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Poor psychosocial job conditions increase sickness absence: Evidence from the PATH Through Life Mid-Aged Cohort

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Poor psychosocial job conditions increase sickness absence: Evidence from the PATH Through Life Mid-Aged Cohort

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Abstract

Objectives: Evidence is mounting that poor psychosocial job conditions increase sickness absence, but there is a need for further rigorous prospective research to isolate the influence of psychosocial job quality from other measured and unmeasured confounders. This study used four waves of prospective longitudinal data (spanning 12 years) to investigate the extent to which increases in poor psychosocial job quality are associated with greater relative risk of sickness absence.

Methods: Data were from the PATH Through Life cohort study (7644 observations from 2221 participants) and included multiple indicators of poor psychosocial job quality (i.e. a combination of low control, high demands, and high insecurity), days sickness absence in the past four weeks, and a wide range of potential confounders from across the lifecourse. The analyses adopted hybrid-regression estimations that isolated the effect of within-person change in psychosocial job quality on sickness absence over time.

Results: The results show that after adjusting for a wide range of factors, as well as unmeasured between-person differences in job quality, each additional psychosocial job adversity was associated with a 15% increase in the number of days of sickness absence. Increases in psychosocial job adversity were also related to functional impairment.

Conclusions: The results of this study strengthen existing research highlighting the importance of addressing poor psychosocial job quality as a risk factor for sickness absence.

Key words: sickness absence, job quality, psychosocial job stressors, functional limitations.

Article Summary

Strengths and limitations of this study

- Findings are based on robust longitudinal cohort data (spanning 12 years) with the original sample randomly selected from the population.
- Adjustments are made for a wide variety of personal, health and demographic predictors of sickness absence, including variables rarely controlled for in prior research (i.e. early life adversities and personality characteristics).
- The study adds information on number of days of sickness absence (rather than a binary outcome only) and replicates the results with functional impairment.
- The main weakness of this study is potential lack of generalisability due to the restricted geographical area from which the sample was recruited and the narrow midlife cohort (aged 40–44 at baseline). It is also important to note that both exposures and outcomes are self-reported and thus may be subject to residual reporting bias

Introduction

Absence from work due to sickness is an important issue in public health. Previous studies have noted that sickness absence is predictive of chronic health conditions^{1,2} and mortality^{1,2}, as well as exit from the workforce³. The broader economic and social costs associated with sickness absence are substantial, running into the tens of billions of dollars for many countries^{4,5}. From a population health perspective, identifying the causes of sickness absence that are amenable to intervention is critical – to reduce both sickness absence and the subsequent adverse health-related consequences.

We know the causes of sickness absence are complex and inter-related, including factors connected to the nature of the illness, the industry a person is employed in, gender⁶, and income⁷. Given a broad range of factors contribute, there is still debate about the extent to which work-related environmental influences, and in particular *psychosocial job stressors* (such as low levels of job control, high job demands, and job insecurity), contribute to sickness absence^{4,8-11}. A 2012 longitudinal study based on the British Birth Cohort⁹ recommended a “life course” perspective, arguing the importance of taking childhood disadvantage, education, coping styles, and personality into consideration. The study concludes by stating that “a greater understanding of the ways in which occupational risk factors interact with individual vulnerabilities across the life-course is required” (p.1).

Building upon this 2012 cohort study, several other longitudinal studies have sought to investigate the contribution of psychosocial job quality to sickness absence whilst controlling for a broad range of possible influences. For example, Wang et al. (2014) found that job strain was associated with long-term sickness absence (>16 days per year) one year later after adjusting for education, income, BMI, physical and mental health, and health-related

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3 behaviours¹²; however this research did not adjust for early life adversities or personality
4 characteristics. In addition, no information about the duration of sickness absence was
5 provided (only a binary indicator was included). This information is important as individual
6 and organisational costs vary based on the length of sickness absence^{3, 13, 14}. Other
7 longitudinal research by Milner et al. (2015) included a measure of days of sickness absence
8 and found that exposure to three or more psychosocial job adversities was associated with an
9 11% increase in days of sick leave¹¹. However, this research made no adjustment for early
10 life adversities or personality characteristics.
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24 The current study uses four waves of Australian cohort data (spanning 12 years) to examine
25 increases in psychosocial job adversity in association with increased days of sickness
26 absence. The analyses uniquely control for influences across the life course, from childhood
27 adversities to proximal adverse life events, as well as personality and health-related
28 conditions. In addition, hybrid analyses isolate and adjust for unmeasured differences in
29 psychosocial job quality between individuals. By controlling for a wide range of confounders,
30 and removing the influence of unmeasured differences between individuals (i.e. accounting
31 for person-related predisposition for reporting psychosocial job stressors), we increase
32 confidence in testing for a causal association between psychosocial job quality and sickness
33 absence. To compliment sickness absence as an outcome, we also examine the effect on
34 functional impairment - defined as impairment at work due to physical/mental health
35 problems.
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Methods

