How does arthritis affect employment in the UK?

Evidence from data on 20,000 people with arthritis compared to people without arthritis

A two-year, big data project led by the Academic Unit of Health Economics, Leeds Institute of Health Sciences, University of Leeds, with expert oversight from people living with arthritis and external advisors

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Project Report

1. Introduction

1.1 Background:

A quarter of the UK's working age population live with arthritis or a similar condition. Women and men of all ages can be affected, from teenagers and young adults who are starting their first jobs or apprenticeships, through to older people who are transitioning towards retirement. There are various types of arthritis and some are more common in particular age groups. But all forms of arthritis can make life difficult for people because of the pain, swelling or stiffness in a joint or joints, and because of difficulties in getting about (Versus Arthritis, 2021). This is a major policy concern, not least because of its potential impact on people's employment (DWP, 2017; 2017a), including in terms of early labour market exit, underemployment and failure to achieve their career potential or ambitions. These concerns are heightened due to the possibility that the COVID-19 pandemic has had a more severe impact on people with long-term health conditions (ONS, 2021; DWP, 2022).

Failing to achieve people's ambitions or potential in the labour market can have substantial and enduring consequences for the economy, as well as for the health and wellbeing of individuals and their families due to missed opportunities that stem from employment. These include opportunities for learning, social interaction, nurturing personal identity and self-esteem, achieving financial security, and enabling wealth accumulation which may be used to support good health and wellbeing in retirement (DWP, 2017; DWP, 2017a; DWP, 2017b).

Understanding the degree to which arthritis affects people's labour supply decisions and how this varies between different groups of individuals and at different life stages is fundamental to informing decisions by policy makers, employers and healthcare systems around maintaining employment opportunities and supporting employees. An early study by Bury (1982) posits that arthritis causes 'biographical disruption,' with different effects across different socio-economic classifications of work. These include the adoption of adaptive processes in people's daily routines, by reducing work hours or exiting the labour market for example (Reeve et al., 2010; Booker et al., 2020). Nevertheless, few empirical studies have specifically assessed the impact of arthritis on these labour market outcomes. Those that have indicate that people with arthritis are more likely to stop work on health grounds (Barrett et al., 2000), take early retirement (Conaghan et al., 2015) and are less likely to be in full-time work (Majeed et al., 2007). Yet these studies are limited by a lack of appropriate control group and/or by small, unrepresentative sample sizes or other potential sources of bias. None of those studies, and few studies from the broader literature examining relationships between ill-health and labour market outcomes (Booker et al., 2020) have identified the types of individuals (e.g., by gender or education status) and the life stages that are most prone to experiencing labour market consequences, or the types of job or employer where these individuals are most likely to be found. Such understanding is necessary to ensure that policies and interventions are designed and targeted in such a way that delivers the greatest benefits and maximises their likelihood of being cost-effective.

1.2 Our analyses:

In this study, we use data from three population-representative household panel surveys to estimate how arthritis affects labour market outcomes in around 20,000 people aged 18-80 in the United Kingdom who have arthritis when compared to closely matched controls. These datasets are the British Household Panel Survey (BHPS) (data collected annually in 18 waves, 1991-2009), UK Household Longitudinal Study (UKHLS; also known as 'Understanding Society') (data collected annually in 11 waves, 2009-2020, with additional data collected in 9 further waves during the COVID-19 pandemic: monthly from April 2020-July 2020, bimonthly from September 2020-March 2021, and finally in September 2021) and the English Longitudinal Study of Ageing (ELSA) (data collected every two years in 8 waves, 2002-2019).

We address two research questions:

Research question 1: How does arthritis affect labour market outcomes and how does this vary by individual-level characteristics including age, gender and educational status?

Research question 2: Is the observed relationship between arthritis and labour market outcomes dependent on the type of work in which people are employed or the type of employer?

Separate analyses were conducted for data collected before the COVID-19 pandemic (data from all three datasets up to early 2020) and data collected immediately before and during the COVID-19 pandemic (UKHLS data collected from January 2020 onwards). The particular labour market outcomes that we focused mainly on were probability of being in work and earnings conditional on being in work. We also looked at people's hours of work and, for the data collected during the COVID-19 pandemic, we used additional outcomes (including furlough and universal credit support) and compared outcomes for people living with arthritis to those living with a range of other long-term conditions (e.g. asthma or epilepsy).

The remainder of this Project Report is structured as follows: Section 2 provides an overview of the datasets used and the statistical analyses conducted. Section 3 provides a summary of some key results. Section 4 concludes with the Discussion. A more detailed description of the Methods and Results are provided in the academic journal articles by Rajah N et al. (2022) and Webb EJD et al. (2023).

