IDSS 2025
Ecosystem of Support:
Connecting the parts, advancing the whole
16-18 November, Brisbane

Actuaries Institute.

# Long term social and economic consequences of workplace injury: Insights from HILDA data

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Presented to the Actuaries Institute

2025 Injury and Disability Schemes Seminar

16-18 November 2025



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## Abstract

**Objectives:** This study investigates the longer-term social and economic consequences of workplace injury in Australia, establishing causal links between workplace injury exposure and outcomes spanning labour force participation, income, wealth, health, and wellbeing. The research aims to inform workers' compensation scheme design by quantifying impacts that extend beyond direct treatment and wage replacement costs, and to identify demographic and occupational risk factors associated with workplace injury incidence.

**Methods:** This study uses longitudinal data from the Household, Income and Labour Dynamics in Australia (HILDA) survey. Random effects logistic regression models identify predictors of workplace injury incidence. Difference-in-differences estimation with multiple time periods is used to establish causal effect of workplace injury. Results are estimates separately for men and women. The analysis examines 15 outcome measures across three domains: labour force outcomes, income and wealth measures, and health and wellbeing indicators.

**Results:** Workplace injuries lead to substantial and persistent negative impacts lasting up to 10 years post-injury. Labour market effects include a 3-percentage point increase in unemployment or marginal labour force attachment (6 percentage points for severe injuries), and approximately $500-$750 annual increases in income support payments. Gross wage losses can reach $10,000 annually for any workplace injury and exceed $20,000 for severe injuries a decade post-injury. General health scores decline by 2-6 points depending on injury severity, with women experiencing more pronounced and deteriorating health effects over time. Overnight hospital visits increase significantly, particularly for women (0.21-0.34 additional visits). Risk of workplace injury is also shown to vary substantially by occupation, industry, education level, and socioeconomic status.

**Conclusions:** Workplace injuries impose substantial long-term economic and social burdens on injured workers that persist far beyond the active workers' compensation claim period. The evidence of cost-shifting from workers' compensation systems to income support programs and increased health system utilisation underscores the importance of whole-of-system policy perspectives. Gender-specific impacts suggest tailored support approaches are needed. The heterogeneity in workplace injury risk highlights priority cohorts for targeted prevention efforts. These findings demonstrate the need for targeted long-term support systems that recognise the persistent nature of impacts on workers' employment, income, health and wellbeing.

***Keywords:*** *Workplace injury; Causal inference; Longitudinal data analysis; HILDA survey; Compensation scheme design; Social impact; Difference-in-differences*

## Introduction

Workplace injuries result in significant economic costs for injured workers, firms and the broader economy, and create considerable hardship for those affected. Economic costs will include wage replacement while a worker is unfit for work due to injury, along with treatment and rehabilitation costs that support recovery from their injury and help workers to return to their pre-injury occupation. Economic costs can be very large. They have been estimated to be as large as $28.6B or 1.6% of GDP in Australia (Deloitte, 2022). Across five countries in the EU Tompa et al. (2021) measured the impact of workplace injuries and disease at between 2.7% and 10.4% of GDP. The consequences of serious injuries may last for years after a workplace injury. Consequences for firms include lost productivity and the costs associated with hiring extra workers to cover for injured employees. Injured workers may suffer an immediate loss of wellbeing due to injury and may also face other negative outcomes over longer periods. These can include lower earnings, reduced labour force participation, missed promotions, difficulty returning to their usual occupation or a reduced capacity to perform it, and in some cases a need for retraining for a different occupation.

Direct costs of workplace injuries can be calculated reasonably straightforwardly as insurers and schemes will collect information about the income and treatment costs resulting from workers' compensation claims. But there are many indirect costs which cannot be easily measured. Scheme managers and insurers may only have visibility of treatment and income costs for injured workers. Once a worker exits a scheme, subsequent outcomes such as loss of wellbeing, use of health and welfare services, income support from other sources are not usually linked to scheme data.

Another challenge in estimating costs of workplace injury is establishing a causal link between the workplace injury and subsequent outcomes. If workplace injuries occurred randomly, then a simple pre-post analysis could provide unbiased estimates of effects of workplace injury. However, if injuries are related to other risk factors such as education or occupation, then simple comparisons may lead to biased estimates.

This study investigates the longer term economic and social consequences of workplace injury using longitudinal survey data. I aim to establish a causal link between exposure to a workplace injury and a range of outcomes that cover labour force participation, income, wealth, health and wellbeing.

Investigation into longer term impacts of workplace injury is important for scheme design. Scheme design is a complex task in which policymakers face trade-offs between providing more services and supports to injured workers whilst containing costs and maintaining financial stability for compensation schemes. Policymakers also need to understand whether current scheme settings are achieving their intended goals. They also need to understand whether scheme changes aimed at reducing costs lead to unintended consequences or perverse outcomes, such as workers switching between support services rather than achieving successful return to work.

Establishing a causal link is also important for policy. If the negative outcomes associated with workplace injury are causally identified, then policy responses should be directed at injured workers, with a focus on supporting return to work and ensuring that adequate health and financial supports are available as they recover. However, if the negative outcomes are correlated with workplace injury but are not caused by it, for example if the risk or demographic profile of workers who experience injury is driving the negative outcomes, then polices would need to be targeted more broadly at workers who are at risk of workplace injury. This is likely to involve specific segments of the workforce and particular demographic groups.

Secondary aims of this study include increasing awareness of the HILDA survey within the actuarial community. The HILDA survey is a valuable data resource for researchers, yet it remains underused for generating insights into workplace injury and compensation schemes. This study also aims to promote greater understanding of causal inference methodologies.

The remainder of this paper is structured as follows. First, I review the literature to date on the social and economic effects of workplace injury. Second, I describe the Household Income and Labour Dynamics Australia (HILDA) survey data used for this study (Department of Social Services et al., 2024). Third, I outline the econometric framework used to estimate risk factors for workplace injury and causal effects of workplace injury. I then present the empirical results and discuss findings.

## Literature review

There are several studies from North America and Europe which have investigated impacts of workplace injury. Labour force outcomes such as unemployment or workforce participation and income have been the most common outcomes studied. Data sources used are either longitudinal survey data or administrative data. In the USA, the earliest study which was based on individual data was Boden and Galizzi (1999) who estimated earnings losses from workplace injuries at $8,000 per injury (1994 dollars) and found greater earnings loss among women than men. Dong et al. (2016) uses National Longitudinal Survey of Youth to estimate effects of workplace injuries on earnings and family wealth, finding significant earnings losses. Boden et al. (2016) used Social Security Administration data to investigate the effect on mortality and found a substantial increase in mortality rates among injured workers. Seabury et al. (2014) measured the impact of lost-time workplace injuries at 15% of earnings over 10 years post injury among claimants in New Mexico. Dobkin et al. (2018) consider the economic costs of hospital admissions more generally. Senthanar et al. (2020) consider the spillover effects of stresses related to work injuries on injured workers families and increased rates of family breakdown. Brown et al. (2007) investigated impacts on social outcomes including residential change, marital instability and social welfare use finding evidence of increased use of income benefits for more seriously injured workers in British Columbia. Parro and Pohl (2021) found negative effect of workplace accidents on employment (decline of 14%) and earnings in Chile. In the UK Mazzolini (2020) analysed data from the British Household Panel Survey to measure the impact of workplace injuries on employment and earnings finding lower employment rates and lower earnings among injured workers. Galizzi et al. (2023) estimated substantial impacts of workplace injury on earnings, employment and use of sick leave for injured workers in Italy. Increased sick leave was also identified by Molinero-Ruiz et al. (2015) as a consequence of workplace injury. The effect of health shocks on labour market outcomes was investigated by Fouquet et al. (2024) who found a negative impact on employment for mild traumatic brain injuries as did Duguet and Le Clainche (2012). Crichton et al. (2011) find that injured workers in New Zealand who have 3 months or more off work because of workplace injuries experience worse employment outcomes compared to similar workers who have not experienced workplace injury. Bíró et al. (2023) propose a wage ladder model to explain the mechanism by which absence from workplace due to injury may lead to lower wages.

The literature consistently indicates that workplace injuries, across multiple jurisdictions, lead to substantial negative impacts on employment and earnings. Several other outcomes such as use of unemployment benefits, sick leave, health system utilization and family breakdown are also indicated, but with a smaller evidence base.

In Australia, several studies have investigated economic and social costs of workplace injuries. Collie et al. (2019) describe the various support systems in place across Commonwealth, State and

Territories. They estimate that 156,000 injured workers accessed workers compensation benefits in the 2015 to 2016 financial year, with direct income support costs of about $2.5 billion for that period.

Griffiths, Di Donato, Lane, Gray, et al. (2022) examined the effect of welfare and health service use among injured workers in NSW who reached the 260-week statutory limit on compensation benefits. They found a 53% increase in social security benefits once workers compensation benefits ceased, which was significantly higher than the increase observed among injured workers who did not reach the 260-week limit. Increased hospital use was also identified. Similar findings were reported in Griffiths, Di Donato, Lane and Gray (2022) and in Griffiths et al. (2023). These studies highlight the importance of careful scheme design and a whole-of-system approach as injured workers transition between support services.

This study adds to the literature on economic and social impacts of workplace injury. To the best of my knowledge, no previous study has estimated the causal effects of workplace injury at a population level in Australia. Furthermore, the effects on outcomes beyond employment and income are less well understood. Few studies have examined subjective wellbeing, and few have explored measures such as out-of-pocket health expenses and hospital use. With longitudinal data from the HILDA survey, we are able to investigate these outcomes in greater detail.

## Data

Data used in this study is taken from the HILDA survey which is a longitudinal annual survey of Australian households (Watson & Wooden, 2012). The first wave of the survey dates from 2001 and the data used in this study is from the 2023 general release. Since the 2006 wave, information has been collected on the number of days absent from work on paid workers compensation in last 12 months. This enables us to identify individuals who have experienced a workplace injury which has resulted in time off work. Workplace injuries which do not result in lost time will not be counted in this indicator, but these will tend to be minor injuries and are not the focus of this study. We are unable to identify if the workplace injury is of a primary physical or psychological injury. Outcomes for both types are likely to be quite different (Smith et al., 2020) but we are only able to identify the average effect.

The focus of this study is on longer term effects, so the cohort selected for analysis consists of individuals who were in the labour force in earlier waves and can be followed over a number of years. The particular sample used in this analysis is taken from respondents who indicated they were employed in one of the years between 2006 and 2011. I use the 2011 cut off to ensure we include respondents added in a large top-up sample which occurred in 2011. Observations are also filtered for respondents of working age only (i.e., aged 15 to 64) within each wave.

The two treatment variables considered are an indicator function for the first occurrence of

1. Experiencing time off work due to a workplace injury and paid workers compensation for more than 0 days (all workplace injury)
2. Experiencing time off work due to a workplace injury and paid workers compensation for more than 30 days (30+ days workplace injury)

A range of economic and social outcomes are measured in the HILDA data. I have identified 15 indicators of interest, which fall into three broad categories: labour force, income and wealth, and health and wellbeing. These are listed in Table 1. The existing literature on effects of workplace injury has consistently highlighted unemployment and labour force participation as key outcomes. The first indicator is an indicator for being unemployed at the time of the survey. The second measure

captures either being unemployed or being not employed and marginally attached to the labour force. Number of days on sick leave and the amount of income support payments are the remaining labour force indicators.

I have selected a range of income and wealth measures to explore the dynamics of how workplace injury affects financial outcomes. It is commonly seen in the literature that injured workers suffer negative financial outcomes, but it is not clear by what mechanism this occurs. There are several ways this effect could be mediated. Injured workers may miss out on promotions or career development opportunities while unfit for work. Their injury, and any resulting disability, may also leave them unable to perform their preinjury occupation, necessitating a change in occupation that may come with a lower rate of pay. A reduction in earnings can also arise simply from time away from work, given that income compensation is generally paid at a lower rate.