Sample

Participants were from the PATH Through Life Project, a prospective community survey that commenced at the Australian National University in 1999 and has been jointly hosted by the ANU and the University of New South Wales since 2019. The survey focuses on individual health and well-being trajectories across the life course and the sample includes three cohorts (young, midlife, and older adults) randomly selected from the Australian Electoral Rolls of Australian Capital Territory and neighbouring Queanbeyan¹⁵. The current study was restricted to the midlife cohort who were assessed every four years from wave 1 in 2000/2001 to wave 4 in 2012/2013. The participation rate of this cohort at baseline was 65% (2,530 participants). Of those who participated at baseline, 93% completed the survey at wave 2, 86% at wave 3, and 71% at wave 4 (Figure 1). For the first three waves, participants were usually assessed in their own home or at the Australian National University. They were invited to complete a questionnaire using a laptop computer under the supervision of a trained interviewer. For the fourth wave, participants were invited to complete an online version of the questionnaire. All participants provided informed consent to participate at each wave of the study, and each wave of data collection was approved by the Human Research Ethics Committee of the Australian National University.

We excluded observations from participants when they were: (i) not employed; (ii) not in the labour force; (iii) employed but on long-term leave; or (iv) had missing data on employment status in each wave (Figure 1). We also excluded participants with less than two waves of data.

--- Please insert Figure 1 ---

Patient and Public Involvement

The PATH study is a general population study and was formed based on pilot testing in Canberra community. There has been a regular feedback process for participants to engage with the study development and findings. PATH has long-standing ties to the Canberra community, with the data forming the basis of several local government reports, as well as regular engagement with both local and national stakeholders.

Measures

Outcome variables – Days sickness absence and functional impairment

‘Days of sickness absence’ was generated based on two items: ‘In the last four weeks, have you stayed away from your work (or school or place of study) for more than half a day because of any illness or injury that you had?’ and ‘How many days in the last 4 weeks have you stayed away from your work (or school, or place of study)?’ The first item offered two response categories (‘yes’ and ‘no’). Those who responded ‘no’ to the first item were classified as having zero day of sickness absence. These two questions were combined to generate the number of days of sickness absence in a four-week period.

‘Functional impairment’ (secondary outcome) was generated based on four questions from the Short-Form Health Survey (SF-12)¹⁶ that asked whether participants had problems with work or regular daily activities over the past four weeks due to their physical or mental health. Respondents were asked if they: a) accomplished less than you would like as a result of your physical health?, b) were limited in the kind of work or other activities undertaken as a result of your physical health?, c) accomplished less than you would like as a result of any emotional problems?, d) did not do work or other activities as carefully as usual as a result of any emotional problems?’ Participants who reported ‘yes’ to any of these items were

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3 classified as having functional impairment due to physical/mental health problems while
4 those who indicated 'no' to all items were classified as not having functional impairment.
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10 *Exposure variable - Psychosocial job quality*