2. Methods

2.1 Dataset description:

The three datasets (BHPS, UKHLS and ELSA) capture information on a population-representative sample of households, with individual-level data collected on each household member. The first wave of BHPS recruited in Great Britain in 1991, with recruitment expanded to the whole of the UK by 2001. BHPS ended after 18 waves in 2009. UKHLS recruited UK households between January 2009 and June 2011, including some households who had participated in BHPS. UKHLS participants are followed-up to the present day. Individuals join the UKHLS cohort if they move into the sample of households and new households may be created when individuals move elsewhere. The ELSA study is population representative of those aged >=50 years living in England in private households. In BHPS and UKHLS, adult household members complete an annual questionnaire (in face-to-face interviews at home or online), whereas in ELSA, participants are interviewed every two years.

2.2 Sample selection and variable selection:

For the analyses of data collected before the COVID-19 pandemic, survey participants were identified from all three datasets for use in our study, regardless of their employment status, if they were aged 18 to 80 at the time of data collection and if they responded at least once to a question about whether they currently had or had ever had an arthritis diagnosis. (Data collected in waves 1 to 10 of BHPS were excluded from our analyses because the relevant arthritis question is first asked in wave 11).

For the analyses of data collected immediately before and during the COVID-19 pandemic, UKHLS survey participants were included if they had indicated being in employment (including self-employment) in January or February 2020.

Variables were identified to address the research questions a priori on the basis of existing literature. For the analyses of data collected before the COVID-19 pandemic, it was necessary to harmonise data across all three datasets. This was done using an established approach that involved assessing the viability of sharing variables across datasets, defining appropriate data processing algorithms and setting rules for recoding variables so they were coded consistently across individuals regardless of the source dataset or time point (Fortier et al., 2011). For all analyses, clustered data, within individuals over multiple time points, were pooled in preparation for analysis.

2.3 Matching:

In the analyses of data collected before the COVID-19 pandemic, all individuals who reported having an arthritis diagnosis at any point in their life were matched to one individual who reported never having had an arthritis diagnosis at any time prior to exiting the cohort. The method used was propensity score matching, which involves assigning a probability of having arthritis to each individual conditional on observed characteristics. Individuals without arthritis are then identified who most closely resemble individuals who have arthritis in terms of those characteristics. The characteristics selected for use in this process were taken from the wave of entry to the cohort. These were age, gender, degree status, number of children in the household, ethnicity and region of residence. The number of individual-level observations in the dataset was also used.

In the analyses of data collected immediately before and during the COVID-19 pandemic, all individuals who reported that they had been diagnosed with arthritis or another selected long-term health condition in any survey wave with a pre-March 2020 response date were matched to individuals who had never been diagnosed with those conditions. These other conditions were asthma; cancer; diabetes; clinical depression and/or an emotional, nervous or psychiatric problem; vascular conditions (heart failure, heart attack, heart disease, angina, stroke, high blood pressure); pulmonary conditions (emphysema, bronchitis, chronic obstructive pulmonary disorder); liver conditions; epilepsy. They were included in order to support a comprehensive understanding of how people with arthritis fared during the COVID-19 pandemic when compared to people living with other long-term conditions. The method used was nearest neighbour Mahalanobis distance matching. The selected individual-level characteristics were similar to those used in the propensity score matching described above but in this case were all measured in January or February 2020.

2.4 Regression analysis:

For each matched sample of individuals with and without a given health condition, a variety of different regression models were used to address research question 1, depending on the outcome of interest. In brief, we focused on two labour market outcomes: whether or not in work (including self-employed) and earnings conditional on employment. We also looked at hours worked conditional on employment. The analyses of data collected during the COVID-19 pandemic additionally examined whether the individual was furloughed or received universal credit at any time after March 2020. All outcomes were analysed using random effects panel data models with a binary variable indicating whether or not participants have a given health condition and selected control variables. The analyses of data collected during the COVID-19 pandemic additionally included a time trend plus an interaction between the binary variable (for a given health condition) and the time trend.

To address research question 2, subgroup analyses were conducted based on the type of work and the workplaces in which people are or were previously employed. Subgroups were created by including observations from individuals who were currently or most recently employed in a given type of work based on their most recent occupational status (using the three level NS-SEC classification) and employer (four levels: large/small, private/non-private).