Wealth effects may differ from income effects, as households may adjust their financial behaviour or draw on family support networks. Including a range of income and wealth measures allows for a more detailed understanding of the pathways through which financial effects are mediated. Early access to superannuation is a further indicator I have included to test whether injured workers face insufficient support or limited employment options after injury. This is defined as receiving regular superannuation payments whilst being younger than the preservation age.

The third set of indicators relate to health and wellbeing. Health service use is an outcome relevant for scheme design, and I include it here to identify potential cost shifting from compensation schemes to health systems similar to Griffiths et al. (2023). HILDA data collects information about hospital visits which are recorded separately for day and overnight admissions. I include total expenditure on health services to test for additional burden on household budgets due to workplace injury. Subjective wellbeing (i.e., self-assessed health status) is also included with the general health score and general mental health scores. These scores follow the methodology in Ware et al. (1993) to construct a single index from a set of health related questions. A score of 0 being worst possible health and 100 being the best possible health.

*Table 1 Outcome variables*

| Category | Indicator |
|---|---|
| Labour force | Unemployed |
| | Unemployed or marginal labour force attachment |
| | Days on sick leave |
| | Income support payments |
| Income and wealth | Hourly wage |
| | Gross wages |
| | Total income |
| | Household total income |
| | Household wealth |
| | Early super access |
| Health and wellbeing | Hospital day visits |
| | Hospital overnight visits |
| | Health expenditure |
| | General health score |
| | General mental health score |

The observation count in each wave together with the counts of individuals who first experience the two types of workplace injury in that year are shown in Table 2. Further descriptive statistics of the sample are included in the appendix.

*Table 2 Sample frequencies*

| year | n | First occurrence any WI | First occurrence WI 30+ days |
|---|---|---|---|
| 2009 | 9259 | 105 | 22 |
| 2010 | 9225 | 99 | 13 |
| 2011 | 11397 | 91 | 30 |
| 2012 | 10502 | 94 | 30 |
| 2013 | 9892 | 78 | 22 |
| 2014 | 9383 | 104 | 32 |
| 2015 | 8930 | 81 | 20 |
| 2016 | 8526 | 76 | 19 |
| 2017 | 8082 | 60 | 20 |
| 2018 | 7673 | 67 | 18 |
| 2019 | 7250 | 65 | 16 |
| 2020 | 6830 | 50 | 23 |
| 2021 | 6325 | 56 | 22 |
| 2022 | 5825 | 51 | 20 |
| 2023 | 5498 | 48 | 24 |

## Econometric framework

The framework described here is designed to answer two key questions.

1. How does risk of workplace injury vary by covariates?
2. What is the causal effect of workplace injury on the labour force, income and wealth, and health and wellbeing measures?

The first component of our investigation is to build a model of incidence of workplace injury to identify predictors of workplace injury. Here we fit one model for each of the two treatment variables. I use a random effect logistic regression to account for repeated measurements. A range of covariates are included which cover industry, occupation, demographics and several health status variables. The dependent variables for the two models are:

**Model 1**: $Y_{it}$= 1 if individual *i* reported any time off work due to workplace injury and on workers compensation in year *t* and 0 otherwise.

**Model 2**: $Y_{it}$= 1 if individual *i* reported time off work due to workplace injury and on workers compensation for more than 30 days in year *t* and 0 otherwise.

For the causal effect estimation I use a difference-in-differences (DID) estimator with multiple time periods approach as set out in Callaway and Sant'Anna (2021) and Sant'Anna and Zhao (2020). DID estimation is a widely used tool for identifying causal effects. The canonical 2-by-2 case for DID estimation compares a dependent variable over two time points for two groups, a treated and a control group with the treated group receiving treatment in time-period two. With a parallel trend assumption, it is possible to construct a counterfactual value for the treated group to estimate an average treatment effect among the treated (ATT).

$$ATT = \left(Y_{\text{treated,post}} - Y_{\text{treated,pre}}\right) - \left(Y_{\text{control,post}} - Y_{\text{control,pre}}\right)$$

In cases where there are more than the two standard time periods, a two-way fixed effect (TWFE) model has commonly been used such as in Mazzolini (2020). In recent years there have been substantial methodological advances that identify weaknesses of the TWFE approach and extend the canonical 2-by-2 setup to incorporate extensions such as conditional parallel trends, variation in treatment timing and heterogeneous treatment effects. See for example De Chaisemartin and d'Haultfoeuille (2020), Goodman-Bacon (2021), Borusyak et al. (2024) and Roth et al. (2023). Sant'Anna and Zhao (2020) developed a doubly robust estimator for a standard 2-by-2 setup which was generalised for estimation over multiple time periods in Callaway and Sant'Anna (2021) which is the approach used for this study.

Following the notation of Callaway and Sant'Anna (2021), we consider a context where we have repeated measures of individuals over time across $T$ time periods, $t = 1 \ldots T$. $D$ is a binary vector indicating at which time point an individual was assigned into the treatment group (I will refer to workers who have reported a workplace injury as being 'treated' in the terminology of causal inference methods). $D_{i,t} = 1$ if unit *i* is treated at *t* and 0 otherwise. $G$ is the time period at which an individual is first treated. For units which are never treated $G = \infty$**.** $G_g = 1$ if a unit is first treated at time *g.* $C$ is a vector if a unit is never treated. $Y_{it}(g)$ is the potential outcome for unit *i* at time *t* if it is first treated in period *g.* $Y_{it}(0)$ is the potential outcome for unit *i* at time *t* if it is never treated.

The DID with multiple time periods approach relies on the following assumptions:

**Assumption 1:** Independent and identically distributed data.

**Assumption 2:** Irreversibility of treatment.

$$D_{t-1} = 1 \Rightarrow D_t = 1$$

This simply states that once an individual enters the treatment group (i.e., they report a workplace injury) they stay in the treatment group for future time periods. The treatment variable can be switched on at some time point but once it is switched on it the individual never is included in the control group again.

**Assumption 3:** Limited treatment anticipation. There is a known $\delta$ such that

$E\left[Y_t(g)\middle|X, G_g = 1\right] = E\left[Y_t(0)\middle|X, G_g = 1\right]$ almost surely for all g ∈ G, $t \in 1 \ldots$ T such that $t < g - \delta$

This assumption is unlikely to be violated in this context as workplace injuries are not known apriori.

**Assumption 4**: Conditional parallel trends based on a "Never-treated" group.

$$E\left[Y_t(0) - Y_{t-1}(0)\middle|X, G_g = 1\right] = E[Y_t(0) - Y_{t-1}(0)|X, C = 1]$$

This states that after conditioning on covariates, trends observed over time for those units treated in period *g* would have followed the same trend as units that are never treated.

**Assumption 5**: Overlap

For each $t \in 2 \ldots T, g \in G$ there exist some $\epsilon > 0$ such that $P\left(G_g = 1\right) > \epsilon$ and $p_{g,t}(X) < 1 - \epsilon$

which indicates that a positive fraction of the population are included in the treatment group at each time g and for each value of the covariates, the probability of treatment is less than one.

The average treatment effect among the treated (ATT) is the causal quantity to be estimated at each time *t* for individuals who are treated (i.e., report a workplace injury) at time *g*.

$$ATT(g,t) = E[\,Y_t(g) - Y_t(0) \mid G_i = g\,]$$

This results in a separate treatment effect estimation for each combination of group and point in time. In many cases the more important causal question may involve some aggregation of the individual group-time treatment effects, such as an overall average treatment effect or an average effect by length of time since first exposure to treatment. The general form for aggregations is

$$\theta = \sum_{g}\sum_{t} w(g,t)\cdot ATT(g,t)$$

Where $w(g,t)$ is a weighting function designed to aggregate the treatment effects in line with policy question. A range of specific aggregations are outlined in Callaway and Sant'Anna (2021).

The final component of the causal framework is to estimate effects firstly for all workers and also separately for men and women. Recent literature such as Galizzi et al. (2023) has highlighted the different responses to workplace injury comparing men and women.

## Results

### Incidence of workplace injury

Results from the incidence of workplace injury models are shown in Table 3.

