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Title:
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Date:
2021-12

Citation:
Lallukka, T., Hiilamo, A., Wooden, M., Glozier, N., Marshall, N., Milner, A. & Butterworth, P. (2021). Recurring pain, mental health problems and sick leave in Australia. SSM - Mental Health, 1, https://doi.org/10.1016/j.ssmmh.2021.100025.

Persistent Link:
https://hdl.handle.net/11343/288849

Recurring pain, mental health problems and sick leave in Australia

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Funding

TL and AH were supported by the Academy of Finland (Grants #287488 and #319200). TL is also supported by the Social Insurance Institution of Finland (grant 29/26/2020). This research was supported (partially or fully) by the Australian Government through the Australian Research Council's Centre of Excellence for Children and Families over the Life Course (Project ID CE200100025).

Acknowledgements

This paper uses unit record data from the Household, Income and Labour Dynamics in Australia (HILDA) Survey. The HILDA Survey project was initiated and is funded by the Australian Government Department of Social Services (DSS) and is managed by the Melbourne Institute of Applied Economic and Social Research (Melbourne Institute). The findings and views reported in this paper, however, are those of the authors and should not be attributed to either DSS or the Melbourne Institute. We honour the memory of Associate Professor Allison Milner, who very sadly and tragically died before the submission of this paper. She participated in the planning of this study and is listed as a co-author.

Abstract

A substantial proportion of Australians report recurring pain and mental health problems, but their separate and joint contributions to sick leave use has not been examined. This study examines the interaction of pain and mental health problems with sick leave usage and the extent to which unobservable time-invariant factors contribute to these conditions and the propensity to take sick leave. Longitudinal data on self-reported paid sick leave days, pain, mental health problems and multiple covariates, and spanning the period 2005 to 2019, were derived from the Household, Income, and Labour Dynamics in Australia Survey. The analysis included 3,404 and 3,448 employed women and men, respectively, with paid sick leave entitlements, with an average of 6 observations each. Negative binomial regression models were used to investigate the association while adjusting for multiple covariates. After multiple adjustments, recurring pain was linked to 1.7 additional sick leave days per year among women and 2.3 among men, whereas the corresponding figures for recurring mental health problems were 1.5 and 0.7, respectively. Further adjustment for time-constant within-individual heterogeneity slightly attenuated these estimates, suggesting that unobserved characteristics contribute to both symptoms and a higher propensity to take sick leave. Pain and mental health problems – single-occasion but particularly recurring – are both important contributors to sick leave days in Australia. However, their effects do not appear to interact with one another. Thus, to help the employees continue working, mental health problems and pain have to be tackled early on, aiming to reduce any stigma related to them. Moreover, modification in working conditions could be useful in finding better matches between employees and their jobs, provided that the employer is aware of the mental health problems and pain of their employees.

Keywords

sick leave; prospective; occupational; work disability; pain; psychological distress; within-individual approach

1. Introduction

Overall, pain causes notable human suffering, limits the ability to function, and increases the risk of mental health problems [1-4]. The 2011–2012 Australian National Health Survey estimated that some 15% of Australians aged 15 years or older experienced pain that persisted or recurred over a 6-month period [5]. Two-thirds of survey respondents reported that their pain was moderate to very severe and caused significant limitations in activities of daily living. It is thus not surprising that pain is linked to higher levels of sick leave among workers [6,7], a greater risk of workers exiting the workforce [8,9], and higher levels of welfare dependence [10]. As with pain, mental health problems are also prevalent across the life course and a leading reason for disability [11-13]. Indeed, worldwide more than a billion people have been estimated to be affected by mental or addictive disorders [13,14].

The available evidence about the contributions of pain and mental health problems to sick leave use has, however, several important limitations. First, the evidence comes mainly from Nordic countries [15-18] with generous social insurance coverage, something which is not shared by all nations. In this article, evidence is presented for Australia, a country with a very different set of institutional arrangements for handling sick leave. Notably, Australian employers do not contribute into a social insurance scheme, but instead are required to simply pay the wages of employees when they are sick. The level of paid sick leave days in Australia has also always been capped at a relatively low number. Australia's National Employment Standard currently specifies a minimum of 10 days per annum for personal leave, which covers both own sickness and caring for a family member who is sick. That said, these are only minimum standards and entitlements do vary across industries and employers. For example, they are higher in the public sector (the current Australian Public Service Agreement specifies a minimum personal leave entitlement of 18 days per annum while the norm in most State Government agreements is 15). Additionally, around one in every five Australian workers is employed on a casual basis, which typically means no paid leave entitlements [19]. As a consequence, while there are no national administrative records on sick leave use in Australia, average levels are likely low compared to Nordic countries. Unused sick leave entitlements, however, do accrue with

length of tenure with an employer, but (apart from some rare exceptions) unused entitlements cannot be cashed out on employment cessation or transferred to different employers. We thus might expect the rate of sick leave use to rise with job tenure. More details about Australia's sick leave system can be found on the Australian Government's Fair Work Ombudsman's website [20].

A second limitation is that previous studies on pain and mental health problems have mainly relied on single measurement occasions. Pain and mental health fluctuate over one's life and are often recurrent in nature [21-24]. Therefore, it is important to examine longitudinal data to capture recurring pain and mental health problems. We expect recurrent symptoms to have a stronger association with sick leave than those from a single occasion [22,25]. Third, there is debate about whether there are any joint effects of pain and mental disorders on sick leave. We argue that it is important to consider whether pain and mental health combined could lead to more sick leave given pain often co-occurs with mental disorders [1,18,26], due to shared liability or (bidirectional) causal relationships [27]. Indeed, their co-occurrence has been shown to be strongly related to self-rated physical work ability [18].

Some evidence suggests that there may be joint additive or multiplicative effects of pain and mental health on sick leave and disability retirement [15,16]. Previous studies have speculated that this is because: (i) mental conditions, such as depression, may increase the severity of pain; (ii) pain may limit the ability to recover from mental conditions; and (iii) pain may increase the severity of negative affects [17,18,28,29]. However, not all studies find interaction effects of pain and mental health conditions on work ability [30,31]. Moreover, the interaction between pain and mental health has been mainly analysed in European contexts with selected occupational cohorts. Less evidence exists for Australia. Especially lacking is evidence from nationally more representative, and hence more heterogeneous, samples.