3. Results

3.1 Descriptive statistics

Table 1 reports descriptive statistics for data collected before the COVID-19 pandemic. The left-hand side of Table 1 provides information on all individuals at the point of entry to the datasets, after exclusion of observations where individuals are aged <18 or >80 years (n=106,655). People who report ever having arthritis are older (median age 59.0, compared to 45.0 for those who have never had an arthritis diagnosis), more likely to be female than male (63.3% of those who have ever had arthritis, compared to 51.4% who have not), to have a degree and to have children in the household. They are also less likely to be in work (28.8% vs 56.6% for those without arthritis) and, if they are in work, to have lower earnings (£20,300 vs £23,000 for those without arthritis).

The right-hand side of Table 1 reports descriptive statistics for the sample of individuals identified after propensity score matching (n=36,028). Compared to the pre-matching sample on the left-hand side, this indicates that the two matched groups (people with arthritis compared to those without arthritis) were more comparable on observed variables including age (59 years in both groups, vs a gap of 14 years in the pre-matched data), gender (59% female in the non-arthritis group and 64% in the arthritis group) and degree status. Although differences remained in terms of whether they were in work (45.0% in the non-arthritis group vs 37.6% for the arthritis group) and their earnings (£21,500 vs £20,500) conditional on being in work, these differences were smaller. This is probably due to differences in the variables that were used in the matching process, such as age and gender.

Table 2 shows descriptive statistics for data collected in January or February 2020 on individuals used in the analysis of data collected during the COVID-19 pandemic (n=12,432).

3.2 Research question 1 (relationship between health conditions and labour market outcomes):

Using the matched data that was collected before COVID-19, our regression models indicated a statistically significant, negative association between having arthritis and being in work after adjustment for the selected control variables. On average, arthritis was associated with a 3 percentage point reduction in the probability of being in work when compared to people without arthritis. Figure 1 (bottom panel) plots the predictions of the regression model in terms of the likelihood of being in work, by age, gender and degree status. These plots show differences in the likelihood of being in work among people with arthritis compared to the matched controls are not homogenous. For example, arthritis appears to be associated with a larger effect among women and people who did not have a degree-level education. As an indication of the magnitude of these differences, estimates from our regression models show that the percentage point reduction in the probability of being in work that is associated with having arthritis varies as follows:

- 2 percentage points for 50 year-old men with a degree
- 5 percentage points for 50 year-old men without a degree
- 6 percentage points for 50 year-old women with a degree
- 11 percentage points for 50 year-old women without a degree
- 17 percentage points for 60 year-old women without a degree

Figure 1 additionally plots the likelihood of being in work for the unmatched data (top panel) and the matched data prior to the regression analysis (middle panel). Comparing the three panels in Figure 1 demonstrates that the matching process and the regression models have narrowed the observed differences in labour market outcomes that are present in the original data, since these are explained partially by differenes in the other selected observed variables.

Our regression models where earnings was an outcome suggested that, for people in work, arthritis is associated with an average 4% reduction in earnings. The mean earnings of people without arthritis is predicted to be £14,228 compared to £13,659 for those with arthritis.

Using the data collected immediately before and during the COVID-19 pandemic, our regression models identified statistically significant negative interactions between arthritis and the time trend, indicating a growing gap between the likelihood of people with and without arthritis being in work. This gap is illustrated in Figure 2, which shows the predicted likelihood of being in work for people with arthritis when compared to matched controls without arthritis (panel 1). This growing gap in the likelihood of being in work was also statistically significant for several other conditions (asthma, cancer, diabetes, vascular conditions and epilepsy) when compared to people without those conditions. Comparisons between each of the eight other long-term health conditions and matched controls are also shown in Figure 2 (panels 2-9).

3.3 Research Question 2 (the role of work-related factors in explaining differences in labour market outcomes)

Using the matched UKHLS data that was collected before COVID-19, our regression models indicated that people with arthritis who had previously worked in small private companies were typically less likely to be in work when compared to people with arthritis who previously worked in larger companies or in the public sector. For instance, a 63 year old male (the median age in our dataset) who had most recently been employed in a small private company had an 80% probability of being in work if they did not have arthritis, after controlling for the selected control variables, whereas those with arthritis had a 60% probability of being in work. This equates to a 20 percentage point reduction in the likelihood of being in work. In contrast, there was a smaller 9 percentage point reduction in the likelihood of being in work that was associated with arthritis among 63 year old males who had most recently been employed in a large, non-private organisation. This effect appears to be greater in older age. For example, for 55 year old males who had most recently worked in a small private company, there was only a one percentage point reduction in the likelihood of being in work when living with arthritis compared to people without arthritis. Yet, the equivalent reduction for 65 year old males was 23 percentage points. Our regression models where earnings was an outcome showed that, for people in work, there was no statistically significant relationship between having arthritis and earnings by the type of employer.