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12 Three aspects of job quality were used to calculate a composite measure of exposure to poor
13 job quality – job control, job demands and job insecurity. Job control and job demands were
14 assessed using 19 items taken from the Whitehall II study¹⁷. Fifteen items assessed job
15 control and four assessed job demands. These items offered four response categories: '3-
16 often', '2-sometimes', '1-rarely', and '0-never'. Following the methodology used in previous
17 studies^{18, 19}, average total scores for job control and job demands were calculated and these
18 scores were then dichotomised to identify the top 30% of respondents with the greatest job
19 adversity (i.e. low job control, high job demands). One item: 'How secure do you feel about
20 your job or career future in your current workplace?' (responses: 'not at all secure',
21 'moderately secure', 'secure', 'extremely secure') was used to assess job insecurity.
22 Individuals who selected either of the first two responses were classified as having '1' high
23 job insecurity while all else were classified as '0' low job insecurity.
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42 As in our previous research,^{20, 21} we used a composite indicator approach to generate an
43 estimate of overall psychosocial job adversity based on the sum of the three individual
44 indicators (i.e. low control, high demands, and high job insecurity), providing a count of
45 adversities between 0 and 3. In the analyses, this job quality score was separated into two
46 variables to represent both the within-person variability over time and between-person
47 averaged differences. To do this, a variable representing within-person variability was
48 calculated by subtracting the composite job quality score at each wave from the mean score
49 across all waves (i.e. a change or deviation score was calculated at each wave). The (time-
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3 invariant) mean score for overall job quality across all waves was used to estimate between
4 person differences. This process of separating within and between-person components is
5 known as ‘demeaning’. Further details are provided in the statistical analyses section below.
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10 11 12 *Potential confounders*

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14 We adjusted for a range of variables that potentially confound the association of sickness
15 absence at work with psychosocial job quality^{12, 22}. These variables included time-invariant
16 measures from baseline (i.e., gender, education, childhood adversity, neuroticism) and time-
17 varying measures from each wave (i.e., partner status, occupational skill level, parental
18 responsibilities, non-work life events, financial hardship, smoking status, alcohol
19 consumption, physical exercise, chronic physical health conditions, and common mental
20 disorders).
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33 Educational attainment was grouped as ‘incompleted high school’, ‘completed high school’,
34 and ‘completed tertiary study’. Partner status included two categories: ‘no partner’ and
35 ‘partnered’ (i.e. currently married or living with a partner). Occupational skill level consisted
36 of three categories: ‘high’ (managers/administrators/professionals); ‘medium’ (associate
37 professionals/tradespersons/advanced clerical and service workers); and ‘low’ (intermediate
38 production and transport workers/elementary clerical, sales and service workers/labourers).
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47 Parental responsibilities were coded based on having a youngest child aged under 15 years.
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3 For childhood adversity, participants were asked about childhood experiences up to the age of
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5 16 years and were categorised as having childhood adversity if they responded 'yes' to any of
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7 eight items (taken from the Parental Bonding Instrument ²³, the British National Survey of
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9 Health and Development ²⁴, the US National Comorbidity Survey ²⁵, or an open-ended
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11 question ²⁶). These items covered neglect, authoritarian upbringing, witnessing
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13 physical/sexual abuse, as well as verbal abuse, psychological abuse, physical abuse, physical
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15 punishment, and sexual abuse by a parent.
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22 Adverse life events were measured using an extended version of the List of Threatening
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24 Experiences Questionnaire ²⁷. Analyses included nine items about non-work adverse events
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26 in the past six months: serious illness/injury/assault, death of a close family member or
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28 friend, relationship separation, serious problems within close relationships, financial crisis,
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30 legal problems, and loss of something valuable. The number of life events were summed and
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32 divided into three categories: none, one, or two or more events.
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38 Smoking status was grouped into never/past smoker and current smoker. Hazardous/harmful
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40 alcohol consumption ²⁸ was derived from the Alcohol Use Disorders Identification Test ²⁹
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42 and classified into 'yes' and 'no'. The hours respondents engaged in moderate or vigorous
43
44 physical exercise per week was assessed by items from the Whitehall II study ³⁰ and
45
46 categorized into five groups (0, < 1.5, 1.5–3, 3.1 – 5.5, > 5.5 hours). A variety of chronic
47
48 physical health conditions such as heart problems, hypertension, cancer, arthritis, thyroid
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50 problems, epilepsy, asthma, diabetes, and stroke were coded as a summary variable
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52 representing the experience of none, one, or two or more of these conditions.
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3 Depression and anxiety were assessed using the Goldberg Anxiety and Depression scales ³¹.
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5 Each scale comprises nine binary items ('yes' or 'no'); total scale score 0-9. Binary scores
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7 representing likely depression and generalized anxiety disorder diagnosis were calculated
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9 based on validated cut-points assessed against diagnosis from a structured diagnostic
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11 interview (i.e. ≥ 5 on the depression scale and ≥ 7 on the anxiety scale) ³². A binary measure of
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13 common mental disorder at Wave 4 was then generated based on the presence of a likely
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15 depressive and/or anxiety disorder.
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21 Neuroticism (the tendency to experience negative emotion) was included as a covariate as
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23 this personality trait may influence self-reported job quality and sickness absence/functional
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25 impairment and thus inflate the observed association. The measure of neuroticism was from
26
27 the Eysenck Personality Questionnaire ³³, and the scale total was categorised into quintiles.
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33 *Statistical analysis*