Building on and extending this prior research, this study examines the contributions of pain and mental health to sick leave using longitudinal survey data from Australia. Our particular focus is on recurrent health conditions, measured on two consecutive occasions, as it is likely that

recurrent/chronic conditions matter most. The analytical strategy employed involves three main steps. First, descriptive estimates of the interaction of pain and mental health on subsequent sick leave are presented. Second, multiple confounding factors are adjusted for, and the number of sick leave days of people with pain/mental health problems is compared to those without these conditions. Third, we focus on within-person variability in pain and mental health problems and the extent to which persons have a higher risk of sick leave on the occasions when they are in pain or experiencing mental health problems compared to themselves when they do not report these conditions. Thus, the study controls for unobservable time-invariant factors that may contribute to both health and the propensity to take sick leave.

2. Materials and Methods

2.1 Data

The dataset used in this study is from the Household, Income, and Labour Dynamics in Australia (HILDA) Survey. The longitudinal HILDA Survey commenced with a sample of Australian households that was nationally representative when weighted. Survey waves have been conducted on an annual basis since 2001. The data have been collected via a personal interview covering general household topics (Household Questionnaire) with a single household informant, a personal interview (Person Questionnaire) with all household members aged 15 years or older, and a self-administered paper questionnaire (Self-Completion Questionnaire) given to all persons interviewed. At the first wave completed interviews were obtained from 7682 households (representing a 66% response rate) and 13,969 individuals [32].

The first wave reference population was all members of private dwellings in Australia (with some minor exceptions). The participating households were selected using multi-stage sampling. While the sample was broadly representative of the adult population at baseline in 2001, and new young people are recruited as they turn 15, immigrants arriving after 2001 would have needed to join an existing

sample household to be included. A top-up sample was thus added in 2011 to help address this problem, but the issue remains for later years. Thus, while the HILDA Survey is representative of the vast majority of the Australian population at any point in time, it is not representative of recent immigrants.

Sample households and their offspring are being followed for an indefinite period with new household members also interviewed. Annual re-interview rates are high, rising from 86.9% in wave 2 to over 95% by wave 8 and remaining above that level ever since [32].

Interviews are conducted, on average, one year apart (mean interview interval = 364 days with inter-quartile range = 350 to 376 days), mostly in the latter half of each year. For this analysis, each observation for each participant draws on data from two consecutive time points (t, t+1) to provide measures from the start (e.g., worker characteristics) and end (e.g., reported sick leave) of each annual observation period. On average, respondents contributed data from six observation years to the analysis (women: 5.8; men: 6.2).

This study also applied the following sample restrictions: (i) must contribute two or more interviews over the study (to provide measures of within-person variability); (ii) within each wave, must have completed both the personal interview and the self-completion questionnaire; (iii) were of prime working age (aged 25 to 54 years); (iv) had no missing data on variables of interest, were employees (meaning the self-employed and business owners are excluded), and were entitled to paid sick leave at the beginning and end of each observation period; (v) worked for at least 50 days during the year; and (vi) provided data to identify attrition in the subsequent wave (t+2) for inclusion in modelling. Questions about paid sick leave were first introduced in wave 5 and thus the study begins with sick leave data collected in wave 5 (2005) and worker characteristics collected in wave 4 (2004). Our estimation period ends with sick leave data collected in wave 18 (2018) and worker characteristics in wave 17 (2017). Data from wave 19, however, are used in the construction of a measure of subsequent attrition at t+2. We also limit analysis to those with data on all model covariates (leading

to the omission of less than 1% of all observations). Ultimately, we were left with a sample for analysis comprising 41,270 observations from 6,852 persons. Full details of the sample selection steps are provided in Appendix Table A.1.

2.2 Measures

2.2.1 Pain

Every year the HILDA Survey administers, as part of its self-completion questionnaire, the 36-item Short-Form (SF-36) Health Survey [15]. It includes a question about pain: 'How much bodily pain have you had during the past 4 weeks?' with response options of 'No bodily pain', 'Very mild', 'Mild', 'Moderate', 'Severe' and 'Very severe'. Those reporting having moderate to very severe pain were coded as having pain and the rest not. The cut point was based on the approach of the Australian Institute of Health and Welfare, an independent statutory agency producing statistics to inform policy. It defines chronic pain as moderate or severe pain lasting longer than 6 months [33]. Hence, we operationalised pain as moderate or greater pain according to the SF-36 item and reported at two consecutive waves, 12 months apart. The main analysis focuses on those respondents who reported pain at both the start (time *t*) and end (*t+1)* of each observation period. This is done because of the importance of chronic pain for sick leave and health-related exit from the workforce overall [21,25]. A measure of reported pain only at the start of each year (time *t*) is also included as a control in the full models. The two pain measures are mutually exclusive (i.e., single-occurring pain is reported at time *t* but not time *t+1*, while chronic pain is reported both at time *t* and *t+1*).

2.2.2 Mental health problems

Similar measures of mental health problems were derived from the Mental Health Inventory (MHI-5), which is a 5-item subscale of the SF-36. To produce estimates most similar to the pain measures, those with a scale score of 52 or less were classified as having mental health problems [34]. Similar to the pain measures, respondents who scored 52 or less on the MHI-5 at both the start (time *t*) and end (*t+1)* of each observation period were coded as having recurring mental health problems. The cut

point selected follows previous research using these data, on the association between mental health and sick leave [34]. The cut point of 52 to define those with severe mental health symptoms has also been used in previous studies [35,36]. If there is an association, it also should not be overly sensitive to any selected cut point, although the cut point is likely to affect the size of the effect. Additionally, the aim of the paper was to focus on significant mental illness (and pain), providing another reason for using the selected cut-point. Furthermore, the cut point of 52 or less provided the best match with the percentage in pain. The Cronbach's alpha for MHI-5 in baseline observations in the current analysis is 0.80. A measure of single-occasion mental health problems at the start of each year (time *t*) was also included as a control in the full models.