Our regression models examining the role of occupational status on the relationship between arthritis and the likelihood of being in work showed that people in ‘routine’ (e.g. lorry drivers or bar staff) and ‘intermediate’ (e.g. paramedics or bank staff) occupational groups were 8 percentage points less likely to be in work when compared with those who do not live with arthritis. This contrasts with people in ‘professional’ work (e.g. lawyers or architects) who typically were as likely to be in work as people without arthritis, at all stages of their working lives. However, some people with arthritis who had a ‘professional’ occupation worked reduced hours and had lower earnings, and this was particularly true for women aged over 40 years.

Table 1: Descriptive Statistics for data collected before the COVID-19 pandemic

	PRE-MATCHING SAMPLE			POST-MATCHING SAMPLE		
	Non Arthritis Group (N=86671)	Arthritis Group (N=19984)	Overall (N=106655)	Non Arthritis Group (N=18014)	Arthritis Group (N=18014)	Overall (N=36028)
Age						
Mean (sd)	41.2 (17.2)	58.6 (12.1)	44.4 (17.7)	58.6 (12.9)	58.3 (12.2)	58.4 (12.6)
Median [Min, Max]	40.0 [18.0, 80.0]	59.0 [18.0, 80.0]	45.0 [18.0, 80.0]	59.0 [18.0, 80.0]	59.0 [18.0, 80.0]	59.0 [18.0, 80.0]
Gender						
Male	42131 (48.6%)	7328 (36.7%)	49459 (46.4%)	7201 (40.0%)	6564 (36.4%)	13765 (38.2%)
Female	44540 (51.4%)	12656 (63.3%)	57196 (53.6%)	10813 (60.0%)	11450 (63.6%)	22263 (61.8%)
Education						
No Degree	64976 (75.0%)	16438 (82.3%)	81414 (76.3%)	16070 (89.2%)	15920 (88.4%)	31990 (88.8%)
Degree	16525 (19.1%)	2148 (10.7%)	18673 (17.5%)	1944 (10.8%)	2094 (11.6%)	4038 (11.2%)
Missing	5170 (6.0%)	1398 (7.0%)	6568 (6.2%)			
Number of children in household						
None	60111 (69.4%)	15746 (78.8%)	75857 (71.1%)	14275 (79.2%)	14304 (79.4%)	28579(79.3%)
One or More	26542 (30.6%)	4223 (21.1%)	30765 (28.8%)	373 (20.7%)	3704 (20.6%)	7441 (20.7%)
Missing	18 (0.0%)	15 (0.1%)	33 (0.0%)	2 (0.0%)	6 (0.0%)	8 (0.0%)
Ethnicity						
White	61395 (70.8%)	16765 (83.9%)	78160 (73.3%)	15621 (86.7%)	15554 (86.3%)	31175 (86.5%)
Non-White	20764 (24.0%)	2656 (13.3%)	23420 (22.0%)	2393 (13.3%)	2460 (13.7%)	4853 (13.5%)
Missing	4512 (5.2%)	563 (2.8%)	5075 (4.8%)			
Number of observations						
Mean (sd)	5.19 (4.15)	6.60 (4.16)	5.46 (4.19)	6.98 (4.37)	7.01 (4.16)	6.99 (4.27)
Median [Min, Max]	4.00 [1.00, 17.0]	6.00 [1.00, 17.0]	4.00 [1.00, 17.0]	7.00 [1.00, 17.0]	7.00 [1.00, 17.0]	7.00 [1.00, 17.0]
Location						
Outside of London	73486 (84.8%)	18040 (90.3%)	91526 (85.8%)	16452 (91.3%)	16341 (90.7%)	32793 (91.0%)
London	12986 (15.0%)	1918 (9.6%)	14904 (14.0%)	1562 (8.7%)	1673 (9.3%)	3235 (9.0%)
Missing	199 (0.2%)	26 (0.1%)	225 (0.2%)			
Labour market status						
Economically inactive or unemployed	24824 (28.6%)	4480 (22.4%)	29304 (27.5%)	2557 (14.2%)	4026 (22.3%)	6583 (18.3%)
Retired	12247 (14.1%)	8183 (40.9%)	20430 (19.2%)	7344 (40.8%)	7223 (40.1%)	14567 (40.4%)
Economically Active	49530 (57.1%)	7321 (36.6%)	56851 (53.3%)	8112 (45.0%)	6765 (37.6%)	14877 (41.3%)
Missing	70 (0.1%)	0 (0%)	70 (0.1%)	1 (0.0%)	0 (0.0%)	1 (0.0%)
Inflation adjusted annual pay for those in the labour market (2019 British Pounds)						
Mean (sd)	23000 (19300)	20300 (17600)	22700 (19200)	21500 (18300)	20500 (17500)	21000 (18000)
Median [Min, Max] 1	8600 [-10600, 266000]	16400 [0, 234000]	18200 [-10600, 266000]	17200 [-10600, 236000]	16600 [0, 234000]	16900 [-10600, 236000]

