jobs. The remaining five occupational groups have less than 40% of working women reporting being in a sedentary job in each group (and an average of 14% sedentary) and are classed as "non-sedentary". In this way we use the information on individual's occupational group (in either their current or last job), to assign them to a group based on average reported physicality of jobs in that group.

Table 6 shows that there is very little difference between the effect of a higher State Pension Age on those in sedentary occupations and those in more physically active occupations, although those in non-sedentary occupations are slightly more likely to have continued to work past age 60 as a result of the higher SPA. It also shows that there is essentially no difference in the effect of a higher State Pension Age on the employment rates of those who are married (or cohabiting) and those who are single (i.e. never married, divorced, separated or widowed).

Table 6 Heterogeneous effects of being under the State Pension Age on probability of being in paid work, by marital status and physicality of occupation

	Effect of being under SPA	Standard error	Number of observations	F-stat
All	0.106***	[0.014]	28,482	59.6
Marital/relationship status				
Married	0.104***	[0.016]	21,051	41.2
Single	0.110***	[0.026]	7,431	17.4
Physicality of occupation				
Sedentary occupation	0.110***	[0.035]	4,480	9.7
Partly sedentary occupation	0.096***	[0.030]	6,417	10.4
Non-sedentary occupation	0.127***	[0.026]	8.025	23.8

Notes: Control variables included as set out in the note to table 3 (including financial year of birth). Estimated by Ordinary Least Squares. Standard errors, reported in brackets, are clustered at the individual level. *** denotes that the effect is significantly different from zero at the 1% level.
Source: Authors' calculations using the English Longitudinal Study of Ageing and Family Resources Survey.

Table 7 shows heterogeneity in the effects of being in employment on cognition and disability. One disadvantage of splitting the sample is that the standard errors are larger and the estimated effects are less precise. Nevertheless, there are some clear results.

The effect of employment on cognition is consistently more positive for those who are single than those who are married across all of the cognitive test scores. For the verbal fluency test, there is a very large (19.1 points) effect on singles compared to only 1.6 points for married, significantly different from each other at the 1% level. This corroborated by large and statistically significant (at the 1% level) differences in the immediate recall test (3.3 for singles vs –0.3 for married), though the larger effect on singles for the delayed recall is not statistically significant. The effect of work on the combined cognitive index is 11.9 points for singles and 3.7 for those who are married (significantly different at the 10% level): i.e. those without a partner benefit more than those in couples in terms of improvements in cognition arising from remaining in paid work. One possible reason for this is that 63% of single

women in our sample also live alone, meaning that they do not have any social interaction within their household. Potentially unsurprisingly, there are no differences in the effect of work on cognition by the average physicality of the occupation.

Table 7 Heterogeneous effects of being in paid work on cognition and physical disability, by marital status and physicality of occupation

	Marital status		Physicality of occupation		
	Married	Single	Sedentary	Partly sedentary	Non-sedentary
Verbal fluency	1.63	19.05***	6.08	3.84	6.11**
	[2.02]	[6.09]	[4.04]	[3.55]	[2.74]
Memory test – immediate	–0.29	3.26***	0.99	–0.05	0.77
	[0.40]	[1.10]	[0.73]	[0.71]	[0.50]
Memory test – delayed	1.31***	2.63**	1.45	1.18	1.95***
	[0.50]	[1.10]	[0.93]	[0.85]	[0.68]
Cognitive index	3.65**	11.91***	6.31**	3.92	4.85**
	[1.52]	[4.13]	[3.14]	[2.69]	[2.06]
Walking speed	0.12*	0.39**	–0.29**	0.26*	0.46***
	[0.07]	[0.17]	[0.14]	[0.14]	[0.13]
Any moderate mobility problems	–0.54***	–0.60**	–0.65**	–0.34	–0.48***
	[0.15]	[0.27]	[0.30]	[0.23]	[0.18]

Notes: Exogenous control variables as set out in section 3 (including financial year of birth). Estimated by Two Sample Two Stage Least Squares. Standard errors, reported in brackets, are clustered at the individual level. *** denotes that the effect is significantly different from zero at the 1% level, ** at the 5% level and * at the 10% level.

Source: Authors' calculations using the English Longitudinal Study of Ageing and Family Resources Survey.