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35 The association between job quality and sickness absence was assessed using a longitudinal
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37 random-intercept negative binomial regression model with two levels, where occasion
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39 clustered within individuals. There was overdispersion in the sickness absence variable and
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41 hence a negative binomial distribution was chosen. This model fitted a fixed (average)
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43 regression slope for the number of sickness absence days over time while permitting the
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45 intercept to vary (to reflect the different initial number of sickness absence days for
46
47 individuals). Coefficients were transformed into relative risks (RRs). To assess the
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49 association between job quality and functional impairment (a binary variable), we used a
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51 longitudinal random-intercept logistic regression model. Coefficients were transformed into
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53 odds ratios (ORs).
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5 For both sets of models (sickness absence and functional impairment) associations with job
6 quality were examined with hybrid-regression estimations that differentiated between- and
7 within-individual associations. The hybrid model is an extension of a random effects model
8 with demeaning ³⁴, in which both the person mean values of the exposure (capturing the
9 between-individual effect) and the person deviation scores from their mean (capturing the
10 within-individual effect) are included as regressors ³⁵. The between-person association
11 compared the risk of sickness absence between different individuals' based on their average
12 level of job quality over time. The within-person association compared the risk of sickness
13 absence across individuals' own changing levels of psychosocial job quality by controlling
14 for all time-invariant factors, both observable and unobservable ³⁴.

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31 In both sets of models, an initial simple model included the original/raw measure of job
32 quality (range 0-3). The following model then separated the within-person (i.e. deviation
33 score) and between-person (i.e. average score) components of the job quality measure.
34 Relevant covariates across the lifecourse were then entered into subsequent models. Model 3
35 included sociodemographic covariates (some assessed at baseline and other more proximal
36 factors assessed at wave three), childhood adversity, and recent non-work adverse life events.
37 Followed by health-related covariates (smoking status, alcohol consumption, exercise and
38 chronic health conditions) (model 4), depression/anxiety (model 5), and neuroticism (model
39 6).

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54 The proportion of observations with missing data on all variables was low, ranging from 0%
55 to 1.5%. Our analyses were based on observations with no missing data (complete analyses).
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58 All analyses were conducted using StataSE 14 ³⁶.
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Results

Descriptive characteristics at baseline (aged 40-46) are shown in Table 1. There was an equal split of males and females. The majority of the sample had completed a tertiary degree (40.4%), were working in high-skilled occupations (53.3%), and had parental responsibilities (65.8%). Data on the key exposure and outcome can be seen in Table 2. Across all waves 41.7% of participants reported exposure to one job stressor, and close to 80% reported exposure to one job stressor across any wave. The overall mean of job quality was 0.87 (SD = 0.81). Across all waves, 8.4% of people reported taking one day and 13.8% reported taking 2 or more days of sickness absence in a four-week period. In any wave, 24.6% reported one day of sickness absence in a four-week period, and 35.4% reported an average of two or more days in a four-week period. The mean of sickness absence days was 0.77 (SD = 2.61). Functional impairment was reported in 31.7% of people across all waves (up to 89.5% across any wave of data).

--- Please insert Tables 1 and 2---

Table 3 shows the findings for the association between job quality and sickness absence over time for the original/raw measure of job quality as well as the separated within-person (i.e. deviation score) and between-person (i.e. average score) components. Model 1 shows that each additional job adversity is associated with a 23% increase in the number of days of sickness absence (RR 1.23, 95% CI 1.16-1.31). Model 2 shows that this represents both within-person change in the number of job adversities experienced (RR 1.17, 95% CI 1.08-1.27) and averaged differences in job quality between people (RR 1.31, 95% CI 1.20-1.43). When adjusting for socio-demographic factors, adverse life events, health behaviours, and other unmeasured between person differences in model 4, the results show that each additional experience of job adversity is associated with a 15% increase in the number of