2.2.3 Sick leave and time at work

Data on sick leave were self-reported and obtained from the personal interviews (around 90% face-to-face and 10% by phone) at the end of each observation period (time *t+1*). Each observation covers a 12-month period prior to *t+1*. More specifically, persons were asked 'During the last 12 months, have you taken any paid sick leave?' and if so, 'How many weeks or days did you spend on paid sick leave?' The number of paid sick leave days was used as a count outcome variable. While previous studies have found good agreement between self-reported and administrative-recorded sick leave [37], the data from the National Health Survey suggest the HILDA Survey data may understate the amount of sick leave. This limitation is discussed in more detail in the methodological considerations section, but our analytical approach assumes that any recall bias affecting sick leave days is independent of our variables of interest.

Given variability in individuals' level of work participation (both differences between different people and within the same person over time), we calculated and used the time at work for each individual in each observation year as the exposure in the model. Data from the beginning and end of each observation period (*t* and *t+1*) on usual work patterns (i.e., days worked), other types of leave taken (e.g., annual leave, maternity leave, unpaid leave), and periods of employment/non-employment

during the year were used to construct an estimate of total days at work. While a few individuals (0.1% of observations) provided inconsistent results (total leave greater than the estimate of days worked; e.g., due to accrued annual leave), and in general the numbers used do not capture all sources of variability in worked days (e.g., public holidays), these numbers do capture the variability expected in number of work and leave days and provides the denominator to calculate the incidence rate of sick leave.

2.2.4 Confounders

The fully adjusted model included variables measuring key social and health-related factors that can be conceptualised as shared causes of pain or mental health and sick leave. As a measure of socioeconomic position, at each observation year, gross weekly salary was categorised to identify those in the lowest and highest quintiles, and compare to those whose income was between these two extremes. Real wages are correlated with hours of work, thus, occupational skill level was included as another indicator of socioeconomic position. It was classified as five categories based on the Australian and New Zealand Standard Classification of Occupations (ANZSCO) [38]. ANZSCO specifies nine major occupational categories, which represent five occupational skill levels based on the range and complexity of the tasks performed (see Table 1 for more details on groupings). Occupation groups range between those requiring skills commensurate with tertiary qualifications and/or five years or more of relevant experience, to those requiring little or no formal qualifications or training. We examine skill level of occupations reported at the two-digit ANZSCO level, comprising 43 different categories. Part-time work (usually working less than 35 hours per week) and fixed-term employment were both dichotomous variables (yes/no), as was an indicator of whether respondents were employed in the public/government sector.

In Australia, paid sick leave entitlements accumulate over time, so a measure of time with the current employer was also included in the models (categorised as: less than half a year, less than 1 year, 1 to 5 years, 6 to 10 years, 11 to 15 years, or 16 years or more). The highest level of educational attainment

reported over the study period was categorised as: tertiary-level (Bachelor or post-graduate), other post-school qualification (diploma/certificates), completed high school (Year 12), or not completed high school. Relationship/partnership status was also dichotomised into married/partnered vs. no partner. Presence of any pre–school aged children aged less than 5 years vs. no young children was adjusted for. Age was dichotomised into young (25–39 years) vs older (40–54 years). Geographic location was coded as major city area, inner regional, outer regional, or remote. All these measures were obtained at wave *t*. Years in the study (centred on 6 years) was included in the model as a quadratic function ("years in study" and "years in study squared"), with both divided by 10 to enhance interpretation of coefficients and confidence intervals. Finally, a measure of attrition/non-participation in the study at wave *t+2* was included in all models. This was to control for potential association between pain/sick leave and later drop-out.

2.3 Analytical strategy

We started with a set of descriptive analyses of the interaction of pain and mental health problems with sick leave. The mean number of paid sick leave days within each category of the recurrent pain–mental health problems strata was calculated. We compared the association between recurrent pain/mental health problems and sick leave days. We used all others as a reference category (including people with pain/mental health problems on a single occasion).

Two measures of interaction were then calculated for the unadjusted data. This was because our focus was on recurrent problems in particular, as single measures are common and recurrent symptoms are assumed to be a clearer risk for sick leave [21,22,25]. The additive interaction was calculated to quantify the extent to which the joint association of pain and mental health problems with sick leave differed, in absolute terms, from the sum of their separate associations with sick leave. When this differed from zero there is an indication of an interaction on an additive scale [39]. The interaction of pain and mental health problems was also measured on the multiplicative scale, which quantified the extent to which the joint association differed, in relative terms, from the product term of their separate

associations with sick leave. For this measure, relative risks were first calculated and then the multiplicative measure was computed. When this differed from one there is an indication of an interaction on a multiplicative scale.

We report both multiplicative and additive interactions to follow previous advice to present interactions on both scales [39]. While additive interaction effects have stronger public health implications, an interaction may be present on one scale (additive or multiplicative) but absent on the other [39]. The assessment of multiplicative moderation may also be important because i) this may be a more natural scale on which to assess interactions, ii) there is less heterogeneity in the multiplicative scale across studies, and iii) it may be more relevant to understanding biological processes (see tutorial by VanderWeele and Knol [39]).

The mean difference in sick leave days, their relative difference and the moderation measures were calculated using Stata's margins and nlcom commands [40]. The 95% confidence intervals were calculated while considering the clustering of the data within-persons. All observations from different waves were stacked, and thus same person contributed multiple observations. The Delta method was used in calculating the confidence intervals for the moderation measures [39].

Negative binomial regression models were then fitted. The negative binomial model was chosen over Poisson because there was overdispersion in the outcome. First, sex-stratified models were fitted with generalised estimating equations (GEE) to handle the within-individual correlation. This produced population-averaged estimates, providing an estimate of the incidence of sick leave of an average person with pain/mental health problems compared to an average person without pain/mental health problems, after adjusting for their differences in the covariates. As shown previously for both pain and mental health [41,42], within-individual variation over time is likely to provide more accurate estimates of the contributions of different health problems, such as chronic pain and mental health problems, to sick leave days. Ignoring unobservable differences between people reporting and not reporting health problems could overstate effect sizes.

Then, to test the extent to which unobservable time-invariant characteristics may explain this observed association, a hybrid model with between-person (person average score) and within-person (deviation scores from the person-specific average) scores was fitted [43]. The between-individual estimates provided an indication of the between-individual differences while ignoring all within-person heterogeneity. The within-individual estimates, in contrast, ignore all between-individual differences and compared a person's incidence of sick leave in periods when having pain/mental health problems to his/her observation periods when not having pain/mental health problems. We fitted this using a GEE (population-averaged) negative binomial model with between- and within-individual scores of all time-varying variables [44].

