Pain predicts being out of work especially for those with low job control: Longitudinal analysis of adults in Australia

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Abstract

Objective: While work provides a crucial source of income and purpose, pain can be a significant limiting factor. Yet robust empirical evidence on the factors underlying the link between pain and being out of work remains scarce. We explore the longitudinal association between pain and being out of work and potential explanatory factors.

Methods: We used nationally representative longitudinal data from the Household, Income and Labour Dynamics of Australia Survey (HILDA; N= 25,973, Obs. = 233,989, 2002-2022). We conducted individual fixed-effects regressions with a wide range of covariates.

Results: We found that pain in a given year was significantly positively associated with the likelihood of being out of work the year after. Pain interference with work explained this link. This association was moderated by job control: participants who reported very severe pain and low job control were more likely (10.6%) to lose their job next year than those who reported very severe pain and high job control (6.7%).

Conclusions: Pain was associated with being out of work with job control moderating that link. Having the autonomy to flexibly adapt the nature of work tasks to accommodate pain may protect against being out of work.

Keywords: Pain, pain interference, workplace, out of work, job control, decision autonomy.

What is already known on this topic

Prior research has shown a close relationship between pain and being out of work. However, very few existing studies explore the factors that might play a role in the link between pain and being out of work.

What this study adds

We found that pain in a given year was significantly positively associated with the likelihood of being out of work the year after. Pain interference with work explained this link. This association was moderated by job control.

How this study might affect research, practice or policy

Our findings highlight the importance of workplace interventions that prioritize job flexibility to support employees with pain.

No competing interest.

Ethics statements. Data collection for the HILDA survey was approved by the Human Research Ethics Committee at the University of Melbourne (ID no. 1647030). Participants gave informed consent to participate before taking part.

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Introduction

Work is a key aspect of people's lives. Work is relevant not only because it helps people to earn an income, but also because it is a source of purpose that increases people's overall wellbeing [1]. The health and wellbeing-related factors that shape labour market outcomes have been largely explored across disciplines [2–4]. One aspect that plays a key role in work is physical pain [see 5] which is an uncomfortable body sensation [6] with important consequences for people's lives [7–10]. Pain has become a worldwide public health challenge with almost 40% of people experiencing daily pain all over the world [11].

Given the importance of both work and pain, prior research has shown a close relationship between pain and being out of work. Using cross-sectional data, one study revealed that men out of the labour force reported significantly greater pain than men in the labour force in the United States [12]. Similar data from Canada showed that chronic pain diagnoses were closely associated with unemployment [13]. Using cross-sectional data from the United States and 20 rich European countries, another study found that non-workers reported greater pain than workers [5].

Some longitudinal studies were also conducted. For example, one study used cohort data from the National Child Development Study (NCDS), binary measures of the existence of aches or pain and a measure of pain intensity that ranged from 1(none) to 6(very severe) [14]. The study found that experiencing pain at age 44 was associated with joblessness at age 55. Similarly, another study used panel data from Germany, and a measure of pain severity that ranged from 1(always) to 5(never) and showed that those who were experiencing greater (vs lower) pain in a given year were more likely to lose their job the following year [15]. A third study used panel data from the Norwegian HUNT Study and a categorical measure of musculoskeletal pain (0, 1, 2 and 3 depending on the number of joints affected) [2]. The study found that people who reported greater (vs lower) musculoskeletal pain at baseline had a greater risk of later being out of work.

Although this body of work has documented a strong link between pain and being out of work, more work is needed to understand the factors that may explain or modify that link. Our study aims to address this question by using large-scale longitudinal data.

Building on previous work that has documented that low job control tends to be a risk factor for musculoskeletal pain [16,17], we test whether job control as gauged by decision autonomy and skill discretion mitigate the relationship between pain and being out of work [18].

This idea is motivated by general theories of job design and stress reduction [19] and the Demand-Control Model of Job Stress [20] which suggest that the possibility of controlling work processes plays a key role in workers' level of stress and work engagement. Decision autonomy means employees have the freedom and independence to make key decisions related to work tasks, and skill discretion captures how well a job utilizes the range of abilities possessed by workers through a variety of tasks [21]. Both decision autonomy and skill discretion are important job resources that protect against the impact of psychological demands on strain, stress, and work disengagement.