*Table 3 Predictors of Workplace Injury*

| | Model 1 | | | Model 2 | | |
|---|---|---|---|---|---|---|
| | Est. | se | p | Est. | se | p |
| (Intercept) | -5.51 | 0.22 | <0.001 | -8.00 | 0.41 | <0.001 |
| Industry - Financial and Insurance Services | -1.40 | 0.35 | <0.001 | -1.56 | 0.65 | 0.02 |
| Industry - Information Media and Telecommunications | -1.08 | 0.42 | 0.01 | -16.72 | 1546.56 | 0.99 |
| Industry - Electricity, Gas, Water and Waste Services | -0.83 | 0.37 | 0.02 | -0.89 | 0.68 | 0.19 |
| Industry - Administrative and Support Services | -0.80 | 0.23 | <0.001 | -0.66 | 0.38 | 0.09 |
| Industry - Other Services | -0.79 | 0.22 | <0.001 | -0.80 | 0.39 | 0.04 |
| Industry - Professional, Scientific and Technical Services | -0.68 | 0.20 | <0.001 | -0.59 | 0.34 | 0.08 |
| Industry - Mining | -0.55 | 0.25 | 0.03 | 0.02 | 0.40 | 0.97 |
| Industry - Accommodation and Food Services | -0.49 | 0.19 | 0.01 | -0.46 | 0.33 | 0.17 |
| Industry - Agriculture, Forestry and Fishing | -0.46 | 0.27 | 0.08 | -0.78 | 0.51 | 0.13 |
| Industry - Construction | -0.29 | 0.16 | 0.07 | 0.05 | 0.27 | 0.84 |
| Industry - Rental, Hiring and Real Estate Services | -0.18 | 0.32 | 0.58 | -0.46 | 0.59 | 0.44 |
| Industry - Retail Trade | -0.17 | 0.18 | 0.33 | -0.23 | 0.30 | 0.44 |
| Industry - Public Administration and Safety | -0.16 | 0.16 | 0.29 | -0.27 | 0.26 | 0.30 |
| Industry - Wholesale Trade | -0.16 | 0.21 | 0.47 | -0.46 | 0.41 | 0.26 |
| Industry - Transport, Postal and Warehousing | -0.03 | 0.17 | 0.89 | 0.19 | 0.29 | 0.51 |
| Industry - Arts and Recreation Services | 0.06 | 0.24 | 0.82 | -0.24 | 0.47 | 0.60 |
| Industry - Manufacturing | 0.06 | 0.15 | 0.70 | 0.03 | 0.26 | 0.90 |
| Industry - Education and Training | 0.13 | 0.13 | 0.32 | 0.01 | 0.22 | 0.97 |
| Occupation - Managers | -0.23 | 0.14 | 0.11 | -0.01 | 0.25 | 0.97 |
| Occupation - Clerical and Administrative Workers | -0.02 | 0.14 | 0.88 | -0.03 | 0.25 | 0.92 |
| Occupation - Sales Workers | 0.17 | 0.19 | 0.37 | 0.67 | 0.33 | 0.04 |
| Occupation - Technicians and Trades Workers | 0.60 | 0.14 | <0.001 | 0.69 | 0.25 | 0.01 |
| Occupation - Community and Personal Service Workers | 0.70 | 0.13 | <0.001 | 0.97 | 0.21 | <0.001 |
| Occupation - Machinery Operators and Drivers | 0.86 | 0.16 | <0.001 | 0.98 | 0.28 | <0.001 |
| Occupation - Labourers | 0.88 | 0.15 | <0.001 | 1.04 | 0.25 | <0.001 |
| Casual worker | -0.31 | 0.09 | <0.001 | -0.38 | 0.16 | 0.02 |
| Union member | 0.78 | 0.07 | <0.001 | 0.81 | 0.12 | <0.001 |
| age - 30 to 39 | -0.10 | 0.11 | 0.35 | 0.45 | 0.21 | 0.03 |
| age - 40 to 49 | 0.01 | 0.12 | 0.92 | 0.63 | 0.22 | 0.00 |
| age - 50 to 65 | -0.10 | 0.12 | 0.41 | 0.51 | 0.22 | 0.02 |
| Male | 0.17 | 0.09 | 0.06 | 0.02 | 0.15 | 0.92 |
| Education - Year 12 and below | -0.21 | 0.09 | 0.01 | -0.11 | 0.14 | 0.42 |
| Education - Bach or higher | -0.55 | 0.11 | <0.001 | -0.42 | 0.19 | 0.03 |
| Seifa | -0.04 | 0.01 | 0.00 | -0.02 | 0.02 | 0.52 |
| Country of birth - Other | -0.48 | 0.14 | <0.001 | -0.27 | 0.23 | 0.23 |
| Country of birth - Main English speaking | -0.21 | 0.14 | 0.13 | -0.04 | 0.22 | 0.85 |
| Household type - Lone person | 0.11 | 0.15 | 0.48 | 0.26 | 0.28 | 0.35 |
| Household type - Lone parent | 0.14 | 0.17 | 0.41 | 0.09 | 0.31 | 0.78 |
| Household type - Group household | 0.16 | 0.32 | 0.61 | 0.36 | 0.60 | 0.55 |
| Household type - Other related family | 0.38 | 0.31 | 0.23 | 0.29 | 0.58 | 0.62 |
| Household type - Multi family household | 0.11 | 0.18 | 0.54 | 0.12 | 0.32 | 0.72 |
| Relationship - single | -0.12 | 0.15 | 0.43 | -0.27 | 0.27 | 0.31 |
| Relationship - separated/divorced/widowed | 0.03 | 0.17 | 0.86 | -0.27 | 0.29 | 0.36 |
| Dependent children 15 to 24 | 0.02 | 0.06 | 0.73 | -0.08 | 0.11 | 0.49 |
| Dependent children <15 | -0.10 | 0.05 | 0.03 | -0.22 | 0.08 | 0.01 |
| Dependent children <5 | -0.07 | 0.08 | 0.36 | 0.10 | 0.14 | 0.48 |
| Dwelling type - other | 0.44 | 0.32 | 0.17 | 1.12 | 0.45 | 0.01 |
| Dwelling type - Apartment | -0.05 | 0.11 | 0.64 | -0.09 | 0.20 | 0.65 |
| Dwelling type - Semi-detached | -0.17 | 0.13 | 0.20 | -0.23 | 0.24 | 0.33 |
| Student | -0.35 | 0.17 | 0.04 | -0.05 | 0.32 | 0.88 |
| Alcohol consumption (st drinks/day) | -0.02 | 0.01 | 0.15 | -0.04 | 0.02 | 0.08 |
| Smoker -No longer | 0.12 | 0.09 | 0.16 | 0.00 | 0.15 | 0.98 |
| Smoker - Smoker | 0.41 | 0.09 | <0.001 | 0.57 | 0.15 | <0.001 |
| Health status - Excellent | -0.38 | 0.14 | 0.01 | -0.28 | 0.26 | 0.27 |
| Health status - Good | 0.29 | 0.07 | <0.001 | 0.36 | 0.14 | 0.01 |
| Health status - Fair | 0.40 | 0.11 | <0.001 | 0.81 | 0.17 | <0.001 |
| Health status - Poor | 0.88 | 0.22 | <0.001 | 1.30 | 0.30 | <0.001 |
| Chronic Health Condition affecting work | 0.96 | 0.08 | <0.001 | 1.54 | 0.12 | <0.001 |
| Region - urban | -0.12 | 0.09 | 0.19 | 0.00 | 0.15 | 0.98 |
| Region - rural | -0.23 | 0.12 | 0.06 | -0.20 | 0.20 | 0.32 |
| Region - regional | -0.05 | 0.19 | 0.79 | -0.24 | 0.34 | 0.49 |
| State - VIC | -0.46 | 0.10 | <0.001 | -0.44 | 0.18 | 0.01 |
| State - SA | -0.46 | 0.15 | 0.00 | -0.42 | 0.25 | 0.09 |
| State - WA | -0.16 | 0.14 | 0.26 | -0.09 | 0.23 | 0.70 |
| State - QLD | 0.00 | 0.10 | 0.98 | -0.06 | 0.17 | 0.73 |
| State - TAS | -0.05 | 0.19 | 0.80 | -0.06 | 0.31 | 0.85 |
| State - ACT | 0.09 | 0.26 | 0.72 | 0.53 | 0.39 | 0.17 |
| State - NT | -0.59 | 0.40 | 0.14 | 0.03 | 0.57 | 0.95 |
| Risk preference 1 - substantial risk | 0.13 | 0.27 | 0.63 | -0.20 | 0.54 | 0.71 |
| Risk preference 2 - above average risk | 0.11 | 0.15 | 0.43 | 0.21 | 0.24 | 0.38 |
| Risk preference 4 - not willing to take risk | 0.25 | 0.08 | 0.00 | 0.07 | 0.14 | 0.63 |
| Risk preference 5 - never has spare cash | 0.37 | 0.10 | <0.001 | 0.34 | 0.17 | 0.05 |

The estimates for the workers current industry are relative to Health Care and Social Assistance which is the most common industry in the data. The Health Care and Social Assistance industry has a relatively high risk of workplace injury with most other industry categories returning lower estimates. Industries with similarly high rates of workplace injury include Public Administration and Safety, Transport, Postal and Warehousing, Retail Trade, Wholesale Trade, Manufacturing and Education and Training. Industries with low estimated workplace injury include Information Media and Telecommunications, Financial and Insurance Services, Electricity, Gas, Water and Waste Services, Administrative and Support Services, Other Services, Mining and Professional, Scientific and Technical Services.

Occupation has a large effect on likelihood of workplace injury with occupations involving manual labour having higher estimates. Technicians and Trades Workers, Community and Personal Service Workers, Machinery Operators and Drivers and Labourers are estimated to have significantly higher likelihood of workplace injury compared to the base category of Professionals. Managers are the least likely to report workplace injury. Union members are also more likely to experience workplace injury than non-union members. This could be explainable by the hazards associated with typical occupations and work environments of unionized labour. Casual workers are less likely to report a workplace injury. It is not clear if this is an effect of casual work itself or a reflection of spending less time in the workplace, compared to permanent employees.

Demographics also explain a some of the variation in incidence of workplace injury. Age groups do not vary significantly, but men are more likely to experience workplace injury than women. Although for more severe injuries under 30's appear to have lower rates. Education is a strong predictor, those with a bachelor's degree or higher are significantly less likely to have a workplace injury. Regional differences do not differ significantly by capital city, other urban, rural or regional areas but some variation is seen across states. There is significant variation by socio-economic status of the workers location, incidence of workplace injury increases as SEIFA index decreases (i.e., low socio-economic status suburb have higher rates of workplace injury). Individuals born in a country other than Australia or a main English-speaking country (e.g., UK, USA, Canada) also have higher incidence of workplace injury.

There is also large variation in incidence of workplace injury along the health and wellbeing measures included in this analysis with poorer health generally associated with higher rates of workplace injury. Individuals who have a chronic health condition which affects their ability to work or who have poorer self-assessed health status or who are smokers are more likely to have workplace injury.

A perhaps surprising result is seen for risk preference. Individuals who are more risk averse and not willing to take risks have a higher rate of workplace injury compared with those willing to take average or higher levels of risk. While more risk averse individuals might be expected to face a lower risk of workplace injury, this finding may suggest that financial risk attitudes do not necessarily align with attitudes to risk in workplace settings. A more targeted risk attitude measure, such as a domain specific risk scale, may be better suited to capturing workplace-related risk preferences.

The results from the initial models of workplace injury demonstrate clearly that workplace injury does not happen at random. There are specific cohorts for which risk of workplace injury is much higher or lower than average. This will have important implications for the next steps of our analysis of causal impacts of workplace injury. The unconditional parallel trends assumption may be called into question given the large variation in workplace injury across the measured covariates.

## DID estimation results

The overall summary results for the DID estimates for all outcomes of interest are displayed in Table 4 for the unconditional DID estimate and Table 5for the conditional DID estimates. Each table shows results for the average effect and the 95% confidence interval. Statistical significance is indicated where the sign of the upper and lower confidence intervals is the same (i.e., the confidence interval does not contain zero). Results include the set of models based on the subset of data for men only and for women only as well as for men and women combined. Panel A in Table 44 and Table 55 shows the results for estimates based on the treatment variable being any days off work and on workers compensation payments. Panel B shows estimates for treatment variable equal to being off work and receiving workers compensation payments for 30 days or more.

*Table 4 ATT Estimates for unconditional DID estimators for all outcomes with 95% CI*

*Panel (A) Workplace Injury >0 days off work*

| | All | | | Men | | | Women | | |
|---|---|---|---|---|---|---|---|---|---|
| Outcome | att | LCI | UCI | att | LCI | UCI | att | LCI | UCI |
| Unemployed | 0.02 | 0.00 | 0.03 | 0.01 | -0.01 | 0.03 | 0.02 | 0.00 | 0.04 |
| Unemployed or marginal LF attachment | 0.04 | 0.02 | 0.06 | 0.03 | 0.00 | 0.06 | 0.05 | 0.03 | 0.08 |
| Days on sick leave | -1.44 | -2.98 | 0.10 | -2.00 | -4.85 | 0.86 | -0.70 | -1.54 | 0.15 |
| Income support payments | 754.04 | 346.97 | 1,161.11 | 510.79 | -34.20 | 1,055.78 | 985.50 | 375.61 | 1,595.40 |
| Hourly wage ($) | -2.16 | -3.32 | -1.00 | -2.88 | -4.55 | -1.20 | -1.60 | -3.17 | -0.03 |
| Gross wages ($000's) | -11.48 | -14.41 | -8.55 | -12.93 | -17.41 | -8.45 | -11.04 | -14.91 | -7.17 |
| Total income ($000's) | -7.02 | -10.10 | -3.93 | -7.91 | -11.95 | -3.86 | -7.41 | -11.14 | -3.67 |
| Household total income ($000's) | -8.07 | -13.10 | -3.04 | -5.44 | -12.37 | 1.49 | -10.75 | -17.84 | -3.65 |
| Household wealth ($000's) | -104.95 | -189.14 | -20.77 | -123.55 | -228.44 | -18.66 | -84.29 | -214.35 | 45.76 |
| Early super access | 0.01 | 0.00 | 0.02 | 0.01 | 0.00 | 0.02 | 0.01 | -0.01 | 0.03 |
| Hospital day visits | 0.00 | -0.09 | 0.08 | -0.01 | -0.12 | 0.09 | 0.03 | -0.13 | 0.19 |
| Hospital overnight visits | 0.13 | 0.04 | 0.21 | 0.06 | -0.01 | 0.12 | 0.20 | 0.04 | 0.37 |
| Health expenditure ($) | -47.41 | -210.74 | 115.93 | -98.89 | -291.29 | 93.51 | -3.25 | -273.95 | 267.46 |
| General health score | -2.61 | -3.89 | -1.33 | -1.69 | -3.48 | 0.09 | -3.40 | -5.61 | -1.19 |
| General mental health score | -0.99 | -2.36 | 0.37 | -0.01 | -1.60 | 1.58 | -1.98 | -3.86 | -0.10 |