As sensitivity analyses, we considered two separate processes in the count of sick leave days – the increased likelihood of having some vs no paid sick leave, and an increase in the number of days of sick leave among those who take sick leave (using logit and zero-truncated regression models, with variance estimates adjusted for the clustering within respondents). Both of these showed the same pattern: an increase in the probability and number of days for both pain and mental health problems, but no evidence of any (additive or multiplicative) interaction (see Appendix Table A.3. to Appendix Table A.6.). The distribution of sick leave days is displayed as an Appendix Figure A.1., and is consistent with expectations from a negative binomial model, with excess zeros. Given our focus is on a population entitled to sick leave, we had no reason to anticipate different processes underlying the taking of any vs. the number of days of sick leave. Thus, we prefer a count model for this study, which is also consistent with previous research using sick leave data from the HILDA Survey [34,45]. Finally, to assess whether there was an effect of the choice of cut-point on the MHI-5 scale, we ran simple sex-stratified Negative Binomial GEE Regression models in which sick leave days was regressed on either i) the MHI scale score (divided by 10 to aid interpretability of the Incidence Rate Ratio and the confidence interval) and ii) the scale categorised into (mainly) 10-point ranges (e.g., 0 to 19; 20 to 29; 30 to 39; etc; see Appendix Table A.7.).

3. Results

The characteristics of respondents during their initial observation year are presented in Table 1. Among women, the prevalence of pain occurring only at the start of the year was 8.3% and 5.9% for recurring pain. The prevalence of mental health problems occurring only at the start of the year was 7.7% and 4.7% for recurring mental health problems (Table 1). For men, the corresponding figures were slightly lower, at 7.1% and 4.4% for pain and 4.6% and 4.6% for mental health problems. The average number of sick leave days reported by participants during their first year was 4.6 days (median 3) for women and 3.7 days (median 2) for men. The table also shows the percentage of participants (14.0% of women and 16.1% of men), who at any point from wave 1 onwards were among the non-respondents (attrition).

Among women, the average number of sick leave days per year in each category of the recurring pain–mental health strata are shown in Table 2. For women without recurring mental health problems, those with recurring pain had an average of 6.80 sick leave days per year, while those without recurring pain had 4.69 sick leave days per year, yielding a mean difference of 2.11 days per year and an incidence rate ratio (IRR) of 1.45 (assuming equal exposure periods). The unadjusted association between pain and sick leave was similar for women with recurring mental health problems, generating a mean difference of 1.00 days and an IRR of 1.15. This provided weak evidence of a negative multiplicative interaction ($p = 0.02$) but no support for an additive interaction.

The corresponding sick leave days for men are shown in the lower half of Table 2. Among men without recurring mental health problems, recurring pain was linked to a 2.99 unadjusted mean difference in sick leave days per year and an IRR of 1.76. The corresponding figures for men with recurring mental health problems were 2.38 and 1.45, respectively. Thus, there was no evidence of a joint/interaction effect on either the multiplicative or additive scales for men.

When adjusting for multiple covariates (Table 3) in women, pain on a single occasion (vs. no pain) was linked to a 1.26-fold increase in the rate of sick leave days (1.25 days per year greater than no pain; standard error = 0.165, predicted differences are shown in appendix Table A.2.), recurring pain to a 1.34-fold rate (1.66 days per year greater than no pain; se = 0.216), mental health problems on a single occasion with a 1.13-fold rate (0.65 days per year greater than no mental health problems; se = 0.179), and recurrent mental health problems with a 1.31-fold rate (1.54 days per year greater than no mental health problems; se = 0.259). In men, pain on a single occasion (vs. no pain) was linked to a 1.21-fold rate in sick leave days (0.86 days per year greater; se = 0.135), and recurring pain (vs. no pain) to a 1.56-fold rate (2.27 days per year greater; se 0=0.245). Mental health problems on a single occasion (vs. no mental health problems) were, in turn, linked to a 1.09-fold rate (0.38 days per year greater; se = 0.154), and recurring mental health problems (vs. no mental health problems) to a 1.18-fold rate (0.74 days per year greater; se = 0.199) of sick leave. Focusing only on within-individual variation in predictors and outcomes (Table 4) attenuated these associations, but the pattern of associations was similar. We found no consistent evidence of interactions in additional models including the relevant interaction terms.

Regarding other predictors in the population-average model for women, high salary was protective, and part-time work and public sector employment increased sick leave days, as did time with employer (since entitlements accumulate over time) and having pre–school aged children. For men, there was some indication of lower occupational skill level being associated with increased sick leave. Part-time work, employment in the public sector and more time with an employer were associated with more sick leave days. In contrast to women, having pre–school aged children did not increase sick leave among men. These associations were generally in the same direction in the within-individual models.

4. Discussion

This study examined the independent and joint contributions of single and recurring pain and mental health problems to sick leave days in Australia. The main finding was that employees with pain and mental health problems had a higher risk of sick leave than their counterparts without these conditions. However, the study did not find consistent evidence of additive or multiplicative joint effects of pain and mental health synergistically increasing the risk for sick leave. Recurring pain was associated with a higher number of sick leave days than mental ill health, particularly for men: the predicted difference in sick leave days was 0.7 days for recurrent mental health problems and 2.3 for recurrent pain (for women, the corresponding figures were 1.5 and 1.7, respectively). Finally, people had a higher risk of sick leave when they reported recurrent pain or mental health problems compared to themselves when reporting no pain or mental health problems, but this adjustment for time-constant within-individual heterogeneity resulted in a slight attenuation of the associations.

4.1 Interpretation

This study found that mental health problems, particularly when reported on two consecutive occasions, are associated with greater sick leave days. This is in line with earlier studies focusing on mental health measures on a single occasion and subsequent sick leave risk in Australia [34], and in other countries [41]. These previous studies also emphasised the importance of considering within-individual heterogeneity. This is to say that ignoring unobservable between-individual differences is likely to overestimate the contribution of mental health problems on sick leave. The added value of this study, however, is in showing that mental health problems reported on two consecutive time points is a stronger predictor of sick leave than mental health problems reported on only a single occasion. Thus, it is crucial to tackle mental health problems early on, and reduce any stigma related to them, to help the employees continue working.