Indeed, workers with high levels of decision autonomy have greater flexibility to adapt their work processes deciding "what tasks to do and how to do them" [22, p. 542] and use this authority to proactively achieve work goals [23]. Perhaps for this reason, decision autonomy has been linked to high levels of work ownership and job satisfaction [24,25]. In the context of physical pain, workers with high levels of autonomy may accommodate their pain condition working more intensively when pain is low and reducing demanding tasks that are likely to lead to strain when their pain is more severe. Those with higher levels of skill discretion who use a wide breath of skills on the job have more opportunities to select tasks that they can manage comfortably when in pain, thus remaining productive.

Taken together, both elements of job control may mitigate the stress associated with pain management and attenuate the impact of pain on exiting work. As such, we anticipated that the relationship between physical pain and subsequent work exit would be most pronounced among those with low (compared to high) levels of job control, as gauged by decision autonomy and skill discretion.

Methods

Sample

Here, we analysed 21 waves of data (2002-2022) from the Household, Income and Labour Dynamics of Australia Survey (HILDA) [26] which contains representative longitudinal data from the Australian population. The survey follows up the same individuals every wave and gathers information about their wellbeing, health, labour market, and economic circumstances. HILDA has high response rates of over 90% in each survey year [26]. Our sample includes 233,989 observations on 25,973 individuals, (46% Male, Age range=15-101 years old, Mean age = 46.42, SD = 18.33) and all measures included in this study were available in every wave. This dataset was chosen because it contains all the necessary measures in all the waves making the dataset appropriate for a robust longitudinal study. Institutional ethical approval for this study was not required because we used publicly available anonymized data. HILDA can be accessed through https://melbourneinstitute.unimelb.edu.au/hilda. Codes for analyses are available through the Open Science Framework [OSF, 27].

Measures

Dependent variable

In our analyses, we used the following dependent variable which was created based on the employment status variable:

Out of work (N = 233,989). This variable represents individuals who were unemployed and out of the labour force (OLF; 36% of the sample) and those who were employed (64% of the sample). This variable, coded as 0 = employed and 1 = unemployed/OLF, was used in our main regression models. Individuals who were unemployed represented 3% of this sample and those out of the labour force 33%.

Independent variables and covariates

Level of pain. Participants were asked *"How much bodily pain have you had during the past 4 weeks?".* Responses were given on a six-point scale ranging from 1 = "No bodily pain" to 6 = "Very severe. This was our main independent variable which was treated as continuous in our main analyses and as categorical in additional tests.

Pain interference. Participants were asked "*During the past 4 weeks, how much did pain interfere with your normal work (including both work outside the home and housework)?."* Responses were given on a five-point scale ranging from 1 = "Not at all" to 5 = "Extremely." This variable was treated as continuous and used as an additional predictor in some of the models.

Covariates. In our regression models we included factors that may affect the link between pain and being out of work like demographic characteristics including age (linear and squared), gender, marital status (single, married, cohabiting, separated, divorced, widowed), level of education (Year 11 or below, Year 12/completion of high school, Certificate level I/II, Certificate level III/IV, Diploma or Advanced Diploma, Bachelor degree, Graduate Certificate or Diploma, Postgraduate degree), personal income, and occupation (Managers, Professionals, Technicians and Trades Workers, Community and Personal Service Workers, Clerical and Administrative Workers, Sales Workers, Machinery Operators and Drivers, Labourers, see https://www.abs.gov.au/statistics/classifications/anzsco-australian-and-new-zealand-standard-classification-occupations/2021 for more information). We included state and survey year fixed effects to account for the factors that were common across states and years.

We also considered a variable that represented whether the participant had long-term health conditions to rule out the possibility that pain was only a proxy for physical health problems. Participants were asked "*Do you have any long-term health condition, impairment or disability that restricts you in your everyday activities, and has lasted or is likely to last, for 6 months or more?*" and could answer yes or no. We conducted robustness checks with a variable of general health: "*In general, would you say your health is?*" with answer categories that ranged from Poor (1) to Excellent (5) and a measure of mental health based on the 9 mental health items included in the SF-36 questionnaire (see question A9 in the SF-36 Health Survey conducted by HILDA in Part A of the General Health and Well-being questionnaire https://melbourneinstitute.unimelb.edu.au/assets/documents/hilda-questionnaires/SelfCompletionQuestionnaireW8.pdf). This variable ranged from 0-100 and indicated better mental health with a higher number. Descriptive statistics for all the variables included in the analyses can be found in Table S.1.