Table 7 shows that there are also no differences in the effect on physical disability by marital status. However, while there are substantial, and statistically significant, positive effects of work on walking speed for those in non-sedentary, or partly sedentary occupations, there are substantial, and statistically significant, negative effects on walking speed for those working in sedentary occupations. Sedentary occupations are the is administrative occupations – the most common job titles for women in this group in our sample are secretary, receptionist and clerk. Being in paid work for those in sedentary occupations is found to reduce walking speed

by 0.29 m/s, compared to increasing it by 0.26 m/s to 0.46 m/s for the less sedentary jobs. This finding is not mirrored by increases in the number of reported mobility problems for this group, which may suggest that the questions on the three moderate mobility problems do not pick up some important changes in physical disability around retirement.

Table 8 shows that the negative effect on work for those in sedentary occupations could be due to the effect of work (compared to retirement) on the amount of exercise taken. We find that this group of older women are much less likely to undertake high levels of exercise (64 percentage points less likely), and much more likely to undertake little or no exercise (by 67 percentage points) when in work. In comparison, there is no evidence of significant changes in exercise for partly sedentary occupations, and evidence that work leads to more exercise being done for non-sedentary workers, helping to explain the particularly large increase in walking speed arising from them remaining in work.

Therefore with work reducing the amount of exercise for sedentary workers, and little physical activity undertaken at work itself, for these workers, being in a sedentary job is bad for their walking speed. These results are consistent with other studies which find that retirement leads to an increase in physical activity for sedentary workers, but a decrease in physical activity for manual workers (see Barnett et al 2012). It also highlights the importance of recognising that the effects of work (compared to retirement) on health will be importantly determined by the kind of work undertaken, and the way that people spend their time in retirement, and these may differ substantially across different groups.

Table 8: Effect of being in paid work on probability of undertaking difference levels of exercise, by physicality of occupation

	Physicality of occupation:		
Amount of exercise:	Sedentary	Partly sedentary	Non-sedentary
None/low	0.67**	0.14	–0.19
	[0.29]	[0.17]	[0.15]
Medium	–0.03	–0.03	–0.18
	[0.22]	[0.23]	[0.16]
High	–0.64**	–0.10	0.38**
	[0.28]	[0.21]	[0.15]
Number of observations	2,526	3,487	4,153

Notes: Number of observations: 10,621. Exogenous control variables as set out section 3 (though specification 1 does not include a control for financial year of birth). Estimated by Two Sample Two Stage Least Squares. Standard errors, reported in brackets, are clustered at the individual level. ** denotes that the effect is significantly different from zero at the 5% level.
Source: Authors' calculations using the English Longitudinal Study of Ageing and Family Resources Survey.

5. Conclusion

Many governments have implemented, or are actively considering, policies designed to increase retirement ages, such as increasing state (public) pension claiming ages. Higher employment rates as a result of these kind of reforms may have important impacts on people's health. However, despite a considerable literature on the effect of retirement on health, there is no clear consensus, as health can be measured in many ways, there may be heterogeneous effects and there is the key challenge that health and labour supply decisions are likely to be simultaneously determined. This paper examines the effect of a longer working life (and therefore a delayed retirement) using an instrumental variables approach on two key measures of health that can plausibly change quickly in response to retiring: measures of cognitive function and physical disability.

There are two key contributions of this paper over the existing literature. First, rather than exploiting differences in pension claiming ages across countries, we exploit a reform – the

gradual increase in the State Pension Age for women in the UK since 2010 – that means that many women born only a few months apart face very different ages at which they can first receive a state pension. Second, by using detailed data from the English Longitudinal Study of Ageing, we have multiple tests of cognitive function, and use the independently-measured walking speed as a measure of mobility/disability in addition to self-reported mobility difficulties.

Using the increase in employment induced by the increase in the State Pension Age, we find that, for women aged 60-63, being in paid work increases cognitive function by around 5 points on a scale between 0 and 30, equivalent to around a 1 standard deviation effect. We find significantly larger effects for women who do not live with a partner. One contributing factor could be that retirees – particularly those who live alone – lose the social participation and engagement (which is associated with better cognition) with their colleagues when they retire, but that social participation and engagement outside of work (such as membership of clubs or societies, and seeing friends, family or children) do not rise upon retirement.

Paid work at older ages is also found to increase walking speed on average by around 0.2 m/s (compared to a pre-reform average of 1.0 m/s), results which are corroborated by substantial falls in the proportion reporting they have moderate mobility problems. We find heterogeneity, and not just in the magnitude of the impact of being in paid work on mobility but in the direction of the impact: for women working in sedentary occupations, being in paid work *reduces* their walking speed by around 0.3 m/s. This is likely to be caused by the fact that we find that work leads to substantially less exercise for workers in sedentary occupations.