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3 days of sickness absence. In the final model also adjusting for depression, anxiety and
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5 neuroticism, there continues to be a 12% increase in days of sickness absence attributable to
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7 each additional exposure to poor quality work.
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12 --- Please insert Table 3---

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17 Results for functional outcomes can be seen in Table 4. These results reflect a similar pattern
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19 of results to those displayed in Table 3. Model 1 shows that each additional job adversity
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21 (combining variation both within and between people) is associated with a 60% increase in the
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23 odds of functional impairment (OR 1.60, 95% CI 1.47-1.74). Model 2 shows that this
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25 represents both within-person change in the number of adversities experienced (OR 1.30,
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27 95% CI 1.17-1.43) and averaged differences in job quality between people (OR 2.50, 95% CI
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29 2.15-2.90). In the final model (6) adjusting for all covariates, each additional job adversity
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31 continues to be associated with a 17% increase in the odds of functional impairment.
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37 --- Please insert Table 4---

38 39 40 **Discussion**

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42 This study found that when the number of psychosocial job adversities people experienced
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44 increased this change was accompanied by significantly greater sickness absence. This was
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46 found to be the case after controlling for childhood adversity, a range of individual health and
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48 personality variables, socio-demographic factors, and job characteristics. This suggests the
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50 importance of not only person-related factors in the occurrence and duration of sickness
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52 absence, but also job-related factors. Results for functional outcomes are similar, indicating
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54 that there are comparable mechanisms explaining both sickness absence and functional health
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56 problems.
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3 The current results align with other studies finding that job strain³⁷ and low decision latitude
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5⁹ are predictors of sickness absence, including previous longitudinal research that has
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7 specifically examined changes in working conditions in association with changes sickness
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9 absence^{11,38}. For example, research from the British Whitehall II study (2006) compared
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11 groups who did and did not change their psychosocial job conditions (across two follow-up
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13 periods) and controlled for sex, age, occupational status, baseline health, alcohol, smoking
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15 and BMI³⁹. The results showed that decreased decision latitude, increased job demands and
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17 decreased social support all predicted a greater risk of sickness absence. More recently,
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19 Milner et al. (2015) used longitudinal fixed effects models to show that increases in
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21 psychosocial adversities were associated with increases in the odds of sickness absence¹¹.
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23 This latter study controlled for time-varying factors including age, household structure and
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25 income, job permanency, occupational skill level, educational attainment, and presence of a
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27 long-term health condition or disability.
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56 Expanding on prior research, the hybrid model in the current study allowed us to control for a
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58 broader range of both time-varying and time-invariant predictors across the lifecourse and to
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60 examine the influence of both time-varying and time-invariant components of psychosocial
job quality. The results predicting sickness absence showed that while between-person
comparisons of average levels of job quality were associated with sickness absence in the
initial models, it was *within-person* change in job quality that remained uniquely associated
in the final fully adjusted model. These within-person specific results add strength to the
argument that job quality is an independent causal predictor of sickness absence^{10,39}.

Limitations and strengths

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3 The limitations of this paper include the restricted geographical area from which the sample
4 was recruited - the cities of Canberra and Queanbeyan, in Australia. As Canberra is a city that
5 includes many professionals and public servants, (baseline sample comprised of 53%
6 professionals)¹⁵, the findings may not be generalisable to samples taken from more
7 disadvantaged communities. Second, as the study only included data from the path midlife
8 cohort (aged 40–44 at baseline), the results may differ in other age groups. We reduced the
9 likelihood of dependent misclassification by controlling for person-specific factors that could
10 influence both sickness absence and reporting of psychosocial job stressors. In saying this, it
11 is important to note that both exposures and outcomes are self-reported, and may still be
12 subject to residual reporting bias.
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28 Important study strengths include the longitudinal design (which facilitated the hybrid
29 modelling), and the adjustment for a wide variety of personal, health and demographic
30 predictors of sickness absence, including variables rarely controlled for in prior research (i.e.
31 early life adversities and personality characteristics). In terms of outcomes, our study adds
32 information on number of days of sickness absence (rather than a binary outcome only) and
33 replicates the results with functional impairment. A final strength is that PATH has a
34 relatively large sample size that has been randomly selected from the population.
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47 *Conclusion*