*Panel (B) Workplace Injury >30 days off work*

| | All | | | Men | | | Women | | |
|---|---|---|---|---|---|---|---|---|---|
| Outcome | att | LCI | UCI | att | LCI | UCI | att | LCI | UCI |
| Unemployed | 0.03 | 0.01 | 0.06 | 0.04 | 0.01 | 0.07 | 0.02 | -0.02 | 0.06 |
| Unemployed or marginal LF attachment | 0.07 | 0.03 | 0.11 | 0.08 | 0.03 | 0.12 | 0.07 | 0.01 | 0.12 |
| Days on sick leave | -4.87 | -10.87 | 1.13 | -7.76 | -19.97 | 4.45 | -2.53 | -4.00 | -1.06 |
| Income support payments | 1,312.01 | 590.49 | 2,033.52 | 1,145.81 | 279.76 | 2,011.87 | 1,298.99 | 285.80 | 2,312.18 |
| Hourly wage ($) | -6.19 | -11.83 | -0.56 | -5.07 | -7.90 | -2.23 | -8.00 | -19.27 | 3.27 |
| Gross wages ($000's) | -22.60 | -28.07 | -17.13 | -23.36 | -32.73 | -14.00 | -20.88 | -27.12 | -14.64 |
| Total income ($000's) | -12.77 | -18.47 | -7.07 | -12.73 | -22.65 | -2.81 | -12.28 | -18.81 | -5.76 |
| Household total income ($000's) | -12.97 | -21.72 | -4.22 | -15.59 | -27.50 | -3.69 | -9.55 | -22.77 | 3.67 |
| Household wealth ($000's) | -108.71 | -208.07 | -9.36 | -131.29 | -252.85 | -9.72 | -92.25 | -234.50 | 50.01 |
| Early super access | 0.01 | 0.00 | 0.03 | 0.01 | 0.00 | 0.03 | 0.01 | -0.02 | 0.04 |
| Hospital day visits | 0.13 | -0.05 | 0.30 | 0.02 | -0.07 | 0.12 | 0.30 | -0.16 | 0.75 |
| Hospital overnight visits | 0.19 | 0.06 | 0.31 | 0.05 | -0.06 | 0.15 | 0.33 | 0.05 | 0.61 |
| Health expenditure ($) | 80.33 | -119.25 | 279.91 | -73.71 | -308.95 | 161.53 | 191.19 | -108.09 | 490.48 |
| General health score | -5.23 | -7.77 | -2.69 | -5.26 | -8.42 | -2.10 | -4.93 | -8.85 | -1.01 |
| General mental health score | -2.21 | -4.78 | 0.37 | -1.72 | -5.35 | 1.92 | -3.35 | -7.42 | 0.72 |

*Table 5 ATT Estimates for conditional DID estimator for all outcomes with 95% CI*

*Panel (A) Workplace Injury >0 days off work*

| | All | | | Men | | | Women | | |
|---|---|---|---|---|---|---|---|---|---|
| Outcome | att | LCI | UCI | att | LCI | UCI | att | LCI | UCI |
| Unemployed | 0.01 | 0.00 | 0.02 | 0.01 | -0.01 | 0.03 | 0.02 | 0.00 | 0.03 |
| Unemployed or marginal LF attachment | 0.03 | 0.01 | 0.05 | 0.02 | -0.01 | 0.04 | 0.04 | 0.01 | 0.07 |
| Days on sick leave | -1.31 | -2.79 | 0.17 | -2.00 | -4.74 | 0.74 | -0.49 | -1.46 | 0.48 |
| Income support payments | 492.26 | 76.77 | 907.74 | 244.73 | -303.80 | 793.27 | 756.53 | 148.42 | 1,364.63 |
| Hourly wage ($) | -0.79 | -1.88 | 0.30 | -1.58 | -3.07 | -0.10 | -0.68 | -2.36 | 1.00 |
| Gross wages ($000's) | -6.64 | -9.67 | -3.62 | -7.88 | -11.95 | -3.82 | -6.45 | -10.01 | -2.89 |
| Total income ($000's) | -3.02 | -5.88 | -0.16 | -4.23 | -8.17 | -0.29 | -3.04 | -6.82 | 0.73 |
| Household total income ($000's) | -1.97 | -6.04 | 2.10 | 0.59 | -5.13 | 6.31 | -3.52 | -9.84 | 2.80 |
| Household wealth ($000's) | -48.28 | -122.59 | 26.03 | -36.45 | -126.57 | 53.67 | -17.79 | -142.90 | 107.32 |
| Early super access | 0.01 | 0.00 | 0.02 | 0.01 | 0.00 | 0.01 | 0.01 | -0.01 | 0.03 |
| Hospital day visits | 0.00 | -0.09 | 0.09 | -0.01 | -0.12 | 0.09 | 0.03 | -0.13 | 0.18 |
| Hospital overnight visits | 0.12 | 0.05 | 0.20 | 0.06 | -0.02 | 0.14 | 0.21 | 0.04 | 0.37 |
| Health expenditure ($) | -31.46 | -199.57 | 136.64 | -84.37 | -280.64 | 111.90 | 76.76 | -223.10 | 376.62 |
| General health score | -2.07 | -3.45 | -0.69 | -1.28 | -3.19 | 0.63 | -2.84 | -5.08 | -0.59 |
| General mental health score | -0.71 | -2.09 | 0.68 | 0.29 | -1.49 | 2.08 | -1.75 | -3.76 | 0.27 |

*Panel (B) Workplace Injury >30 days off work*

| | All | | | Men | | | Women | | |
|---|---|---|---|---|---|---|---|---|---|
| Outcome | att | LCI | UCI | att | LCI | UCI | att | LCI | UCI |
| Unemployed | 0.03 | 0.00 | 0.06 | 0.04 | 0.01 | 0.07 | 0.02 | -0.02 | 0.06 |
| Unemployed or marginal LF attachment | 0.06 | 0.02 | 0.10 | 0.07 | 0.01 | 0.13 | 0.05 | -0.01 | 0.11 |
| Days on sick leave | -4.89 | -11.89 | 2.11 | -8.16 | -22.34 | 6.03 | -2.34 | -3.82 | -0.86 |
| Income support payments | 719.72 | -19.57 | 1,459.02 | 1,086.48 | 232.98 | 1,939.98 | 722.11 | -324.95 | 1,769.18 |
| Hourly wage ($) | -4.53 | -9.62 | 0.57 | -5.28 | -8.03 | -2.54 | -8.06 | -18.76 | 2.64 |
| Gross wages ($000's) | -15.07 | -21.04 | -9.11 | -17.24 | -27.64 | -6.84 | -15.37 | -22.01 | -8.73 |
| Total income ($000's) | -5.86 | -11.61 | -0.10 | -1.31 | -16.08 | 13.46 | -7.08 | -12.14 | -2.02 |
| Household total income ($000's) | -2.15 | -9.17 | 4.87 | -3.70 | -15.44 | 8.04 | -5.02 | -15.04 | 4.99 |
| Household wealth ($000's) | -45.76 | -122.88 | 31.36 | -53.07 | -156.17 | 50.03 | -335.05 | -722.02 | 51.92 |
| Early super access | 0.01 | -0.01 | 0.03 | 0.01 | 0.00 | 0.02 | 0.01 | -0.02 | 0.04 |
| Hospital day visits | 0.12 | -0.05 | 0.29 | 0.01 | -0.10 | 0.11 | 0.24 | -0.19 | 0.67 |
| Hospital overnight visits | 0.17 | 0.05 | 0.30 | 0.05 | -0.06 | 0.16 | 0.34 | -0.01 | 0.69 |
| Health expenditure ($) | 121.34 | -72.91 | 315.60 | 66.68 | -201.20 | 334.55 | 245.50 | -58.31 | 549.31 |
| General health score | -5.61 | -8.01 | -3.20 | 1.34 | -5.19 | 7.87 | -4.43 | -8.43 | -0.43 |
| General mental health score | -2.49 | -5.25 | 0.26 | 3.60 | -0.50 | 7.71 | -3.99 | -8.22 | 0.25 |

Results are elaborated further below, but a few initial observations can be made. Overall, we see statistically significant effects on labour force outcomes, with workplace injury associated with higher rates of unemployment and marginal attachment to the labour force, as well as higher average income support payments. Effects on the use of sick leave are generally not significant.

Effects on gross wages and total personal income are significant, while the effects at the household level are somewhat weaker. Some significant effects are observed for early access to superannuation, although the magnitude is small.

Among the health and wellbeing measures, general health scores are lower for women who have experienced a workplace injury, while effects for men are not significant. Mental health scores, although directionally lower, show limited statistical significance. Health expenditure is not significantly affected. Day hospital visits are also not significantly affected, but we see a significant increase in overnight hospital visits, particularly for women.

As expected, the more severe workplace injury shows consistently larger effect sizes. Estimates based on the 30 days or more on workers compensation treatment variable have larger size compared to the estimates based on the any days on workers compensation treatment variable.

Comparing Table 4 and Table 5 we can see that estimates from the unconditional parallel trend assumption generally have larger absolute value than those conditioned on covariates which suggests that the unconditional parallel trend assumption is likely violated in this data. Our analysis will focus on the set of results relying on conditioning on covariates.

### Labour force outcomes

From Table 5 we see there are small but statistically significant effects on rate of unemployment for those who have experienced a workplace injury, similar to Mazzolini (2020), Crichton et al. (2011) and Galizzi et al. (2023). For all workplace injury's there is an increase of 1 percentage point in the rate of unemployment and 3 percentage points for those who have received 30 or more days of workers compensation payments. The effect of any workplace injury greater than 0 days is slightly larger for women than for men (2 percentage points against 1) but the opposite effect is seen for 30 day+ workplace injury (4 percentage points for men versus 2 for women). The second labour force measure includes those who report being unemployed as well as those who are not employed and marginally attached to the labour force, despite being of working age. The effects of workplace injury are more pronounced for this measure. Any workplace injury greater than 0 days leads to 3 percentage points increase and 30 day+ workplace injury leads to 6 percentage point increase.

We can further explore the dynamic effect of workplace injury by examining the aggregated group-time treatment effect estimates shown in Figure 1. Recall that we have from the DID with multiple time periods approach an estimated treatment effect for each combination of the year in which the workplace injury occurred and the survey wave (i.e., the calendar year). We have reported the overall pre-post effect in Table 5 but it is particularly important to consider the treatment effect over time (i.e., time since the year when the workplace injury occurred). The estimates shown in Figure 1 are aggregate to a time since the workplace injury. The x-axis is the difference in years between when the workplace injury occurred and when the outcome is measured. Years prior to the workplace injury are shown in red and years subsequent to the workplace injury are shown in blue. There are several important diagnostics revealed from this view. Firstly, we must check for violations of the parallel trends assumption in the pre-treatment periods. A violation would occur if we can identify trends in the treatment effect prior to exposure. Ideally all the pre-treatment estimates (i.e., the red series) would have confidence intervals containing zero and show now discernible trend over time. That is what we actually observe in Figure 1.

Secondly, the post-treatment effects describe how the effect of workplace injury evolves over time. Here we are particularly interested in identifying whether the effects of workplace injury persist over time, or even if they may become worse over time. The effects for women for any workplace injury and for men for 30 days+ workplace injury persist for a number of years after the incidence of workplace injury. The trend over time appears to hold for at least 8 years for these groups.