There is also a growing body of studies examining the contribution of pain to sick leave, but the research has relied mainly on study designs that compare the sick leave risk of different individuals

while adjusting for some of the differences in their characteristics [46,47]. Many previous studies are likely prone to bias due to unmeasured differences. In the HILDA Survey data, pain has not been widely studied in relation to other health outcomes, but chronic pain has been shown to have a large negative effect on life satisfaction [48,49]. The current study showed that, as with mental health, reports of recurrent pain contribute most to sick leave, but this association is also attenuated somewhat once time-constant within-individual heterogeneity is accounted for.

While a difference of few days of sick leave for people with chronic pain or mental problems on an annual basis may not sound like much, there are two key points to note. First, an average increase of a couple of days is substantial given the annual average total sick leave. Indeed, the average difference of 2 days between for women with and without recurring pain does represent a 50% increase. Second, it is important to note that these figures need to be interpreted at the population level. Thus, while a difference of e.g. 2 days may appear small regarding any individual employee, when it is multiplied by the number of sick leave days among all people with chronic pain or mental problems, the overall cost can be very high, and the significance for both employers and society can be notable. As an example, among a population of million employees, 2 million less sick leave days per annum could be avoided, resulting in substantial savings.

It is difficult to compare these current estimates and their magnitude to other surveys or cohorts, with different measures of pain, mental health and sick leave, and in particular different sick leave systems entirely. Hence, instead of making such comparisons, the effect sizes could be contrasted to the previous studies using the HILDA Survey data. While no previous study has used these data to study pain and sick leave, a prior study focusing on mental health and sick leave has reported similar effect sizes [34]. In that study scoring 52 or less on the same mental health measure was similarly associated with more paid sick leave among men (incidence rate ratio [IRR] = 1.38) and women (IRR = 1.31).

The key implications of these results are twofold. First, research using cross-sectional or even longitudinal designs that do not account for time-constant heterogeneity are likely to overestimate the contribution of pain to work disability. Second, early detection and treatment of pain is vital, as are interventions and policies to help people continue working with recurrent pain. A previous Australian qualitative study suggested that for those with chronic pain, it is important to have a good match between employees and their jobs [50]. Modifications to working conditions have proven useful to assist in finding such matches, provided that the employer is aware of the pain conditions of their employees. Since chronic pain is a notable public health and societal challenge, it is important to consider preventative actions that will facilitate work.

The existence of joint contributions of pain and mental health problems to sick leave has been investigated without consistent findings. This study contributed to this debate by showing that, in Australia, pain and mental health problems are both independent predictors without evidence of either additive or synergistic interactive effects. This contrasts with some previous studies [17,51]. For example, pain and insomnia have been shown to have synergistic effects on work disability in Scandinavian countries [51].

The findings of this paper should be further considered within the somewhat peculiar Australian sick leave arrangements. Notably, the fact that Australian employers directly pay the wages of employees when they are sick likely means they have more incentive to scrutinise and monitor sick leave taking. Comparisons of the current findings with previous studies from Scandinavian settings must therefore be made with caution.

Another distinctive feature of the Australian setting is the very large number of casual employees, the vast majority of whom have no paid sick leave entitlements at all. We, however, are forced to exclude all employees without paid sick leave entitlements from our analysis, meaning our sample will be somewhat selective. Excluding casual employees means that young workers, part-time workers, workers in low-skilled occupations, and workers in retail trade and hospitality sectors are likely to be

under-represented. It could be further asked if, by excluding casual employees, we also ended up excluding more female employees, given women are much more likely to work part-time than men, and part-time work, in turn, is much more likely to involve casual employment [52-54]. The question that then arises is whether these casual employees are more likely to suffer from pain. A recent paper [55], also using the HILDA Survey data, looked at associations between employment status and all eight sub-scales of the SF-36, including Bodily Pain. In correlated random effects models, no negative associations with casual employment were found. Indeed, casual employees scored more favourably on bodily pain than permanent employees, and for women this positive difference was statistically significant, albeit the effect size was rather small. These results suggest that the exclusion of casuals is unlikely to lead to the under-representation of women suffering from chronic pain.

There were also some gender differences in the associations (regarding mental health in women vs. pain in men) that warrant further corroboration. There is no clear explanation for this in these data, as we do not, for example, know the severity of the symptoms or their duration. There could be variation in these factors between genders, which could explain these gender differences. We also cannot confirm the reasons for these symptoms, or if there was any medical certificate. Previous studies, including those using Australian data, typically report a higher prevalence of symptoms of mental ill-health and pain among women than men [34,48,49]. However, it is possible that for men, pain is more severe and therefore more likely to lead to sick leave. Previous analysis using HILDA Survey data suggested that women react to chronic pain better than men [49], though the focus of this study was on life satisfaction. It is possible, however, that the associations between pain and sick leave are similarly shaped by gender differences in how pain is reported, the underlying causes of pain, or in reactions to pain. It is also worth noting that, on average, women take more sick leave than men, and in Nordic settings this is known to be largely explained by their concentration in different occupations [56]. However, in other systems this may not apply, and different factors could be of more importance, contributing to the observed gender differences in the current results. Indeed, previously described structural differences in the sick leave behaviour between genders [57] justify our estimations of models separately for women and men, as men remain more likely to work full-time and have a higher income than women in Australia.

Finally, Australia's sick leave system is also mainly focused on protecting workers against very short absence spells. For those succumbing to a long-term illness and extended work disability, adequate protection from paid sick leave depends on both years of employment with the same employer and the extent to which sick leave entitlements have been used in the past. This provides a case for schemes that make sick leave entitlements portable across employers, or within the same industry, as exist in a small number of sectors. Alternatively, some form of insurance-based system could be preferred. These suggestions, however, are purely speculative, and certainly cannot be tested with the data used in this analysis.