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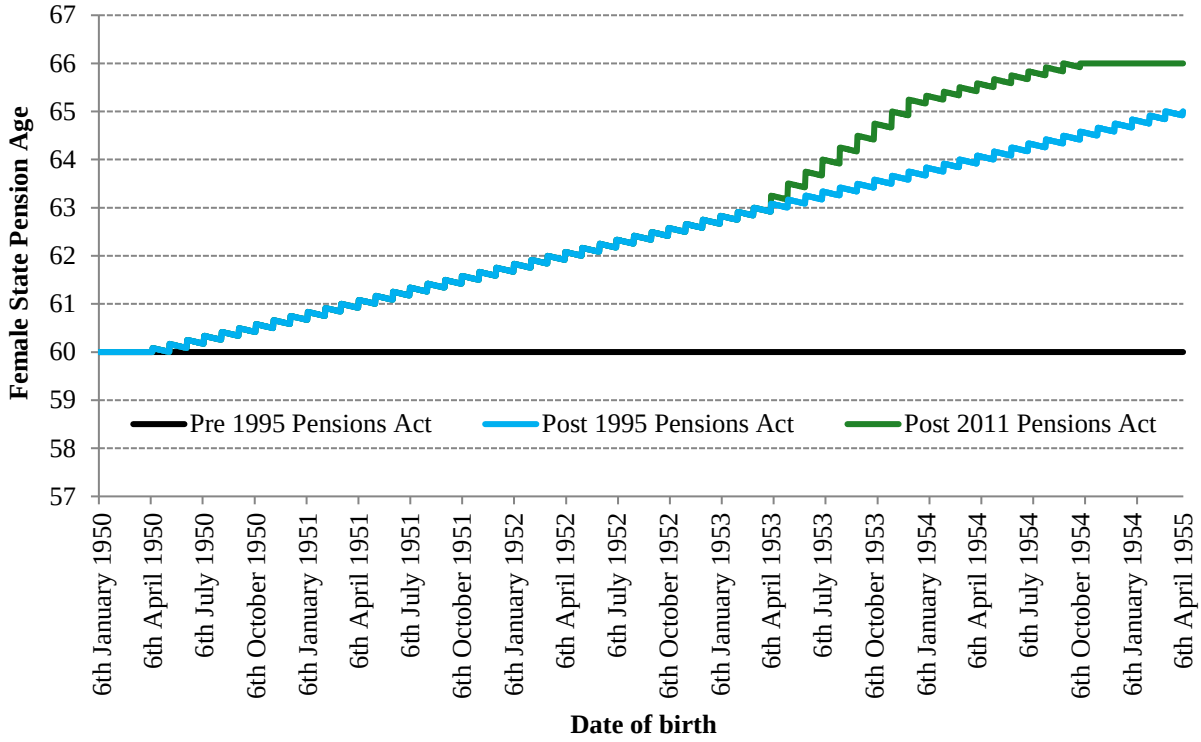
Appendix

Appendix Figure 1. UK State Pension Age for women under different legislation



Note: The reason the State Pension Age increases in a 'sawtooth' pattern, rather than a smooth line or a 'step' pattern, is that women born on any day in a given month are allocated the same 'State Pension Date' at which they are eligible for a state pension. Therefore women born later in the month have a slightly lower State Pension Age (measured in days) than those born earlier in the month.

Source: Pensions Act 1995, schedule 4 (http://www.legislation.gov.uk/ukpga/1995/26/schedule/4/enacted); Pensions Act 2007, schedule 3 (http://www.legislation.gov.uk/ukpga/2007/22/schedule/3); Pensions Act 2011, schedule 1 (http://www.legislation.gov.uk/ukpga/2011/19/schedule/1/enacted).

Appendix Table 1 OLS estimates of the relationship being in paid work and measures of cognition and physical disability

Outcome	Effect of being in paid work	Number of observations
Verbal fluency test score	1.09***	8,490
	[0.22]	
Memory test score – immediate	0.19***	10,296
	[0.05]	
Memory test score – delayed	0.23***	10,309
	[0.06]	
Cognitive index score	0.85***	8,480
	[0.17]	
Walking speed (m/s)	0.05***	3,992
	[0.01]	
Any moderate mobility problems	–0.16***	10,628
	[0.02]	

Notes: Reported effects are the coefficients on a dummy for being in paid work in the regression where the dependent variable is the outcome listed, and the control variables as listed in section 2, including linear control for financial year of birth. Standard errors, reported in brackets, are clustered at the individual level. *** denotes that the effect is significantly different from zero at the 1% level.
Source: Authors' calculations using the English Longitudinal Study of Ageing