Note. Labour market status and inflation adjusted pay were not included in the propensity score model.

Table 2: Descriptive Statistics for data collected in January or February 2020 (n=12,432)							
		PRE-IMPUTATION		MISSING DATA		POST-IMPUTATION	
				N	%		
Age	Mean (sd)	45.2	13.2	0	0	45.2	13.2
Female	N (%)	7164	57.7	9	0.1	7169	57.7
White	N (%)	10532	85.8	152	1.2	10665	85.8
Hours worked	Mean (sd)	33.4	13.1	92	0.7	33.4	13.1
Inflation adjusted annual pay	Mean (sd)	22,300	18.7	1167	9.4	22,300	18.1
Work from home	Always N (%)	801	6.5	135	1.1	809	6.5
	Hybrid N (%)	3239	26.3			3291	26.5
	Never N (%)	8257	67.1			8332	67
Job type	Professional or managerial N (%)	5025	49.8	2340	18.8	5908	47.5
	Intermediate N (%)	2357	23.4			2880	23.2
	Routine N (%)	2710	26.9			3644	29.3
Universal credit	N (%)	223	1.9	729	5.9	227	1.8
Location	North East N (%)	407	3.3	1	0	407	3.3
	North West N (%)	1185	9.5			1185	9.5
	Yorkshire N (%)	1052	8.5			1052	8.5
	East Midlands N (%)	933	7.5			933	7.5
	West Midlands N (%)	1036	8.3			1036	8.3
	East England N (%)	1177	9.5			1177	9.5
	London N (%)	1508	12.1			1508	12.1
	South East N (%)	1663	13.4			1663	13.4
	South West N (%)	1101	8.9			1101	8.9
	Wales N (%)	718	5.8			718	5.8
	Scotland N (%)	1083	8.7			1083	8.7
	Northern Ireland N (%)	568	4.6			568	4.6
Household size	Mean (sd)	3	1.3	2780	22.4	3	1.2
Inflation adjusted annual household income	Mean (sd)	39,800	58.6	1982	15.9	39,600	54.1

Note. Missing variables were replaced using random forest multiple imputation

Figure 1 - Probability of being in work using data collected before COVID-19 pandemic, by arthritis group, age, gender and degree status: unmatched data (top panel), matched data (middle panel), marginal effects in logistic regression analysis (bottom panel)