4.2 Methodological considerations

This study had some notable strengths. First, the sample is large and, with the exception of recent immigrants, representative of the Australian population of households, and response rates have been high throughout the study [32]. Second, we used longitudinal data with repeated measures of health, sick leave and key covariates. Consideration of the interactive effects was also a strength that provided a more comprehensive picture of the effects of pain and mental health on sick leave. Third, psychometric properties of the exposure measures have been found to be good. An earlier analysis demonstrated both the validity of the SF-36 baseline data of the HILDA Survey, and that all the eight sub-scales – including those used in the study, bodily pain and mental health – are psychometrically sound, as shown by good internal consistency, discriminant validity and high reliability [58]. Internal-consistency reliability (Cronbach's Alpha) at baseline was 0.82 for the MHI-5 scale. Item-internal consistency ranged between 0.54 and 0.69 (correlations between items). The weighted mean score for mental health in the HILDA Survey population was 73.42 (SD 17.7), while the corresponding figure for Australian population norms was 75.9 (SD 17.0). Fourth, each participant was observed on multiple occasions (i.e., once each year), on each occasion both pain/mental health (through year) and sick leave (during year) were measured. The strength of our between / within analysis is that it explicitly considered the role of unmeasured time-invariant differences. For subsequent studies,

modelling a cumulative effect of multiple pain/mental health episodes over multiple waves may reveal additional insights.

This study also had some limitations. First, pain, mental health and sick leave were all self-reported, as were the covariates. Thus, we cannot rule out reporting bias. In addition, the outcome is affected by the number of days worked in the follow-up year. The use of self-reports and a relatively long reference period could contribute to the rate of sick leave in the HILDA Survey being noticeably lower than in the national health surveys, where the reporting period is just two weeks [37]. Social desirability might cause some respondents to under-report work absences, while the need to recall absences over a relatively long period (12-month) may mean short-absence episodes, especially if not recent, could be forgotten. That said, the independent associations between pain and sick leave and mental health problems and sick leave were relatively similar to those reported in previous studies with more objective, register-based outcomes [41,42]. The impact of common method bias is another potential limitation in studies such as this, where surveys use self-reported measure of both the exposures and the outcome [59]. Individual differences, such as in negative affectivity, could result in consistent reporting of pain, mental health and days of sick leave [60]. To the extent that these individual differences are stable over time, the within-individual analysis (reported in Table 4) shows that the effect of recurrent pain and mental health problems were attenuated but each remained significantly associated with days of sickness absence.

Second, since we could only examine these associations with those entitled to sick leave, and since this excluded many young employees, we may not have captured the full effect of mental health problems or pain on short-term workforce absence. Mental health problems are particularly common among young employees [61,62], and by focusing on those with an entitlement to sick leave, our estimated associations may be affected by a healthy worker effect. In light of our current observations, we are undertaking another study to address this limitation. Nonetheless, we need to acknowledge that the exclusion of those with no entitlement to sick leave could have diluted our associations and made

them more conservative [63,64]. That said, healthy worker effects may also be operating in the opposite direction, with more robust employees continuing to work despite chronic pain [65].

Third, our measures of pain and mental health are not specific, and a future study could aim to include measures of multi-site pain and more specific indicators of mental health, such as anxiety and depressive symptoms.

Fourth, one could question the selection of the cut point for our mental health measure. In our sensitivity tests (Appendix Table A.7), there was evidence of a negative association between scores on the MHI-5 (noting higher scores mean better mental health) and sick leave days. A 10-point increase on the 100-point scale was associated with a 5% reduction in sick leave days for women and a 6% reduction for men. The strong association suggests the decision of cut-point is not critical. However, categorising the scale showed that the association between mental health and sickness leave was not consistent at all points of the MHI-5 scale, and rates of sick leave did not increase in a strictly linear manner.

Fifth, we are unable to include diagnoses, and thus it cannot be established, if sick leave was due to mental disorders or other reasons. As our focus was on the interaction between mental health and pain, this focus on all-cause sick leave is important. Even with mental disorders, sick leave can be due to various reasons. As an additional note, it cannot be ruled out that some sick leave days were used to take care of a sick child. However, we cannot address that with these data.

Sixth, a differential response rate or attrition by outcome could bias the results (i.e., if the least healthy, hence those likely to take sick leave most often, were most likely to exit our sample, either because they ceased employment or because they ceased responding to the survey). However, we adjusted for this, at least in part, by including an attrition variable in the models, as used or recommended by previous studies [34,66].

5. Conclusions

Both recurring pain and mental health problems are important contributors to sick leave days in Australia. However, no consistent evidence was found of additive or synergistic effects of pain and mental health on sick leave. Policy responses seeking to increase productivity and reduce levels of sick leave can benefit from a focus on both recurrent pain and mental health problems, as each is an important factor. The results suggest that occupational and other healthcare workers should act in a timely manner to detect and treat pain and mental disorders early on, and aim to prevent their recurrence. Work modifications or psychotherapies might be a potential means to tackle these conditions. Since high cost is involved, employers are also likely to benefit if they support employees at risk for pain, mental disorders and subsequent sick leave.

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Table 1. Description of the study sample at baseline/first occasion

	Women %/mean/n	Men %/mean/n
Exposure variables		
Pain %		
Single occasion (t only)	8.3	7.1
Recurrent (t & t+1)	5.9	4.4
Mental health %		
Single occasion (t only)	7.7	4.6
Recurrent (t & t+1)	4.7	4.6
Outcome		
Sick leave days in year (%)		
0 days	16.9	27.0
1 day	7.6	7.8
2 days	13.9	15.6
3 days	1.4	11.3
4 days	9.6	8.2
5 days	15.4	12.1
6 or more days	23.4	18.2
Mean sick leave days in year (sd)	4.6 (6.13)	3.7 (5.41)
Confounders		
Age (years)		
Mean (sd)	36.1 (8.61)	35.7 (8.50)
Partner status %		
Married or de facto	72.2	76.7
Pre–school aged children at home %		
Any	15.5	22.8
Occupational skill level %**		
Highest skill level	42.7	36.9
2nd highest	11.9	10.4
Middle	6.7	21.9
2nd lowest	28.4	18.4
Lowest skill level	10.2	11.8
Highest level of educational attainment %*		
Tertiary	47.0	34.4
Post school	31.4	42.0
Completed high school (Year 12)	10.3	11.3
Not completed high school	11.4	12.4
Geographical location		
Major city	72.9	71.2
Inner regional	18.1	18.5
Outer regional	7.8	8.8
Remote or very remote	1.3	1.5
Time with current employer		
< 6months	12.8	11.5
< 1 year	12.3	10
< 5 yrs	46.5	44.4
< 10 yrs	14.7	17.2
< 15yrs	7.3	7.2
16 yrs +	6.5	9.7
Work characteristics		
Part-time %	32.4	3.8
Public sector employment %	31.3	17.8
Fixed-term contract employment %	15.8	9.5
Weekly salary (%)		
Lowest quintile	36.0	11.9

Middle (reference group)	57.0	64.4
Highest quintile	7.0	23.6
Attrition		
Any attrition (any point of time)		
%	14.0	16.1
Numbers and observations		
Number of persons	3,404	3,448
Number of observations	19,722	21,548
Mean number of observations	5.8	6.2

All measures are from baseline or first measurement occasion except * which is the highest level of educational attainment reported during study period, and attrition, which is referring to the entire follow-up at any data collection point **no info omitted.