Moderator

Job control. We created a variable of job control by combining items that represented decision autonomy and skill discretion [18,28]. Participants indicated whether they strongly disagreed (1) or strongly agreed (7) with five statements. Decision autonomy was assessed through the following items "*I have lots of freedom to decide how I do my work*", "*I have a* *lot of say about what happens on my job*", and "*I have a lot of freedom to decide when I do my work.*" Skill discretion was assessed through the following items "*My job often requires me to learn new skills", "I use many of my skills and abilities in my current job*." The five items were averaged in a measure of job control (Cronbach's alpha = 0.73) which ranged from 1 to 7.

Statistical analysis

To examine the link between pain and being out of work over time we used individual linear fixed effects regressions. When using panel data, it might happen that the responses of the same person over time are correlated with each other due to participants' unobserved time-invariant characteristics (e.g. genetic variation, childhood environment, stable aspects of personality traits). The inclusion of individual fixed effects helped us to account for these unobserved factors that might affect the main relationship.

This approach is particularly well-suited for our research question for several reasons. First, it allows us to control for all time-invariant unobserved individual characteristics which might confound the relationship between pain and being out of work. Second, it enables the inclusion of a wide range of time-varying covariates and factor variables with many categories (e.g., occupation and state), which are not easily accommodated in fixed-effects logistic models due to convergence issues and the incidental parameter problem. Third, the linear model retains individuals with no variation in the outcome, which fixed-effects logit models automatically drop, potentially leading to sample selection bias and reduced generalisability. In contrast, the linear fixed effects model allows us to leverage the full panel structure of the data, thereby improving statistical power and the representativeness of our findings. Moreover, the resulting coefficients are highly interpretable for policy and applied audiences.

We lagged our main independent variable, pain, by one wave to explore the effect of pain in a given year on being out of work the year after. This way, we explored whether pain at time t-1 predicted being out of work at time t. This approach helped us to reduce the possibility of reverse causality as being out of work might also influence pain. Our main fixed-effects model included individual, state, year, and occupation fixed effects as well as a set of demographic characteristics: age (linear and squared), gender, level of education, marital status, and personal income and the presence of long-term health conditions. Two further health covariates, namely general health, and mental health, were included in additional sensitivity tests as these variables may partially reflect the impact of pain. Variables of occupation, long-term health conditions, and other health covariates were lagged by one wave to match the time in which pain was measured. This allowed us to account for potential confounding effects.

Finally, we examined whether this relationship persisted after accounting for pain interference and whether job control moderated this association. We aimed to understand whether pain interference with work explained the link between pain and being out of work, and whether the association between pain and being out of work differed between people with low (-1 SD) vs high (+1 SD) job control in the workplace.

Results

Column 1 in Table 1 shows that pain at t-1 was significantly positively associated with being out of work at t after accounting for individual fixed-effects, a large set of covariates, and the presence of long-term health conditions ($b = 0.004$, $p < .001$, 95% CI (0.002, 0.005)). These results also held after accounting for general health ($b = 0.003$, $p < .001$, 95% CI (0.002, 0.005), column 2), and mental health ($b = 0.003$, $p < .001$, 95% CI (0.002, 0.005), column 3). Models with coefficients from all variables can be found in Table S.2.

Using the measure of pain as categorical, we found a gradient of likelihood of being out of work across the pain level scale. In comparison to 'no bodily pain', the likelihood of being out of work increased from 'mild' (b = 0.008, p < .001, 95% CI (0.004, 0.013)) to 'very severe' (b = 0.020, p < .001, 95% CI (0.006, 0.034)) by 1.2%. These models can be found in Table S.3. Analyses testing transitions from employment to out of work and vice-versa showed that pain is relevant for both moving into and out of employment and can be found in Tables S.4, S.5, and S.6.

We also conducted our main regression (presented in column 1 of Table 1 and in column 1 of Table S.7) with pain interference with work as a covariate (Table S.7, column 2). This regression model shows that the link between pain at t-1 and being out of work at t became statistically insignificant when controlling for pain interference (b = -0.001, p = .928, 95% CI (-0.002, 0.002)). Instead, pain interference remained significantly and positively associated with the likelihood of being out of work (b = 0.008, p < .001, 95% CI (0.006, 0.011)). As such, pain was no longer related to being out of work when it's interference with work was accounted for.

Table 2 shows that job control at t-1 moderated the association between pain level at t-1 and being out of work at t (column 1). This suggests that participants who reported greater levels of pain and experienced low job control were more likely to lose their job a year later than those who reported greater pain and high job control (b = -0.002, p = .001, 95% CI (-0.003, -0.001)). Our analyses also show that of the two components of job control assessed, decision autonomy was the main moderating factor (b = 0.002, p = .002, 95% CI (-0.003, -0.001), column 2) instead of skill discretion (b = -0.001, p = .098, 95% CI (-0.002, 0.0001), column 3). These findings held after accounting for general health and mental health. Full models can be found in Tables S.8, S.9, S.10, and S.11.