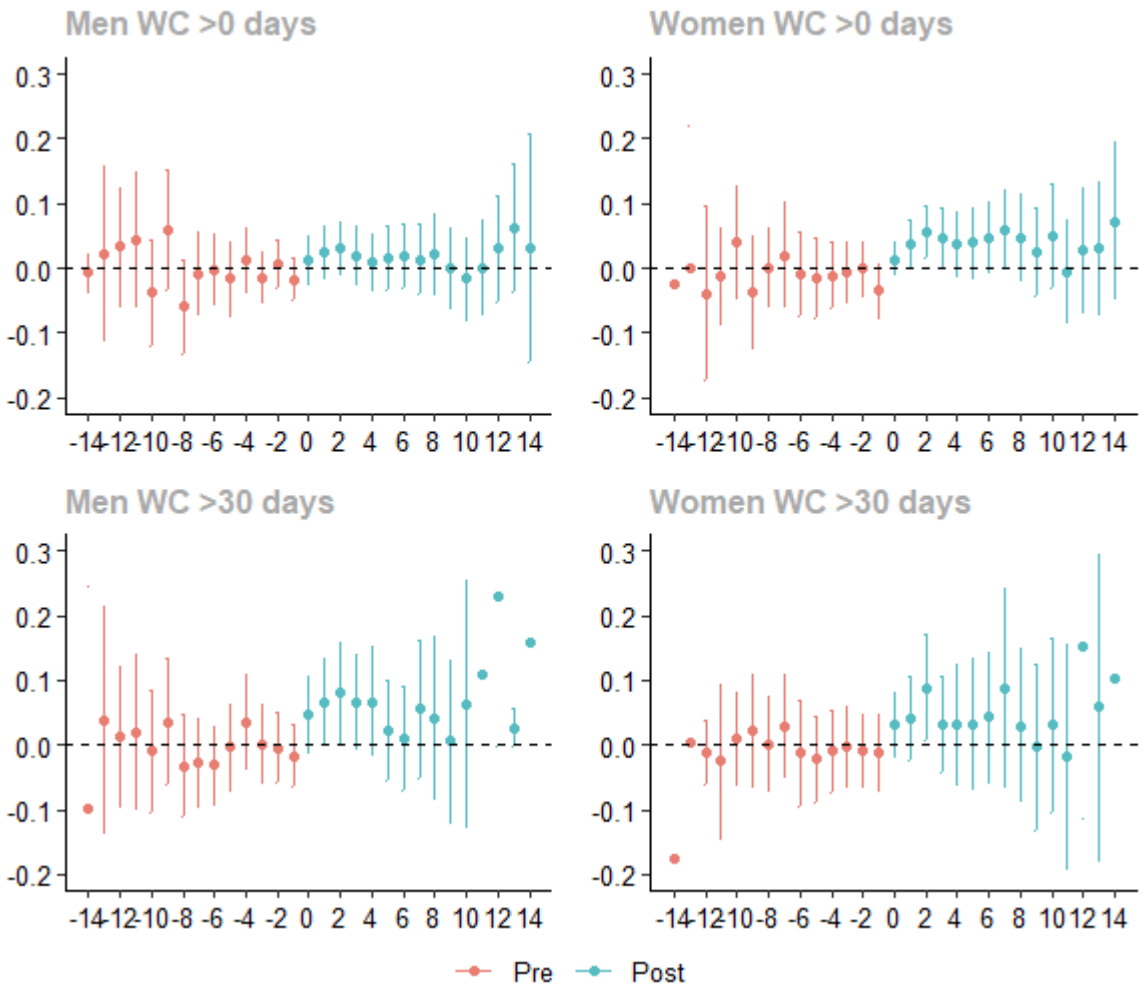


*Figure 1 Aggregated ATT for unemployment or marginal labour force attachment*

We have also identified a significant effect on average amount of income support payments due to workplace injury. We have estimated approximately $500 increase in the average amount of income support payments among individuals who have experienced a workplace injury. The effect for men is lower and not statistically significant but is higher for women at $757 and is statistically significant. For workplace injuries resulting in 30 or more days of workers compensation, the effect overall is higher at $720 and is higher for men at $1,086.

The dynamic treatment effect of workplace injury on income support payments is shown in Figure 2. From the pre-treatment results, we do not invalidate the pre-treatment parallel trends assumption. For the four subsets, the first year after experiencing a workplace injury shows a negative effect with injured workers receiving less income support payments suggesting that wage replacement from workers compensation is providing adequate support. However, the years following workplace injury show an increase in average amounts of income support. The trends seen in the post-treatment effects are similar as for unemployment with the effects most clear for women for all workplace injury and for men for 30 or more days workplace injury. The increased income support amounts do not appear to resolve back to pre-treatment levels within the timeframe of the data available.

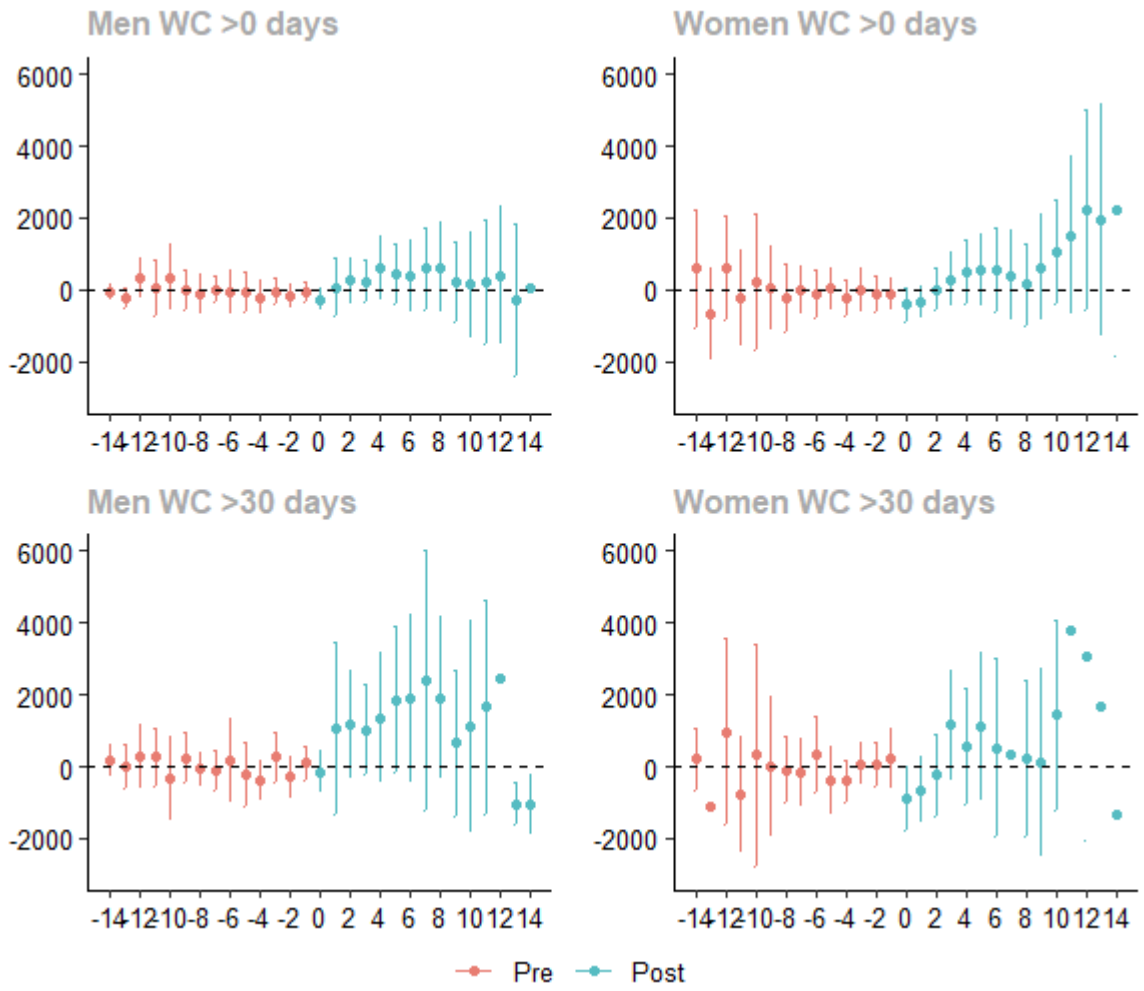


*Figure 2 Aggregated ATT for income support payments*

## Income and wealth outcomes

There are 6 outcomes measured relating to income and wealth. For overall average effects, statistically significant effects are seen for hourly wages for men but not for women. Significant effects are seen for individuals gross wages and total income, but household wealth and income effects are not statistically significant.

The effect for hourly wages does not appear large when considering all workplace injury at $1.58 an hour for men. But for 30+ days' workplace injury the earning loss is larger at $5.28 an hour for men and $8.06 an hour for women although not statistically significant.

Gross wages are strongly impacted by workplace injury for men and women for both types of workplace injury. Dynamic effects are shown in Figure 3. Downwards trends in gross wages emerge in the years following workplace injury and persist for the length of time available in this data. Even after 10 years, injured workers experience a decrease in wages of approximately $10,000 for all workplace injuries and greater than $20,000 for 30+ days' workplace injury.

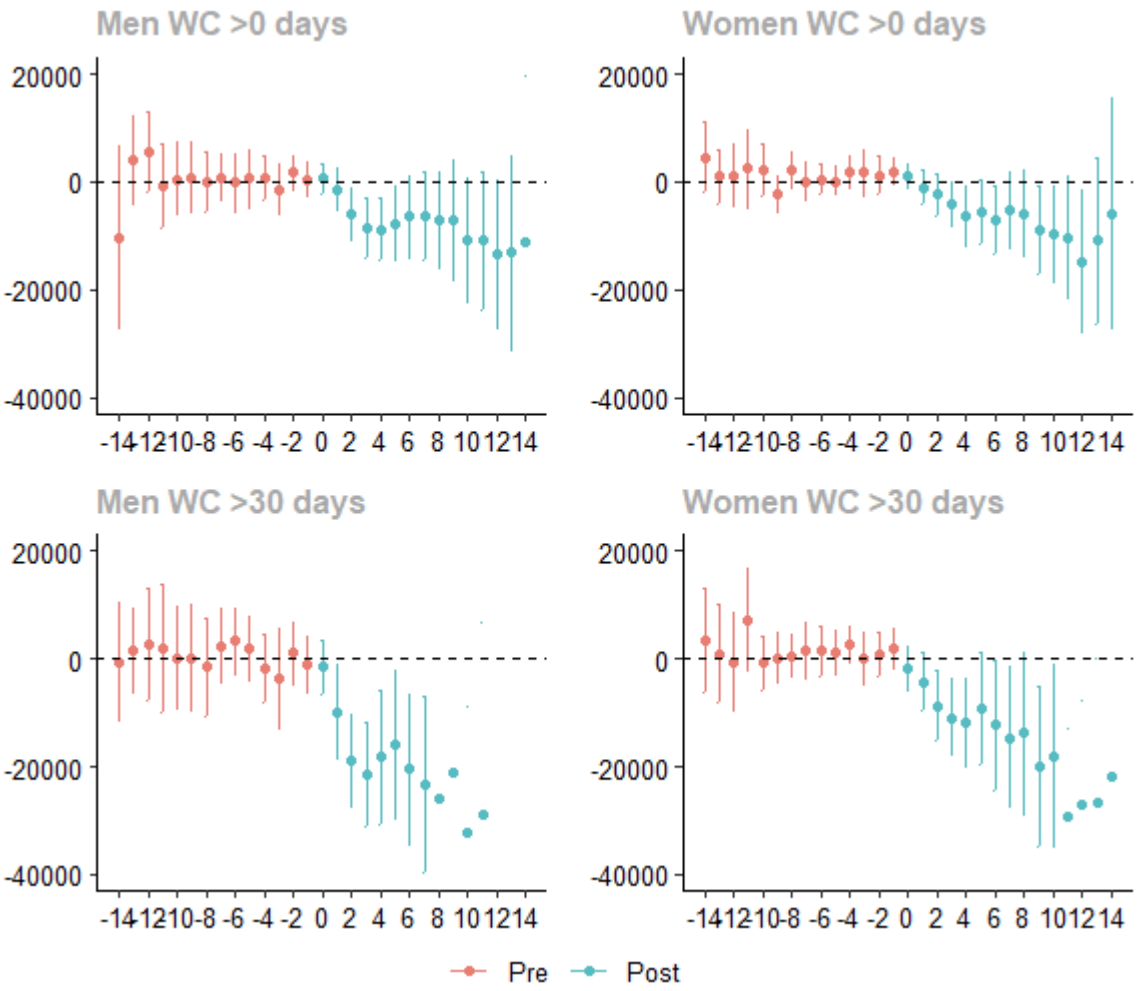


*Figure 3 Aggregated ATT for gross wages*

Similar results are seen for individual's total income (comprising wages together with all other sources of income) although the effect is not as large as for wages alone, other sources of income are compensating for some of the loss of wages. The trend over time is clearest for men with 30+ days' workplace injury with the loss of income reaching $30,000 10 years after the injury.