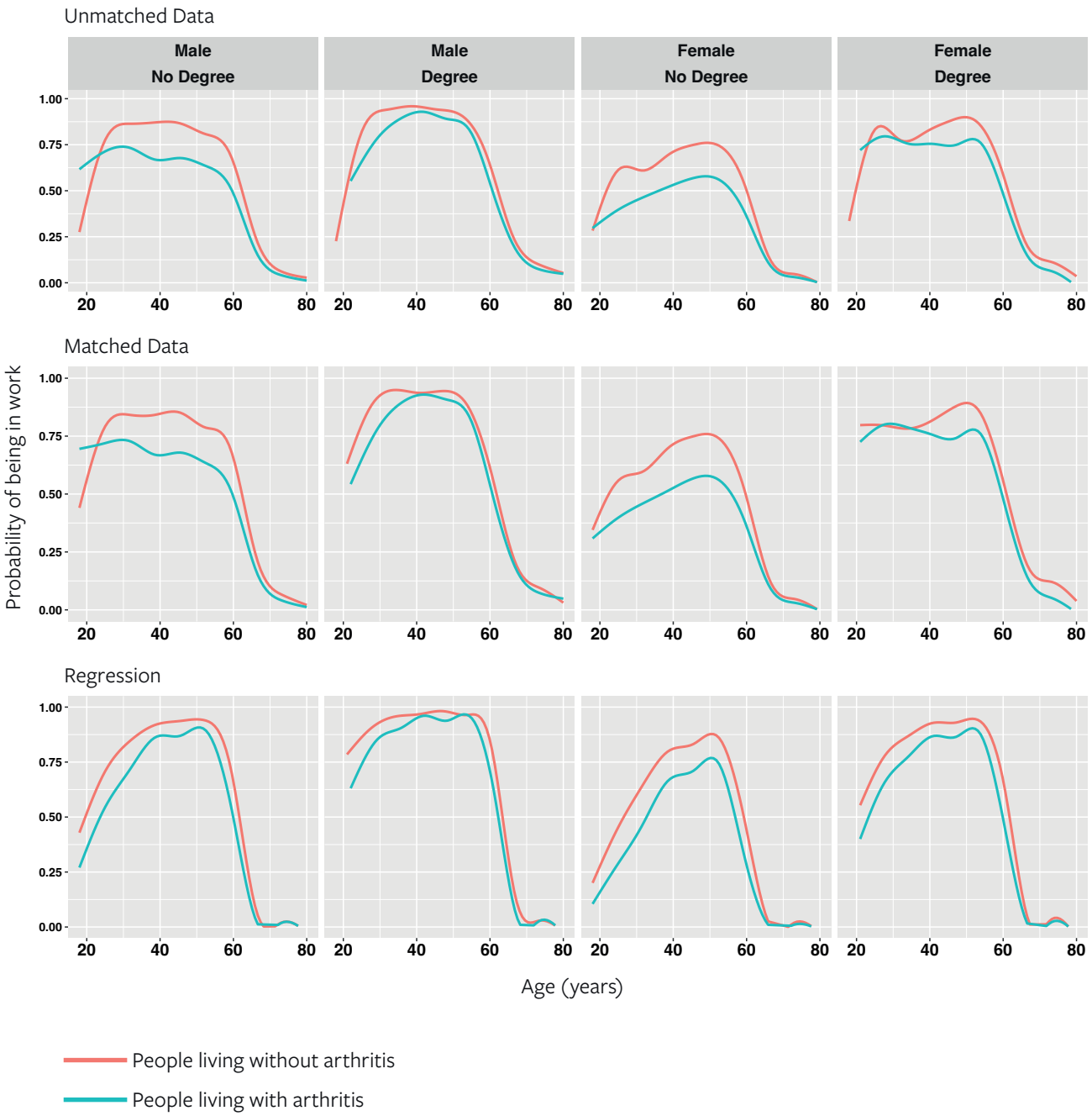
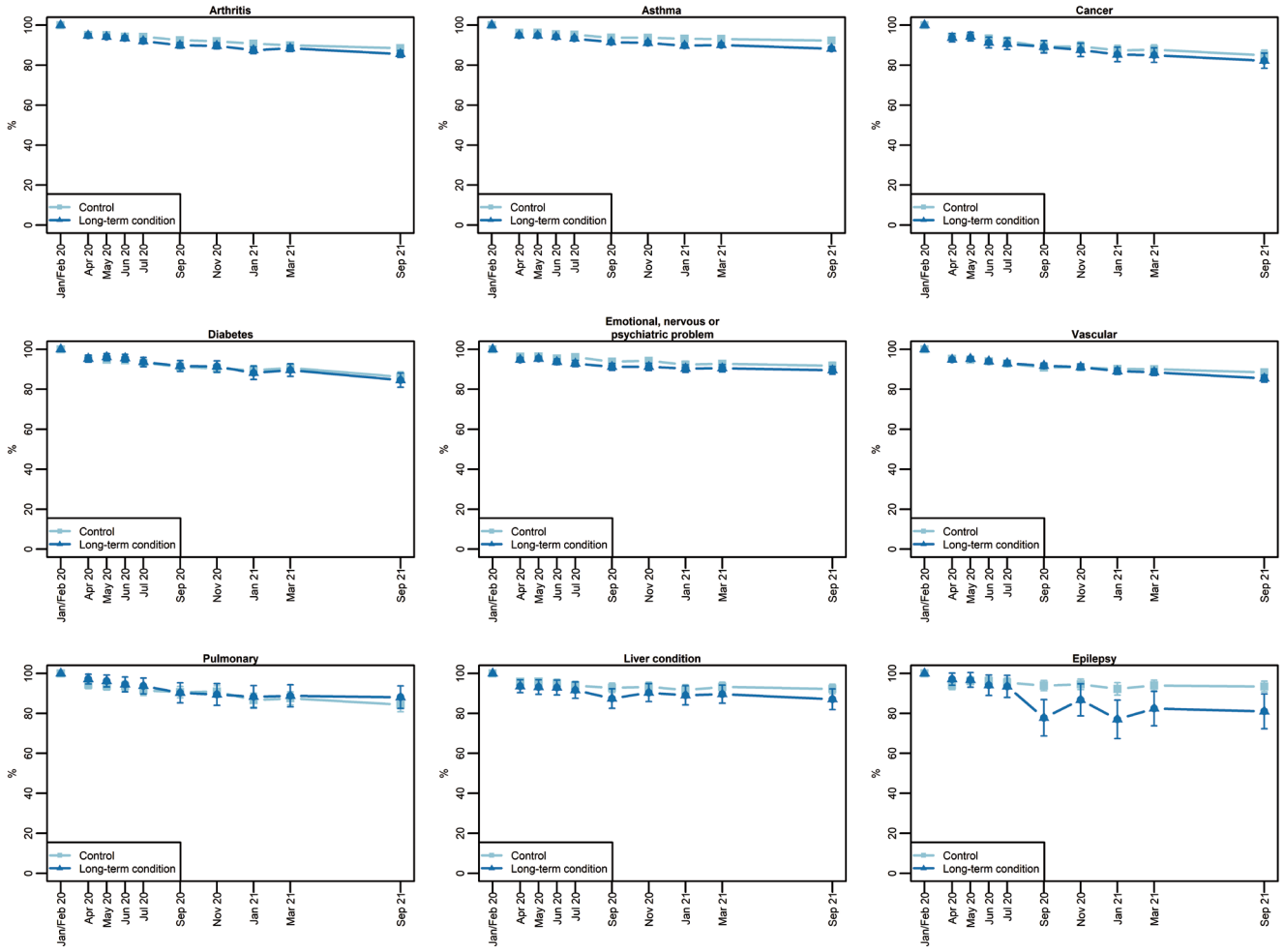