Figure 1 shows the results from the interaction term included in column 1 of Table 2. This graph shows that participants who reported very severe pain and low job control were more likely (10.6%, 95% CI (0.096, 0.116)) to lose their job next year than those who reported very severe pain and high job control (6.7%, 95% CI (0.058,0 .076)).

Discussion

While pain is considered a key risk factor for leaving the workplace, few prospective studies have attempted to understand this relationship. To address this gap, we conducted a longitudinal study of the relationship between pain and being out of work and the factors that might explain or modify this link.

Using 21 waves of data from the Household, Income and Labour Dynamics of Australia (HILDA) Survey and individual fixed effects regressions, we found that pain was significantly positively associated with subsequent being out of work. These findings align with the small set of longitudinal studies that suggest that pain can predict being out of work [2,14,15].

Looking at potential explanatory factors, we found that the link between pain and being out of work became insignificant after accounting for pain interference. This finding supports the idea that it is the impact of pain in undermining people’s ability to work that explains why pain eventually leads to being out of work [see 29]. Moreover, we documented that job control (decision autonomy and skill discretion) moderated the link between pain and being out of work: people who reported greater pain and low job control in a given year were more likely to lose their job the year after than those who reported greater pain and high job control. This finding aligns with prior research that revealed that job strain represented by high demands and low control preceded the onset of pain [16]. The negative emotions that low job control can create might explain this finding [30]. Prior work has shown that low job control can lead to greater psychological distress [30] and that negative emotions can increase pain [31]. Our findings may indicate that the negative emotions that result from low job control might lead to pain and, subsequently, to being out of work.

One limitation of this study is that our data do not allow us to establish causality. A second concern is that the relationship explored here can go in the opposite direction (i.e., being out of work can lead to greater pain). Yet to reduce the risk of reverse causality, we used panel data with a dependent variable (out of work) at time t and an independent variable (pain) at time t-1 because a variable measured at time t cannot affect a variable measured at time t-1. Another possibility is that pain levels impact job control which influences being out of work. Future research should conduct experimental studies to confirm the causal link of the variables explored here as well as the cumulative role of pain during multiple periods. A third limitation is that we used data from Australia, and we cannot guarantee the generalizability of findings to other regions. Yet these limitations are offset by the fixed effects methods which allowed us to control for observed and unobserved factors that might act as confounders, the large sample size (233,989 observations), the 21 waves of data, and the relevant variables in all the waves.

Our findings have important practical implications. Employers should recognize pain's impact on retention, turnover, and associated costs. Notably, even mild pain increases out of work risk, highlighting the need for proactive interventions. Granting employees autonomy to adjust tasks and schedules may reduce the risk of being out of work. These insights emphasize the value of workplace interventions that enhance worker autonomy to mitigate pain-related employment challenges [32–34].

This study provides evidence that pain can lead to exiting work and how job control might shape that link. Workplace policies that aim at reducing individuals' level of pain and keeping individuals in the labour force will benefit from these findings.

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Tables and figures

Table 1: Level of pain and out of work, 2001-2022, fixed effects regressions, HILDA.

	Dependent variable: Out of work at t (0-1)		
	(1)	(2)	(3)
Level of pain at t-1	0.004***	0.003***	0.003***
	(0.001)	(0.001)	(0.001)
Long-term health condition t-1 - Yes	0.015***	0.014***	0.014***
	(0.002)	(0.002)	(0.002)
General health t-1	-	-0.005***	-0.004***
		(0.001)	(0.001)
Mental health t-1	-	-	-0.0001
			(0.0001)
Personal characteristics	Yes	Yes	Yes
Constant	0.263***	0.284***	0.291***
	(0.018)	(0.019)	(0.019)
N of observations	233,989	233,989	233,989
R^2	0.229	0.230	0.230

Note: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Models show coefficients from fixed effects regressions. Standard errors in parentheses. All models include state, wave, and occupation code fixed effects. Personal characteristics: Age, age squared, gender, marital status, level of education, and income. Out of work represents participants who were unemployed and out of the labour force with 1 and those employed with 0. Level of pain: How much bodily pain have you had during the past 4 weeks ? 1: No bodily pain to 6: Very severe. Full models are presented in Table S.2.

Table 2: Level of pain and out of work moderated by job control 2001-2022, fixed effects regressions, HILDA.