Appendix Table 2 Average (mean) levels of cognition and physical disability, by decile of net equivalised family income, for 60-63 year old women

Decile of equivalised net income	Verbal fluency	Memory test-immediate	Memory test - delayed	Cognitive index	Walking speed	Any moderate mobility problems	Family income (£ per week)
1 (lowest)	20.8	6.2	5.0	16.1	0.87	0.559	97
2	22.0	6.3	5.2	17.0	0.88	0.525	173
3	22.0	6.3	5.2	17.1	0.92	0.497	227
4	22.6	6.5	5.4	17.9	0.93	0.456	273
5	23.0	6.5	5.4	18.1	0.98	0.416	325
6	22.6	6.7	5.6	18.0	0.98	0.456	377
7	23.6	6.6	5.6	18.7	1.00	0.424	444
8	24.1	7.0	5.8	19.1	1.00	0.394	523
9	24.6	7.1	6.0	19.8	1.03	0.329	641
10 (highest)	25.2	6.9	6.1	19.9	1.02	0.295	1,151
Differences:							
Decile 10 – Decile 1	4.4	0.8	1.1	3.8	0.2	–0.26	1,055
Quintile 5 – Quintile 1	3.5	0.8	1.0	3.3	0.2	–0.23	761

Source: Authors' calculations using the English Longitudinal Study of Ageing.

Appendix Table 3 Average (mean) levels of cognition and physical disability, by decile of family non-pension wealth, for 60-63 year old women

Decile of non-pension wealth	Verbal fluency	Memory test-immediate	Memory test - delayed	Cognitive index	Walking speed	Any moderate mobility problems	Family non-pension wealth (£)
1 (lowest)	20.3	5.9	4.5	15.2	0.74	0.71	–1,000
2	20.6	6.2	5.0	16.2	0.85	0.54	49,000
3	21.6	6.3	5.1	16.8	0.93	0.50	133,000
4	22.8	6.5	5.3	17.7	0.97	0.47	196,000
5	23.2	6.6	5.5	18.3	0.96	0.45	253,000
6	24.1	6.8	5.8	18.9	0.99	0.41	317,000
7	22.7	6.8	5.8	18.6	1.02	0.35	391,000
8	24.7	6.9	6.0	19.8	1.01	0.34	498,000
9	24.8	7.1	6.2	20.1	1.05	0.34	701,000
10 (highest)	25.6	7.0	6.1	20.4	1.08	0.24	1,710,000
Differences:							
Decile 10 – Decile 1	5.3	1.1	1.6	5.2	0.3	–0.5	1,711,000
Quintile 5 – Quintile 1	4.5	0.8	1.1	3.9	0.2	–0.3	1,619,000

Source: Authors' calculations using the English Longitudinal Study of Ageing.

Appendix Table 4 Results of placebo tests: testing for whether there are effects of being under State Pension Age had reforms been implemented 4, 6 or 8 years earlier

	"Effect" of being under State Pension Age on outcome			
Timing of reform:	Actual timing	4 years early	6 years early	8 years early
In paid work	0.095***	–0.009	0.002	–0.003
	[0.024]	[0.039]	[0.030]	[0.026]
Verbal fluency	0.69*	0.14	–0.32	–0.21
	[0.38]	[0.53]	[0.38]	[0.34]
Memory: immediate	0.08	0.14	–0.03	–0.04
	[0.07]	[0.13]	[0.10]	[0.09]
Memory: delayed	0.19**	–0.04	–0.09	0.00
	[0.09]	[0.15]	[0.12]	[0.10]
Cognitive index	0.65**	0.17	–0.19	–0.18
	[0.27]	[0.38]	[0.29]	[0.27]
Walking speed	0.023	0.029	–0.030	–0.011
	[0.017]	[0.038]	[0.029]	[0.025]
Any moderate mobility problems	–0.055**	0.006	–0.002	0.030
	[0.023]	[0.039]	[0.031]	[0.027]

Note: Effects for "actual timing" are results of estimating equation (1) but with the outcomes listed as the dependent variables instead of a dummy for being in paid work. The effects for the "placebo" reforms e.g. "4 years earlier" use data from before the increase, estimating the same model but coding the variable "under State Pension Age" as if reform had been implemented 4, 6 or 8 years previously. Controls included as set out in section 3 and include a linear control for financial year of birth. Estimated by OLS. Standard errors, reported in brackets, are clustered at the individual level. *** denotes that the effect is significantly different from zero at the 1% level, ** at the 5% level and * at the 10% level. ELSA data only.
Source: Authors' calculations using the English Longitudinal Study of Ageing.