Figure 2 – Marginal effects of arthritis (panel 1) and eight other long-term health conditions (panels 2-9) on the probability of being in work when compared to matched controls (using data collected immediately before and during the COVID-19 pandemic)



4. Discussion

4.1 Summary of results and comparison with existing literature

Our results showed that arthritis was associated with an overall reduction of around 3 percentage points in people's probability of being in work. Yet this overall figure hides a large amount of heterogeneity both in terms of individual-level characteristics and workplace type. The effect size varies over people's life course as well as being larger amongst women, people without a degree, and those in routine or intermediate type occupations. In contrast, arthritis seemed to have less impact on men, people with a degree, or those in professional type occupations. People with arthritis were more likely to exit the labour market if they had previously worked for small private companies, compared to large private companies and non-private employers. These results complement previous findings in the literature. For example, they support the findings of Sørensen et al. (2021), who highlight the interplay between employment and health, suggesting that the ageing population in developed economies further complicates individual and societal issues about workforce participation. Our study also identified inequalities in labour market outcomes associated with arthritis and other long-term health conditions during the COVID-19 pandemic. These results complement other recent findings in the literature. For example, Bell and Blanchflower (2020) show that the effects of the pandemic on labour market outcomes have been unequally distributed across age groups, gender and ethnicity.

4.2 Implications

We already know that arthritis is more common amongst women and people from lower socio-economic backgrounds. When combined with our findings of substantial inequalities in how the work outcomes of these groups are affected by arthritis, it seems clear that interventions to better support people living with arthritis could help address inequalities in both health and employment. There have been several studies examining interventions designed to help working-age people with arthritis with employment (Faisting et al., 2019; Holland et al., 2020; NICE, 2019; Palmer et al., 2012; Skamagki et al., 2018; Wainwright et al., 2022). This includes, for example, personalised case management by an occupational health practitioner to encourage constructive dialogue between employees, healthcare practitioners, and employers. However, they are not generally targeted at particular groups. Our results suggest that due to heterogeneity in who is most likely to be impacted by an arthritis diagnosis, it may be advantageous to focus on different groups when developing and trialling policies and interventions. Our results also suggest that it may be beneficial to focus on different outcomes among workers in each work type or sector. For example, with routine work it may be better to target staying in employment. In contrast, with professional work it is possible that there is greater potential for benefit in supporting people to reach their earnings potential, as arthritis does not appear to affect employment in this sector. In addition, our results indicate that people employed by smaller private firms may especially benefit from support. This is possibly due to such firms having fewer resources available, and/or less scope to transfer people with arthritis to alternative roles.