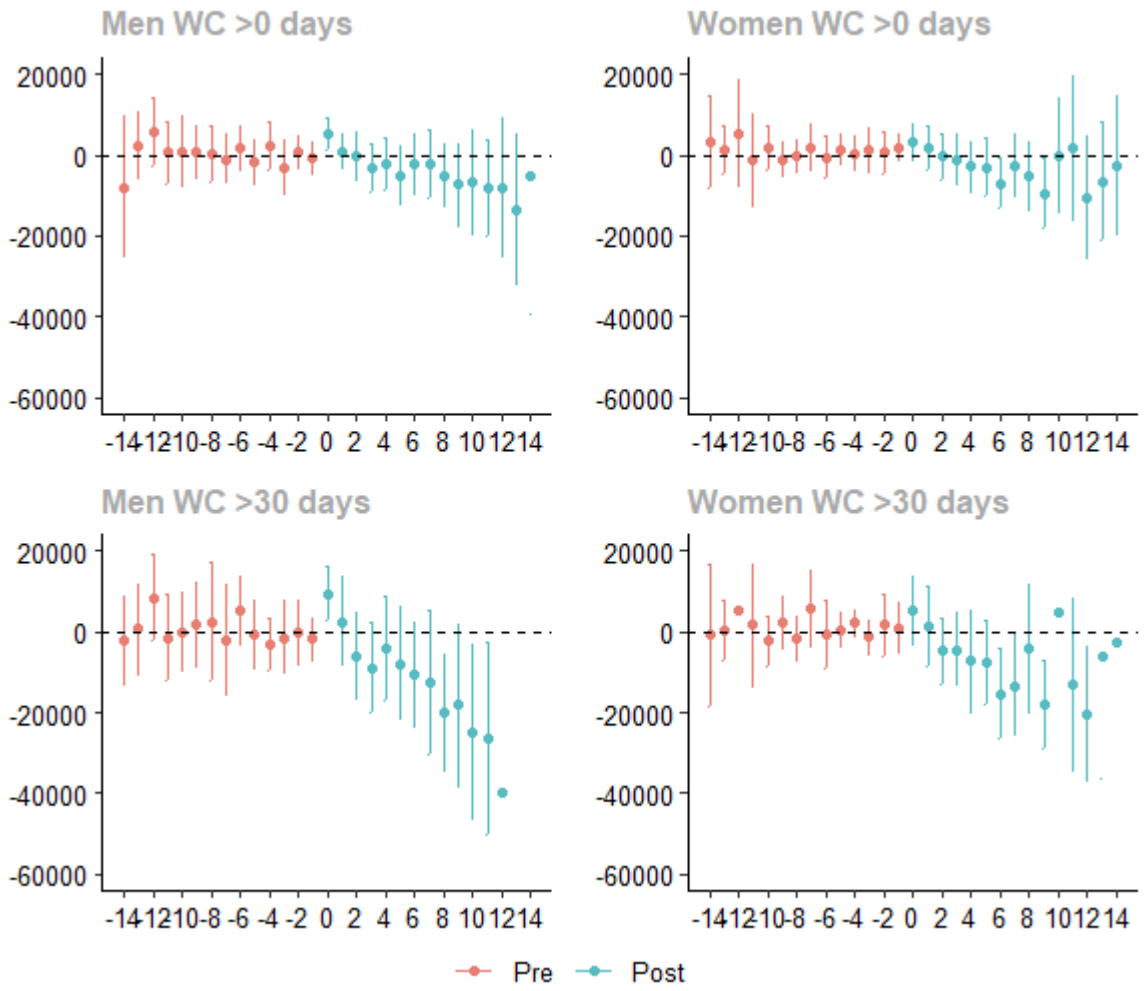


*Figure 4 Aggregated ATT for total income*

### Health and wellbeing outcomes

We have considered 5 health and wellbeing measures in our analysis. The first two relate to use of health services by measuring the number of day and overnight hospital visits. No significant effect is seen for hospital day visits, but we do see a statistically significant effect on overnight hospital visits. Overall, workplace injury leads to 0.12 more hospital visits, with a larger and significant effect for women of 0.21 extra hospital visits. For 30+ days' workplace injury there are 0.34 extra hospital visits for women. The third health outcome is the individuals own expenditure relating to health services and no significant effect is seen for this measure.

General health scores are negatively impacted by workplace injury. The general and mental health scores range from 0 (poorest health) to 100 (best health). Overall workplace injuries reduce the general health score by 2.07 points. For men the reduction is 1.28 points but for women the reduction is 2.84 points. More severe workplace injuries result in greater reduction of 5.61 points overall with no statistically significant result for men but statistically significant reduction of 4.43 points. The shape of the effect over time is also shown in Figure 5. All workplace injuries result in an immediate reduction in general health scores, but the experience is quite different for men and women. For men the immediate drop in health score reduces over time but for women the initial effect is small but appears to deteriorate over time

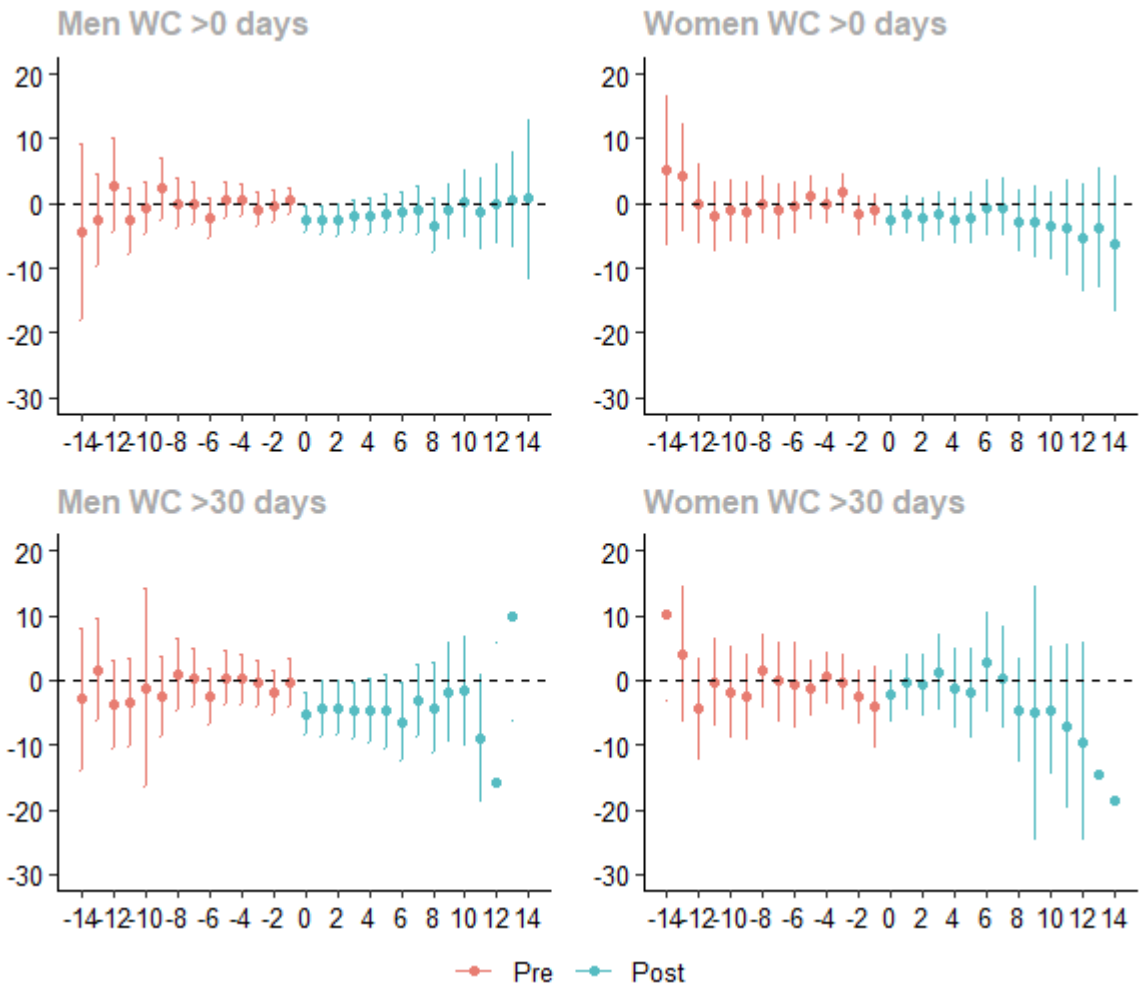


*Figure 5 Aggregated ATT for General Health Score*

For mental health scores the only statistically significant effect is seen for 30+ days' workplace injuries for women with a 4-point reduction. The effect also appears to deteriorate over time. It is also interesting to note that the effect in the year immediately prior to the workplace injury is significantly lower than zero. This may indicate there are significant reductions in mental health for women in the year leading up to serious workplace injury, which could be the case for primary psychological injures.