Appendix Table 5: Construction of variable summarising amount of exercise undertaken

Panel A: Show Card provided to ELSA respondent when asked about physical activities, split by vigorous, moderate and mildly energetic

Vigorous	**Moderately energetic**	**Mildly energetic**
For example:	*For example:*	*For example:*
Running or jogging	Gardening	Vacuuming
Swimming	Cleaning the car	Laundry
Cycling	Walking at a moderate pace	Home repairs
Aerobics or gym workout	Dancing	
Tennis	Floor or stretching exercises	
Digging with a spade or shovel		

Source: ELSA Documentation Main Showcard Wave 8 (https://www.elsa-project.ac.uk/uploads/elsa/docs_w8/W8_MS_Showcards_Interviewer.pdf)

Panel B: Coding of information on intensity and frequency of exercise into summary variable on amount of exercise undertaken

For each intensity, individuals state the frequency they undertake exercise: **1) Hardly ever/never ; 2) 1-3 times per month; 3) Once a week; 4) More than once per week**	
These data are combined to create a mutually exclusive and exhaustive categorisation of exercise:	
None	Vigorous: Hardly ever/never **AND** Moderate: Hardly ever/never **AND** Mild: Hardly ever/never
Low	Vigorous: Hardly ever/never **AND** (Moderate: Hardly ever/never **OR** 1-3 times per month **OR** Once a week) **AND** Exercise not already coded as "None"
Medium	(Vigorous: Once per week **AND** (Moderate: Hardly ever/never **OR** 1-3 times per month)) **OR** Vigorous: 1-3 times per month **OR** (Vigorous: Hardly ever/never **AND** Moderate: more than once per week)
High	Vigorous: More than once per week **OR** (Vigorous: Once per week **AND** (Moderate: Once a week **OR** More than once a week))
None and Low categories are subsequently combined into one category	

Appendix Table 6: Definition of physicality of occupation

Panel A: ELSA question WPJACT on physicality of job

Q: Which of these best describes the work that you do in your main job? [Code One Only]

1. Sedentary occupation: You spend most of your time sitting (such as in an office)
2. Standing occupation: You spend most of your time standing or walking, however the way you spend your time does not require intense physical effort (e.g. Shop assistant, hairdresser, security guard etc.).
3. Physical work: This involves some physical effort including handling of heavy objects and use of tools (e.g. plumber, cleaner, nurse, sports instructor, electrician, carpenter etc.).
4. Heavy manual work: This involves very vigorous physical activity including handling of very heavy objects e.g. docker, miner, bricklayer, construction worker).

Source: ELSA Main Questionnaire Wave 8 https://www.elsa-project.ac.uk/uploads/elsa/docs_w8/W8_Interviewer_Questionnaire_FINAL_v02.pdf

Panel B: Proportion of women in each occupational class that are in jobs that are sedentary, standing or physical/heavy manual. Women born April 1948 to March 1957

	Percentage that are in:		
	Sedentary jobs	**Standing jobs**	**Physical /heavy manual jobs**
All	44.8%	36.2%	19.0%
Sedentary occupations			
SOC Group 4: Administrative	85.4%	11.9%	2.7%
Partly sedentary occupations			
SOC Group 1: Managerial	55.3%	30.7%	14.0%
SOC Group 3: Associate Professional	47.4%	33.6%	19.0%
SOC Group 2: Professional	46.1%	50.7%	3.2%
Average	*48.7%*	*39.2%*	*12.1%*
Non-sedentary occupations			
SOC Group 8: Process, plant and machinery	35.2%	34.2%	30.6%
SOC Group 7: Sales and Customer Service	23.8%	56.6%	19.6%
SOC Group 6: Caring & Leisure services	12.8%	54.0%	33.2%
SOC Group 5: Skilled trades	10.0%	46.9%	43.1%
SOC Group 9: Elementary occupations	3.4%	41.5%	55.1%
Average	*14.0%*	*49.4%*	*36.6%*

Notes: Number of observations: 8,370. Sample is women in ELSA waves 3-8 (2006/7 to 2016/17) born between April 1948 and March 1957, who were in work at time of interview. "Sedentary occupations" are those where 60% or more of the workers are in a sedentary job. "Partly sedentary occupations" are where 40% to 60% are in sedentary jobs, and "Non-sedentary occupations" are where less than 40% are in sedentary jobs.