The impact that arthritis has on society means that it is important to quantify its effects on individuals, as well as the economy, and to examine how these effects differ for different sectors of society. It is hoped that our findings will be useful for future research, for example by guiding interventions and policies to target those most in need. Our results may also be useful in assessing their long-term cost-effectiveness, given that evaluation studies are often limited by necessity to relatively short follow-up periods.

4.3 Strengths and weakness

Our study has several strengths. The datasets we used availed us of a large sample size, which enabled us to explore individual-level heterogeneity and ensures that the matching procedures were well supported.

Individuals in our datasets were followed for long periods of time and, compared to previous literature, these datasets had a reduced risk of recall bias, as interview intervals were short (one year for BHPS/UKHLS, two years for ELSA). A previous Australian study by Majeed et al. (2017), for example, relied on retrospective life-history data collected through questionnaires and interviews with a small sample of participants aged over 60 (n=1,261). The study reported that arthritis was associated with a lower probability of being in full time work for men, but not women. However, this data would be at high risk of recall bias because participants were required to recall details of their health, living conditions, education and employment throughout their lifetime.

Our large sample size also compares favourably to other previous studies. For example, Barrett et al. (2000) used the Norfolk Arthritis Register to show that people with arthritis were 32 times more likely to stop work on health grounds, but relied on a sample size of under 300 from a single area of England. Conaghan et al. (2015) showed that 15% of people with osteoarthritis had taken early retirement on average 7.8 years earlier than planned, but had responses from only 2,001 people. Finally, Syddal et al. (2020) examined data on 5,143 older workers (aged 50–64 years at baseline) who participated in the Health and Employment after Fifty (HEAF) cohort study. After two years, 297 participants had reported exiting work for any health-related reason. Although only a subsample of these were living with arthritis, the study examined differences by job type. The study found that women who had worked in teaching, education, nursing, midwifery or caring roles, and men who had worked in vehicle trades or as road transport drivers, were more likely than average to have exited work for health-related (versus non-health-related) reasons.

Few other large datasets have collected information on both arthritis and labour market outcomes. One exception is the UK's Labour Force Survey which reports the number of working days lost to sickness due to MSK conditions (HSE, 2021). However, this data does not assess arthritis independent of other MSK conditions. A further exception is the UK Biobank dataset. However, studies using this dataset may be limited by selection bias, given the relative health and age of UK Biobank participants. One recent study using UK Biobank data did not identify any associations between arthritis and income or employment outcomes among White British people aged between 39 and 72 years (n=336,997). However, the authors suggest that there may be a lack of statistical power to detect effects (Harrison et al., 2020). This may be partly due to the study relying on a subsample of people who are more genetically prone to arthritis, rather than observed cases of an arthritis diagnosis.

Our study also has several weaknesses. The links and causal relationships between arthritis and some co-morbidities, for example obesity or mental health, is complex. Future research could fruitfully explore the holistic effects of multimorbidities. Our measure of arthritis was based on self-report, and did not distinguish between severity or type of arthritis. Thus it could be that it includes other MSK conditions that respondents interpreted as arthritis. (Though note that all three surveys ask whether respondents have been given a formal diagnosis by a medical professional.) We compared outcomes for people with and without arthritis using two matching techniques. While these techniques are useful in controlling for confounding factors, it does not provide definitive proof of causal inference (Garrido et al., 2014; Rosenbaum and Rubin, 1983). Another weakness is that, while we observe that people with arthritis may be more likely to leave the labour market, it is not clear whether this is due to barriers to working, or differing preferences. It is doubtless the case that people with arthritis and other long-term health conditions do face hurdles to full employment. However, it is also plausible that some people with long-term conditions have different leisure-labour trade-offs. For example, early retirement may become more attractive if life expectancy is reduced. Thus just because people with long-term conditions react differently to a labour market shock does not necessarily imply that they are worse off, or that interventions targeted at increasing employment would be desirable or beneficial. It is therefore vital that future research should go beyond labour market outcomes to examine how arthritis and the labour market interacts with quality of life, as well as investigating why people with arthritis make the labour market decisions they do.

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Full details of the statistical methods and results can be found in two academic journal articles which are available online or by contacting the authors directly (**a.martin1@leeds.ac.uk** +44(0)113 343 0822):

- Rajah N et al. (anticipated 2022) How does arthritis affect employment? Longitudinal evidence on 18,000 British adults with arthritis compared to matched controls.
- Webb EJD et al. (anticipated 2023) Long-term health conditions and labour market outcomes during the COVID-19 pandemic.

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