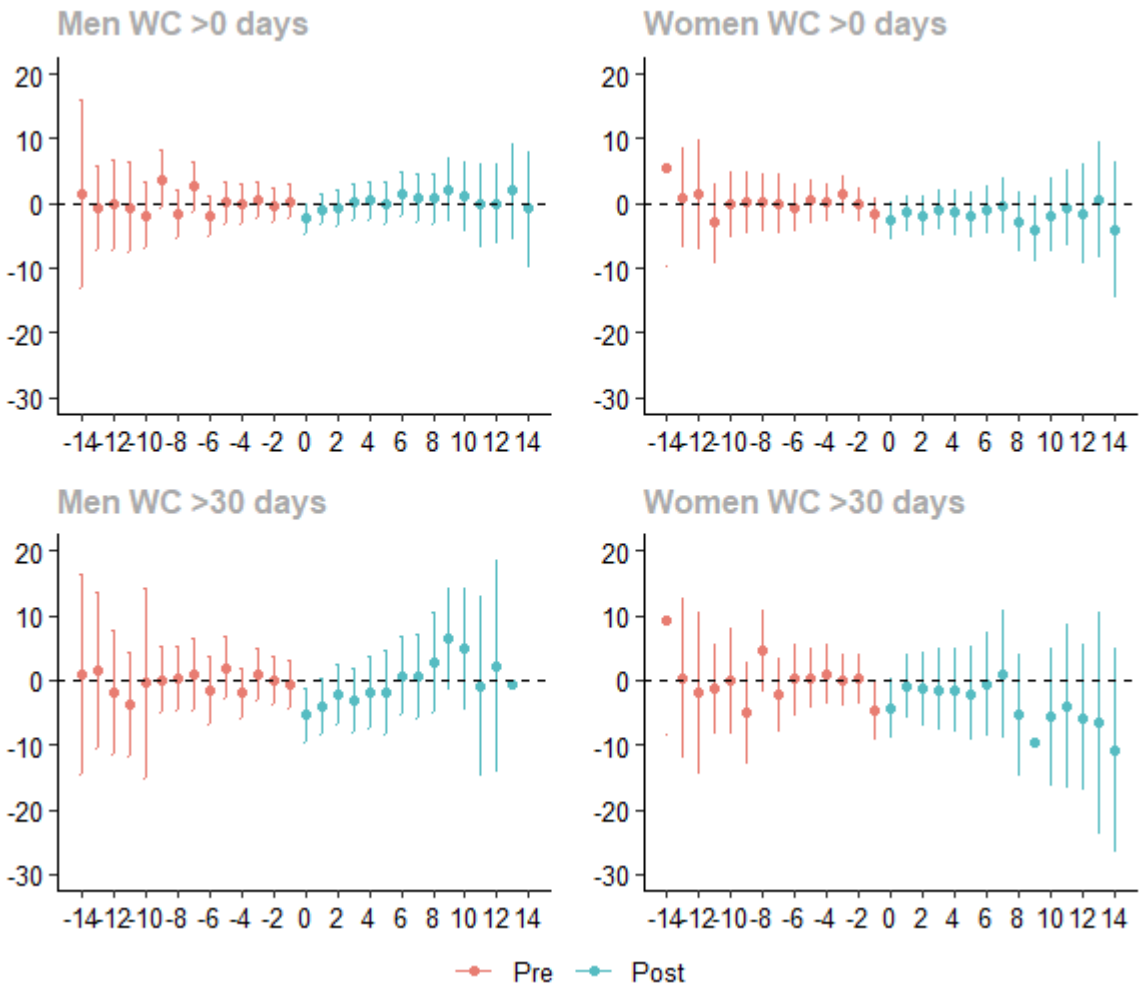


*Figure 6 Aggregated ATT for Mental Health score*

## Discussion and conclusion

This study has investigated a wide range of social and economic consequences of workplace injuries amongst workers across Australia using longitudinal data from the HILDA survey. We have analysed risk factors which predict the occurrence of workplace injuries and identified significant variation in risk of workplace injury. We have used a difference-in-differences approach to establish a causal link between workplace injury and economic and social outcomes across labour force participation, income and wealth, and health and wellbeing.

My analysis has shown that workplace injury leads to substantial and persistent negative impacts on injured workers employment, income and health domains. As would be expected, effects have a greater magnitude for more serious injuries (i.e., those requiring 30 or more days on workers compensation benefits). Effects also differ considerably for men and women.

**Labour Market Impacts**: Workplace injuries significantly increase unemployment rates and marginal labour force attachment, with effects persisting for at least 8 years post-injury. The 3 percentage point increase in unemployment/marginal attachment for any workplace injury, rising to 6 percentage points for severe injuries, represents a substantial disruption to workers' employment trajectories. The dynamic treatment effects demonstrate that these are not transitory effects that resolve quickly but rather represent long-term displacement from employment.

The increase in income support payments of approximately $500-$750 annually suggests a substantial shift in how injured workers are supported financially, with the burden partially transferring from workers compensation systems to other income support systems. This finding aligns with the observations of Griffiths et al. (2023) regarding transitions between support systems. The pattern of decreased income support in the first year post-injury (when workers compensation is providing support) followed by sustained increases in subsequent years provides clear evidence of cost-shifting between systems.

**Income and Wealth Effects**: The wage and income losses documented in this study are substantial and persistent. Gross wage losses of approximately $10,000 annually for any workplace injury, rising to over $20,000 for severe injuries a decade post-injury, represent a significant long-term economic burden on injured workers and their families. These findings are consistent with international evidence from Seabury et al. (2014), Mazzolini (2020) and Galizzi et al. (2023), but provide the first population-level causal estimates for Australia. The smaller effect size noticed for total income compared to wages suggests that compensation and social welfare systems are providing substantial supports to injured workers, but the persistence of statistically significant total income effects indicates that the supports in place to not completely ameliorate the financial effects of workplace injury.

The fact that household-level income and wealth effects are less pronounced than individual effects suggests that households are able to adapt to some extent. Perhaps through increased labour force participation by partners, support from broader family networks or access to savings. This is consistent with the findings for early superannuation access, though statistically significant, we do not see a very large effect size suggesting early super access is not a systemic issue for injured workers.

**Health and Wellbeing**: The deterioration in general health scores, particularly for women experiencing workplace injuries, highlights that the consequences extend well beyond initial injury recovery. The divergent patterns between men and women are particularly striking: men show immediate health score reductions that generally recover over time, while women show smaller initial effects that worsen progressively. This gender difference warrants further investigation and may reflect differences in injury types, recovery support, or the compounding effects of balancing work and caring responsibilities during recovery.

The increase in overnight hospital visits, particularly for women (0.21 additional visits rising to 0.34 for severe injuries), indicates ongoing health system utilization beyond immediate injury treatment. This represents an additional cost to the health system that is not captured in workers compensation data.

**Heterogeneity in Workplace Injury Risk**

The predictive models of workplace injury incidence show that some sectors of the workforce have much higher risk of workplace injury. Clear patterns emerge across industry, occupation, demographics, and a range of health indicators. Workers in manual occupations, those with lower educational attainment, workers in lower socioeconomic areas, and those with poorer self-reported health status face substantially higher risks. This heterogeneity has important implications for prevention strategies.

The finding that more risk-averse individuals experience higher rates of workplace injury is counterintuitive and suggests that general risk preferences may not translate directly to workplace safety behaviours. This could indicate that workplace injury risk is more strongly determined by

occupational hazards and working conditions than by individual risk-taking behaviour. Alternatively, it may reflect that individuals in higher-risk occupations develop greater financial risk aversion due to their exposure to income uncertainty. A more domain specific risk preference measure may be better suited to identifying higher risk individuals. For example the domain-specific-risk-taking (DOSPERT) scale (Blais & Weber, 2006).

**Implications for Policy and Scheme Design**

**Whole-of-System Perspective:** The evidence of cost-shifting from workers compensation to income support programs and increased health system utilization reinforces the importance of taking a whole-of-system view in scheme design. Policy changes that reduce workers compensation eligibility or benefits may appear to reduce scheme costs but can result in costs being transferred to other parts of the social support system. Results here are consistent with the increased social security and health care utilisation identified by Griffiths et al. (2023) and Griffiths, Di Donato, Lane and Gray (2022).

**Long-Term Support Needs:** The persistence of effects for 8-10 years post-injury suggests that return-to-work programs and rehabilitation supports need to maintain longer-term engagement with injured workers. Current workers compensation systems typically have limited visibility beyond the period of active claims, yet our evidence shows that workers continue to experience substantial impacts for many years post-injury.

**Gender-Specific Responses**: The different patterns of impacts between men and women suggest that tailored supports are needed rather than one-size-fits-all. The mechanisms underlying these gender differences require further investigation but may relate to differences in injury types, occupational contexts, access to flexible work arrangements, or broader gender inequalities in labour markets and caring responsibilities.

**Prevention Focus:** We have identified specific cohorts of high-risk workers. The risk factors we have quantified are unlikely to be surprising for insurers and scheme managers but still highlight the importance of injury prevention among these cohorts. Workers in manual occupations, lower socioeconomic areas, with lower educational attainment, and with pre-existing health conditions should be priority groups for workplace safety interventions.

**Future research** could explore several important questions raised by this study. First, what are the mechanisms through which workplace injuries lead to such persistent labour market effects? The wage ladder model proposed by Bíró et al. (2023) provides one potential explanation, but other mechanisms such as human capital depreciation, employer discrimination, or health limitations could play important roles. Second, why do men and women experience such different health trajectories following workplace injury? Understanding these mechanisms could inform more effective support strategies. Third, what interventions are most effective at reducing the long-term consequences documented in this study? Natural experiments from policy changes in workers compensation schemes could provide valuable evidence on effective approaches. Heterogeneity of treatment effects would be another avenue for further exploration. This could include exploring differences between impacts of psychological and physical injuries and also further exploration of subgroups who exhibit effects different from average treatment effects.

**Limitations**

This study has several limitations. Firstly, we cannot identify if the workplace injury in question was a primary physical or primary psychological injury. The expected outcomes could differ significantly for

these injury types. Secondly, while HILDA data provides a rich data source, sample sizes can become quite small when considering certain subgroups or longer time periods post-injury. Some effects, particularly for women with severe injuries, show clear patterns but do not always reach statistical significance perhaps due to low statistical power of the data sample. Larger administrative datasets could provide stronger evidence for specific subgroups of interest. Thirdly, we rely on the conditional parallel trends assumption which can not be tested directly. We have conditioned on a broad set of covariates, but it is always possible there are unmeasured confounders which could bias our estimates. Furthermore, as is the case with all survey data, our analysis relies on self-reported time off work on workers compensation and we can not rule out recall bias.

**Conclusion**

This study provides a causal analysis of long-term workplace injury impacts at the population level in Australia. The evidence demonstrates that workplace injuries lead to substantial and persistent negative consequences across multiple aspects of workers' lives, including employment, income, and health outcomes. Effects can persist for up to 10 years post-injury, with severe injuries having particularly large impacts.

The economic burden of workplace injuries extends well beyond the direct costs visible to insurers and workers compensation schemes. Lost wages of $10,000-$20,000 annually, increased reliance on income support programs, and ongoing health system utilization represent substantial costs to injured workers, their families, and society.

These findings underscore the importance of workplace injury prevention as a public health and economic priority. They also highlight the need for comprehensive, long-term support systems for injured workers that recognize the persistent nature of impacts and take a whole-of-system view of costs and outcomes. Policy makers face difficult trade-offs in scheme design, and this analysis demonstrates that restrictions on compensation and support can lead to costs being shifted to other parts of the social support system and to injured workers and their families bearing increased burdens.

The heterogeneity in workplace injury risk across occupations, industries, and demographic groups highlights high priority cohorts for targeted prevention efforts. However, the substantial causal impacts identified suggest that even with improved prevention, comprehensive support for injured workers will remain essential.

By establishing causal evidence on the long-term impacts of workplace injuries using longitudinal survey data, this study provides policy makers with a more complete picture of the full consequences of workplace injuries. This evidence can inform more effective scheme design, prevention strategies, and support services that address not only the immediate impacts of workplace injuries but also their long-lasting effects on workers' employment, income, and wellbeing. The development of whole-of-system outcomes frameworks and integrated monitoring systems would enable ongoing assessment of whether policy settings are achieving their intended goals while avoiding unintended consequences, with the ultimate goal of increasing wellbeing among injured workers whilst promoting sustainability in compensation schemes.

## Data Availability

This paper uses unit record data from Household, Income and Labour Dynamics in Australia Survey [HILDA] conducted by the Australian Government Department of Social Services (DSS). The findings

and views reported in this paper, however, are those of the author[s] and should not be attributed to the Australian Government, DSS, or any of DSS' contractors or partners. DOI: 10.26193/NBTNMV

## References


Bíró, A., Bisztray, M., Fonseca, J. G., & Molnár, T. (2023). *Accident-induced absence from work and wage ladders*.

Blais, A.-R., & Weber, E. U. (2006). A domain-specific risk-taking (DOSPERT) scale for adultpopulations. *Judgment and Decision making*, *1*(1), 33-47.

Boden, L. I., & Galizzi, M. (1999). Ecnomic consequences of workplace injuries and illnesses: Lost earnings and benefit adequacy. *American Journal of Industrial Medicine*, *36*(5), 487-503.