Table 2. Mean number of sick leave days by mental health problems and pain among women and men. All observations and 95% confidence intervals (CI) corrected for clustering.

Women	No mental health problems	Mental health problems
Mean sick leave days when no recurring pain	4.69	6.58
Mean sick leave days when recurring pain	6.80	7.58
Unadjusted difference in days (B-A)	2.11	1.00
95% CI	1.49 – 2.73	-0.43 – 2.43
Unadjusted relative risk (B/A)	1.45	1.15
95% CI	1.31 – 1.58	0.92 – 1.38
Additive interaction		-1.11
95% CI		-2.64 – 0.43
Multiplicative interaction		0.79
95% CI		0.62 – 0.97
Men	No mental health problems	Mental health problems
Mean sick leave days when no recurring pain	3.94	5.34
Mean sick leave days when recurring pain	6.93	7.73
Unadjusted difference in in days (B-A)	2.99	2.38
95% CI	2.04 – 3.95	0.10 – 4.66
Unadjusted relative risk (B/A)	1.76	1.45
95% CI	1.51 – 2.01	1.00 – 1.89
Additive interaction		-0.61
95% CI		-3.06 – 1.84
Multiplicative interaction		0.82
95% CI		0.55 – 1.10

Table 3. Adjusted incidence rate ratios (IRR) and their 95% confidence intervals (CI) for sick leave days by mental health problems and pain* Generalised estimating equations (GEE).

	Women		**Men**	
Variable	**IRR**	**95% CI**	**IRR**	**95% CI**
Recurrent pain (ref. no pain)	1.34	1.26 - 1.43	1.56	1.44 - 1.68
Recurrent mental health problems (ref. no mental health problems)	1.31	1.21 - 1.42	1.18	1.09 - 1.28
Pain single occasion (ref. no pain)	1.26	1.19 - 1.33	1.21	1.15 - 1.28
Mental health problems single occasion (ref. no mental health problems)	1.13	1.06 - 1.2	1.09	1.02 - 1.17
Low salary (ref. middle salary)	0.96	0.92 - 1.01	0.98	0.92 - 1.05
High salary (ref. middle salary)	0.89	0.84 - 0.95	0.92	0.88 - .96
No data on occupational skill level (ref. highest skill level)	0.88	0.67 - 1.15	1.29	1.1 - 1.51
2nd highest occupational skill level (ref. highest skill level)	0.96	0.9 - 1.01	1.06	1 - 1.12
Middle occupational skill level (ref. highest skill level)	0.97	0.89 - 1.05	1.05	0.99 - 1.11
2nd lowest occupational skill level (ref. highest skill level)	1.02	0.96 - 1.07	1.17	1.1 - 1.24
Lowest occupational skill level (ref. highest skill level)	0.98	0.9 - 1.06	1.07	1 - 1.15
Part-time work	1.13	1.08 - 1.18	1.20	1.08 - 1.33
Fixed-term contract	0.95	0.91 - 1	1.02	0.97 - 1.08
Public sector work	1.21	1.16 - 1.26	1.22	1.16 - 1.28
Time with the employer: < 1 year (ref. < 6 months)	1.09	1 - 1.19	1.05	0.96 - 1.14
Time with the employer: < 5 year (ref. < 6 months)	1.20	1.13 - 1.96	1.17	1.1 - 1.24
Time with the employer: < 10 year (ref. < 6 months)	1.27	1.18 - 1.36	1.35	1.26 - 1.44
Time with the employer: < 15 year (ref. < 6 months)	1.27	1.17 - 1.38	1.38	1.28 - 1.49
Time with the employer: 16+ years (ref. < 6 months)	1.42	1.3 - 1.54	1.47	1.36 - 1.59
Post-school education (ref. tertiary qualifications)	0.99	0.93 - 1.04	1.10	1.04 - 1.16
Year 12 (ref. tertiary qualifications)	1.00	0.92 - 1.08	1.03	0.95 - 1.11
Not completed high school (ref. tertiary qualifications)	0.92	0.85 - 1	1.05	0.97 - 1.14
Partner (ref. no)	1.02	0.98 - 1.07	1.03	0.98 - 1.09
Pre–school aged children (ref. no)	1.17	1.11 - 1.23	1.04	1 - 1.08
Inner regional (ref. major city area)	0.99	0.94 - 1.04	0.95	0.9 - 1
Outer regional (ref. major city area)	0.99	0.92 - 1.06	0.93	0.86 - 1.01
Remote/very remote area (ref. major city area)	0.80	0.67 - 0.95	0.89	0.75 - 1.06
Older (40–54) (ref. young (25–39))	0.92	0.89 - 0.96	0.95	0.91 - 0.99
Future attrition in t+2 (ref. no attrition)	1.06	0.96 - 1.16	1.01	0.93 - 1.11
Years in study/10 – linear	1.09	1.02 – 1.16	1.25	1.18 – 1.32
Years in study/10 – squared	0.95	0.82 – 1.10	0.98	0.86 – 1.12

Table 4. Adjusted incidence rate ratios (IRR) and their 95% confidence intervals (CI) for sick leave days by mental health problems and pain*: within- and between-individual estimates. Generalised estimating equations (GEE).