	Dependent variable: Out of work at (0-1)		
	(1)	(2)	(3)
Level of pain at t-1	0.013***	0.010***	0.008**
	(0.003)	(0.002)	(0.003)
Job control at t-1	-0.002	-	-
	(0.002)		
Level of pain at t-1 x Job control at t-1	-0.002***	-	-
	(0.001)		
Decision autonomy at t-1	-	0.001	-
		(0.001)	
Level of pain at t-1 x Decision autonomy at t-1	-	-0.002**	-
		(0.001)	
Skills discretion at t-1	-	-	-0.005***
			(0.001)
Level of pain at t-1 x Skills discretion at t-1	-	-	-0.001
			(0.001)
Long-term health condition at t-1 -Yes	0.012***	0.012***	0.012***
	(0.003)	(0.003)	(0.003)
Personal characteristics	Yes	Yes	Yes
Constant	0.369***	0.357***	0.391***
	(0.022)	(0.021)	(0.022)
N	145,200	145,533	145,691
R^2	0.031	0.030	0.031

Note: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Models show coefficients from fixed effects regressions. Standard errors in parentheses. All models include state, wave, and occupation code fixed effects. Personal characteristics: Age, age squared, gender, marital status, level of education, and income. Out of work represents participants who were unemployed and out of the labour force with 1 and those employed with 0. Level of pain: How much bodily pain have you had during the past 4 weeks ? 1: No bodily pain to 6: Very severe. Full models are presented in Tables S.8, S.9, S.10, and S.11. Simple slopes indicate that the link between pain and out of work at mean job control (4.5) was b = .003, p < .001, at job control + 1SD (5.8) b = .0003, p = .741, and at job control – 1SD (3.3) b= .006, p < .001.

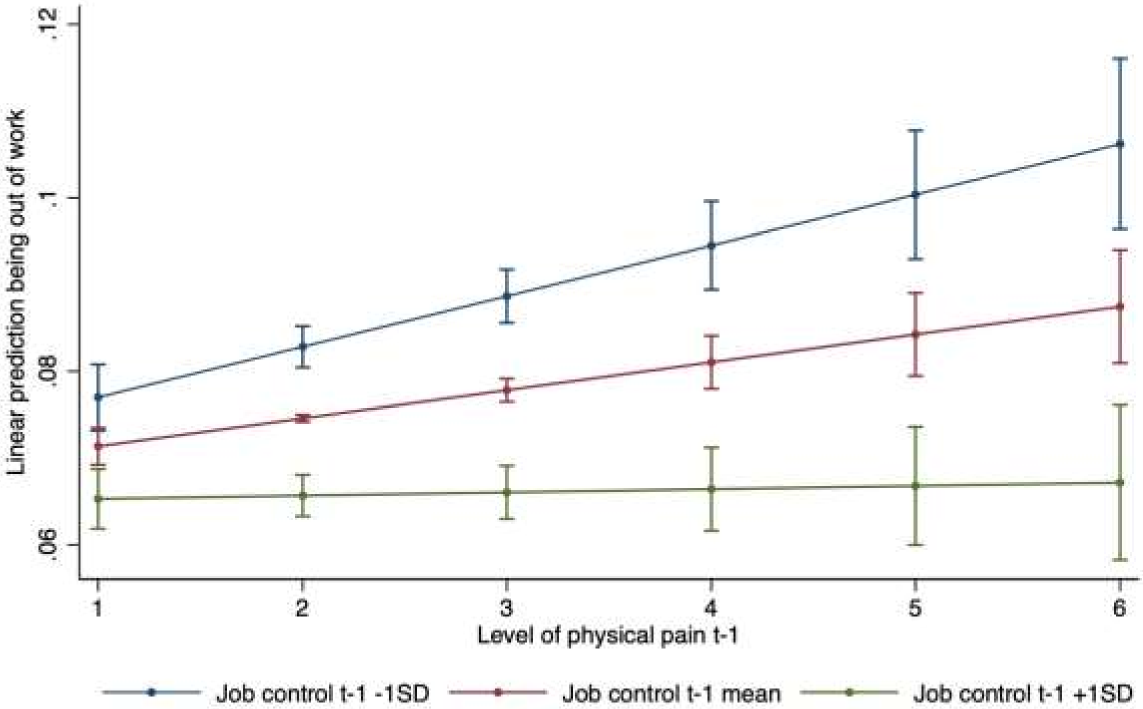

Figure 1: Relationship between level of pain and likelihood of being out of work for low and high job control.

Estimates from adjusted regression (Table 2, Column 1), HILDA.