Boden, L. I., O'Leary, P. K., Applebaum, K. M., & Tripodis, Y. (2016). The impact of non-fatal workplace injuries and illnesses on mortality. *American Journal of Industrial Medicine*, *59*(12), 1061-1069.

Borusyak, K., Jaravel, X., & Spiess, J. (2024). Revisiting event-study designs. *Review of Economic Studies*, *91*(6), 3253-3285.

Brown, J. A., Shannon, H. S., Mustard, C. A., & McDonough, P. (2007). Social and economic consequences of workplace injury: A population-based study of workers in British Columbia, Canada. *American Journal of Industrial Medicine*, *50*(9), 633-645.

Callaway, B., & Sant'Anna, P. H. (2021). Difference-in-differences with multiple time periods. *Journal of Econometrics*, *225*(2), 200-230.

Collie, A., Di Donato, M., & Iles, R. (2019). Work disability in Australia: an overview of prevalence, expenditure, support systems and services. *Journal of Occupational Rehabilitation*, *29*(3), 526-539.

Crichton, S., Stillman, S., & Hyslop, D. (2011). Returning to Work from Injury: Longitudinal Evidence on Employment and Earnings. *ILR Review*, *64*(4), 765-785. https://doi.org/10.1177/001979391106400407

De Chaisemartin, C., & d'Haultfoeuille, X. (2020). Two-way fixed effects estimators with heterogeneous treatment effects. *American Economic Review*, *110*(9), 2964-2996.

Deloitte. (2022). Safer, Healthier, Wealthier: The Economic Value of Reducing Work-Related Injuries and illnesses–Technical Report. In: Safe Work Australia, Commonwealth of Australia, https://www ….

Department of Social Services, Melbourne Institute of Applied, & Economic Social, R. (2024). *The Household, Income and Labour Dynamics in Australia (HILDA) Survey, GENERAL RELEASE 23 (Waves 1-23)* Version V2) [Survey data]. ADA Dataverse. https://doi.org/doi:10.26193/NBTNMV

Dobkin, C., Finkelstein, A., Kluender, R., & Notowidigdo, M. J. (2018). The economic consequences of hospital admissions. *American Economic Review*, *108*(2), 308-352.

Dong, X. S., Wang, X., Largay, J. A., & Sokas, R. (2016). Economic consequences of workplace injuries in the United States: Findings from the National Longitudinal Survey of Youth (NLSY79). *American Journal of Industrial Medicine*, *59*(2), 106-118. https://doi.org/https://doi.org/10.1002/ajim.22559

Duguet, E., & Le Clainche, C. (2012). The impact of health events on individual labor market histories: the message from difference in differences with exact matching.

Fouquet, F., Meehan, L., Pacheco, G., & Theadom, A. (2024). The effect of a minor health shock on labor market outcomes: The case of concussions. *Health Economics*, *33*(12), 2838-2853.

Galizzi, M., Leombruni, R., & Pacelli, L. (2023). Severe work disabilities and long-lasting losses. *Labour Economics*, *85*, 102432. https://doi.org/https://doi.org/10.1016/j.labeco.2023.102432

Goodman-Bacon, A. (2021). Difference-in-differences with variation in treatment timing. *Journal of Econometrics*, *225*(2), 254-277.

Griffiths, D., Di Donato, M., Lane, T., & Gray, S. (2022). Impacts of past occupational injury and long-duration compensated work disability on future hospital admissions. *International Journal of Population Data Science*, *7*(3), 1973.

Griffiths, D., Di Donato, M., Lane, T., Gray, S., Iles, R., Berecki-Gisolf, J., Smith, P., & Collie, A. (2022). Changes in health and welfare after workers' compensation benefits cease. *International Journal of Population Data Science*, *7*(3). https://doi.org/10.23889/ijpds.v7i3.1974

Griffiths, D., Di Donato, M., Lane, T. J., Gray, S., Iles, R., Smith, P. M., Berecki-Gisolf, J., & Collie, A. (2023). Transition between social protection systems for workers with long term health problems: A controlled retrospective cohort study. *SSM-Population Health*, *23*, 101491.

Mazzolini, G. (2020). The Economic Consequences of Accidents at Work. *Oxford Bulletin of Economics and Statistics*, *82*(5), 1068-1093. https://doi.org/https://doi.org/10.1111/obes.12358

Molinero-Ruiz, E., Navarro, A., Moriña, D., Albertí-Casas, C., Jardí-Lliberia, J., & de Montserrat-Nonó, J. (2015). Estimating non work-related sickness leave absences related to a previous occupational injury in Catalonia (Spain). *Archivos de prevención de riesgos laborales*, *18*(2), 81-95.

Parro, F., & Pohl, R. V. (2021). The effect of accidents on labor market outcomes: Evidence from Chile. *Health Economics*, *30*(5), 1015-1032. https://doi.org/https://doi.org/10.1002/hec.4230

Roth, J., Sant'Anna, P. H., Bilinski, A., & Poe, J. (2023). What's trending in difference-in-differences? A synthesis of the recent econometrics literature. *Journal of Econometrics*, *235*(2), 2218-2244.

Sant'Anna, P. H., & Zhao, J. (2020). Doubly robust difference-in-differences estimators. *Journal of Econometrics*, *219*(1), 101-122.

Seabury, S. A., Scherer, E., O'Leary, P., Ozonoff, A., & Boden, L. (2014). Using linked federal and state data to study the adequacy of workers' compensation benefits. *American Journal of Industrial Medicine*, *57*(10), 1165-1173.

Senthanar, S., MacEachen, E., & Lippel, K. (2020). Return to Work and Ripple Effects on Family of Precariously Employed Injured Workers. *Journal of Occupational Rehabilitation*, *30*(1), 72-83. https://doi.org/10.1007/s10926-019-09847-0

Smith, P., LaMontagne, A. D., Lilley, R., Hogg-Johnson, S., & Sim, M. (2020). Are there differences in the return to work process for work-related psychological and musculoskeletal injuries? A longitudinal path analysis. *Social psychiatry and psychiatric epidemiology*, *55*(8), 1041-1051.

Tompa, E., Mofidi, A., van den Heuvel, S., van Bree, T., Michaelsen, F., Jung, Y., Porsch, L., & van Emmerik, M. (2021). Economic burden of work injuries and diseases: a framework and application in five European Union countries. *BMC Public Health*, *21*(1), 49. https://doi.org/10.1186/s12889-020-10050-7

Ware, J. E., Snow, K. K., Kosinski, M., & Gandek, B. (1993). SF-36 health survey. *Manual and interpretation guide*, *2*.

Watson, N., & Wooden, M. P. (2012). The HILDA survey: a case study in the design and development of a successful household panel survey. *Longitudinal and life course studies*, *3*(3), 369-381.

## Appendix

*Table 6 Labour force outcome summary statistics*

| year | n | Unemployed | Unemployed or marginal LF attachment | Days on sick leave | Income support payments |
|---|---|---|---|---|---|
| 2006 | 8923 | 3.4% | 8.0% | 2.13 | 952 |
| 2007 | 8889 | 3.0% | 6.9% | 2.18 | 951 |
| 2008 | 8909 | 3.0% | 6.9% | 2.38 | 893 |
| 2009 | 9259 | 3.7% | 7.8% | 2.55 | 887 |
| 2010 | 9324 | 3.6% | 7.8% | 2.55 | 1,115 |
| 2011 | 11586 | 2.2% | 4.7% | 1.97 | 1,080 |
| 2012 | 10765 | 3.3% | 6.8% | 2.64 | 1,094 |
| 2013 | 10234 | 3.4% | 7.4% | 2.64 | 1,260 |
| 2014 | 9789 | 3.3% | 7.2% | 2.77 | 1,345 |
| 2015 | 9410 | 3.5% | 6.7% | 2.72 | 1,469 |
| 2016 | 9087 | 3.1% | 6.8% | 2.80 | 1,487 |
| 2017 | 8698 | 2.7% | 6.0% | 2.89 | 1,514 |
| 2018 | 8307 | 2.5% | 6.0% | 2.92 | 1,361 |
| 2019 | 7929 | 2.5% | 5.7% | 3.01 | 1,441 |
| 2020 | 7535 | 3.2% | 7.0% | 2.76 | 1,673 |
| 2021 | 7037 | 2.4% | 5.7% | 2.82 | 1,781 |
| 2022 | 6533 | 1.8% | 5.0% | 4.09 | 1,608 |
| 2023 | 6204 | 2.0% | 4.6% | 3.48 | 1,517 |

*Table 7 Income and wealth outcomes summary statistics*

| year | Hourly wage ($) | Gross wages ($) | Total income ($) | Household total income ($) | Household wealth ($) | Early super access |
|---|---|---|---|---|---|---|
| 2006 | 23.8 | 35,502 | 46,081 | 81,435 | 663,275 | 0.7% |
| 2007 | 24.9 | 38,268 | 47,706 | 85,212 | | 0.8% |
| 2008 | 26.3 | 40,394 | 50,275 | 90,132 | | 0.5% |
| 2009 | 27.2 | 41,963 | 53,126 | 96,786 | | 0.6% |
| 2010 | 28.9 | 43,900 | 54,522 | 99,809 | 736,432 | 0.4% |
| 2011 | 30.1 | 46,812 | 58,313 | 103,925 | | 0.4% |
| 2012 | 31.7 | 50,595 | 63,386 | 108,731 | | 0.4% |
| 2013 | 33.0 | 52,725 | 65,584 | 110,334 | | 0.6% |
| 2014 | 34.1 | 54,198 | 68,945 | 113,541 | 809,965 | 0.5% |
| 2015 | 35.2 | 56,028 | 71,548 | 114,884 | | 0.5% |
| 2016 | 36.5 | 58,001 | 74,292 | 116,903 | | 0.5% |
| 2017 | 38.0 | 59,990 | 75,911 | 118,180 | | 0.7% |
| 2018 | 39.9 | 62,905 | 80,441 | 122,214 | 1,044,447 | 0.6% |
| 2019 | 41.2 | 66,336 | 84,690 | 128,852 | | 0.9% |
| 2020 | 44.4 | 68,028 | 88,858 | 135,158 | | 2.6% |
| 2021 | 45.3 | 71,097 | 92,827 | 140,214 | | 2.0% |
| 2022 | 47.1 | 76,822 | 99,937 | 149,885 | 1,520,758 | 0.8% |
| 2023 | 50.1 | 81,218 | 103,293 | 153,178 | | 1.0% |

*Table 8 Health and wellbeing outcomes summary statistics*

| year | Hospital day visits | Hospital overnight visits | Health expenditure ($) | General health score | General mental health score |
|---|---|---|---|---|---|
| 2006 | | | 1,318 | 73 | 75 |
| 2007 | | | 1,363 | 72 | 75 |
| 2008 | | | 1,472 | 72 | 75 |
| 2009 | 0.16 | 0.15 | 1,372 | 73 | 75 |
| 2010 | | | 1,451 | 71 | 75 |
| 2011 | | | 1,448 | 72 | 75 |
| 2012 | | | 1,483 | 72 | 75 |
| 2013 | 0.18 | 0.15 | 1,536 | 71 | 75 |
| 2014 | | | 1,534 | 70 | 75 |
| 2015 | | | 1,510 | 70 | 74 |
| 2016 | | | 1,524 | 70 | 74 |
| 2017 | 0.22 | 0.15 | 1,536 | 69 | 74 |
| 2018 | | | 1,497 | 69 | 74 |
| 2019 | | | 1,572 | 69 | 73 |
| 2020 | | | 1,407 | 69 | 72 |
| 2021 | 0.20 | 0.16 | 1,527 | 68 | 71 |
| 2022 | | | 1,760 | 66 | 72 |
| 2023 | | | 2,008 | 66 | 71 |