	Women		Men	
Variable	**IRR**	**95% CI**	**IRR**	**95% CI**
Between: Recurrent pain (ref. no pain)	1.55	1.39 - 1.74	1.96	1.71 - 2.26
Between: Recurrent mental health problems (ref. no mental health problems)	1.32	1.15 - 1.52	1.31	1.13 - 1.53
Between: Pain single occasion (ref. no pain)	2.59	2.19 - 3.07	2.09	1.73 - 2.53
Between: Mental health problems single occasion (ref. no mental health problems)	1.51	1.25 - 1.82	1.53	1.23 - 1.92
Between: Low salary (ref. middle salary)	0.96	0.88 - 1.05	0.88	0.78 - 0.98
Between: High salary (ref. middle salary)	0.75	0.68 - 0.83	0.80	0.75 - 0.85
Between: Part-time work	1.05	0.97 - 1.13	1.39	1.18 - 1.63
Between: Fixed-term contract	0.93	0.85 - 1.03	0.77	0.68 - 0.86
Between: Public sector work	1.32	1.25 - 1.4	1.47	1.37 - 1.57
Between: Partner (ref. no)	0.99	0.94 - 1.04	1.03	0.96 - 1.11
Between: Pre–school aged children (ref. no)	1.38	1.27 - 1.51	1.02	0.95 - 1.1
Between: Future attrition in t+2 (ref. no attrition)	0.85	0.69 - 1.06	0.73	0.59 - 0.91
Between: Inner regional (ref. major city area)	1.01	0.96 - 1.07	0.90	0.85 - 0.95
Between: Outer regional (ref. major city area)	0.97	0.89 - 1.05	0.91	0.84 - 0.99
Between: Remote/very remote area (ref. major city area)	0.78	0.63 - 0.96	0.98	0.78 - 1.23
Between: Time with the employer: < 1 year (ref. < 6 months)	0.76	0.6 - 0.96	1.00	0.77 - 1.29
Between: Time with the employer: < 5 year (ref. < 6 months)	0.92	0.78 - 1.09	0.91	0.75 - 1.09
Between: Time with the employer: < 10 year (ref. < 6 months)	1.02	0.87 - 1.2	1.15	0.97 - 1.37
Between: Time with the employer: < 15 year (ref. < 6 months)	1.12	0.93 - 1.34	0.86	0.71 - 1.05
Between: Time with the employer: 16+ years (ref. < 6 months)	1.16	0.98 - 1.38	1.29	1.08 - 1.54
Between: No data on occupational skill level (ref. highest skill level)	0.53	0.27 - 1.06	1.92	1.22 - 3.01
Between: 2nd highest occupational skill level (ref. highest skill level)	0.92	0.84 - 1.01	1.00	0.9 - 1.12
Between: Middle occupational skill level (ref. highest skill level)	0.94	0.83 - 1.05	1.09	1 - 1.18
Between: 2nd lowest occupational skill level (ref. highest skill level)	1.07	0.99 - 1.16	1.23	1.13 - 1.34
Between: Lowest occupational skill level (ref. highest skill level)	1.01	0.9 - 1.13	1.16	1.04 - 1.3
Within: Recurrent pain (ref. no pain)	1.15	1.05 - 1.25	1.34	1.22 - 1.47
Within: Recurrent mental health problems (ref. no mental health problems)	1.19	1.08 - 1.32	1.05	0.96 - 1.16
Within: Pain single occasion (ref. no pain)	1.12	1.06 - 1.19	1.15	1.09 - 1.22
Within: Mental health problems single occasion (ref. no mental health problems)	1.07	1 - 1.15	1.02	0.95 - 1.1
Within: Low salary (ref. middle salary)	0.98	0.92 - 1.03	1.01	0.94 - 1.09
Within: High salary (ref. middle salary)	1.00	0.93 - 1.09	1.07	1.01 - 1.13
Within: Part-time work	1.16	1.1 - 1.23	1.08	0.95 - 1.23
Within: Fixed-term contract	0.97	0.91 - 1.03	1.13	1.06 - 1.21
Within: Public sector work	1.09	1.02 - 1.16	0.99	0.92 - 1.06
Within: Partner (ref. no)	1.04	0.97 - 1.12	1.05	0.98 - 1.13
Within: Pre–school aged children (ref. no)	1.08	1.01 - 1.15	1.05	1 - 1.11
Within: Future attrition in t+2 (ref. no attrition)	1.14	1.02 - 1.27	1.08	0.98 - 1.2
Within: Inner regional (ref. major city area)	0.96	0.84 - 1.11	1.03	0.92 - 1.17
Within: Outer regional (ref. major city area)	1.10	0.91 - 1.34	0.97	0.82 - 1.15
Within: Remote/very remote area (ref. major city area)	0.92	0.67 - 1.27	0.95	0.73 - 1.24

Within: Time with the employer: < 1 year (ref. < 6 months)	1.15	1.05 - 1.26	1.07	0.98 - 1.16
Within: Time with the employer: < 5 year (ref. < 6 months)	1.25	1.16 - 1.33	1.21	1.14 - 1.29
Within: Time with the employer: < 10 year (ref. < 6 months)	1.27	1.17 - 1.37	1.37	1.27 - 1.48
Within: Time with the employer: < 15 year (ref. < 6 months)	1.19	1.08 - 1.32	1.45	1.32 - 1.59
Within: Time with the employer: 16+ years (ref. < 6 months)	1.30	1.16 - 1.46	1.35	1.22 - 1.5
Within: No data on occupational skill level (ref. highest skill level)	0.91	0.68 - 1.23	1.17	0.98 - 1.39
Within: 2nd highest occupational skill level (ref. highest skill level)	0.97	0.9 - 1.05	1.04	0.97 - 1.12
Within: Middle occupational skill level (ref. highest skill level)	0.99	0.88 - 1.11	0.98	0.9 - 1.07
Within: 2nd lowest occupational skill level (ref. highest skill level)	0.96	0.89 - 1.04	1.03	0.96 - 1.12
Within: Lowest occupational skill level (ref. highest skill level)	0.98	0.86 - 1.11	0.94	0.86 - 1.04
: Post-school education (ref. tertiary qualifications)	0.97	0.91 - 1.03	1.05	0.99 - 1.12
: Year 12 (ref. tertiary qualifications)	0.98	0.9 - 1.06	1.00	0.92 - 1.08
: Not completed high school (ref. tertiary qualifications)	0.92	0.85 - 1	0.98	0.89 - 1.07
: older (40–54) (ref. young (25–39))	0.93	0.89 - 0.97	0.94	0.9 - 0.98
: Years in study – linear	1.11	1.04 – 1.19	1.25	1.18 – 1.33
: Years in study - squared	0.96	0.83 – 1.12	1.03	0.90 – 1.18