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49 The results of this study suggest that increases in psychosocial job adversity (i.e. high job
50 demands, low job control and job insecurity) are accompanied by increases in sickness
51 absence, and that this effect is not explained by differences or changes in other
52 sociodemographic factors, physical or mental health status, childhood or recent adverse life
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3 events or personality. The findings highlight the importance of addressing poor job quality as
4 a risk factor for sickness absence.
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10 **Contributorship statement**

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12 PB oversaw the study and contributed the key job quality measures to the PATH study. LL
13 and AM wrote the first draft of the manuscript and LL wrote revised versions. LST
14 performed the statistical analyses and all authors (LST, PB, AM and LL) interpreted the
15 findings. All authors revised the draft and LL, LST and PB contributed to the final version of
16 manuscript. We would like to note that AM passed away in 2019. Although she has not
17 approved the final submitted version of the paper, the paper closely aligns with the original
18 drafts AM contributed to.
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31 **Competing interests**

32
33 None to declare.
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Data availability statement

Data may be obtained from a third party and are not publicly available. PATH is not a publicly available dataset and so it is not possible to gain access to the de-identified data without developing a genuine, scientifically-based collaboration with a PATH investigator. The PATH investigators welcome research that complements the aims of the PATH study and optimises the use of the data, please contact us (info@pathstudy.org.au) to discuss your research proposal. For further information about the study see <http://www.pathstudy.org.au/>

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43 the field of occupational epidemiology.
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54 **Ethics approval**

55
56 The PATH Through Life Project was approved by the Australian National University Human
57 Research Ethics Committee: #M9807; #2002/190; #2006/314 and #2010/542.
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Tables

Table 1. Sample characteristics at baseline (n = 2106)

Sample characteristic	n	%
Sex		
Male	1052	49.9
Female	1054	50.1
Partner status		
No partner	414	19.7
Having a partner	1692	80.3
Education completion		
Incomplete high school	561	26.6
Completion of high school	695	33.0
Completion of tertiary study	850	40.4
Occupational skill level		
High	1122	53.3
Medium	564	26.8
Low	420	19.9
Parental responsibilities		
No	720	34.2
Yes	1386	65.8
Childhood adversities		
No	1476	70.1
Yes	622	29.5
Unknown	8	0.4
Financial hardship		
No	1620	76.9
Yes	482	22.9
Unknown	4	0.2
Smoking status		
Never/past smoker	1729	82.1
Current smoker	377	17.9
Hazardous/harmful alcohol consumption		
No	1978	93.9
Yes	128	6.1
Moderate/vigorous physical exercise (hours spent in the last week)		
0	406	19.3
<1.5	444	21.1
1.5–3.0	357	17.0
3.1–5.5	514	24.4
>5.5	385	18.3
Average hours spent in the last week (mean, SD)	3.58	5.95
Number of chronic physical health conditions		
0	1195	56.7
1	704	33.4
≥ 2	207	9.8

Number of adverse non-work life events		
0	1072	50.9
1	617	29.3
≥ 2	417	19.8
Depression/anxiety		
No	1563	74.2
Yes	532	25.3
Unknown	11	0.5
Neuroticism (mean, SD)	3.91	3.17

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Table 2. Descriptive statistics on exposures and outcome at each wave

	All waves (n = 7644)	Wave 1 (n = 2106)	Wave 2 (n = 2095)	Wave 3 (n = 1984)	Wave 4 (n = 1459)	Any wave^a (persons = 2221)
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Job quality (number of job adversities)						
0	2834 (37.1)	683 (32.4)	825 (39.4)	785 (39.6)	541 (37.1)	1464 (65.9)
1	3190 (41.7)	892 (42.4)	863 (41.2)	833 (42.0)	602 (41.3)	1717 (77.3)
2	1357 (17.8)	436 (20.7)	351 (16.8)	313 (15.8)	257 (17.6)	931 (41.9)
3	242 (3.2)	95 (4.5)	52 (2.5)	51 (2.6)	44 (3.0)	205 (9.2)
Unknown	21 (0.3)	0	4 (0.2)	2 (0.1)	15 (1.0)	21 (1.0)
Number of days of sickness absence						
0	5916 (77.4)	1616 (76.7)	1647 (78.6)	1502 (75.7)	1151 (78.9)	2133 (96.0)
1	643 (8.4)	185 (8.8)	171 (8.2)	183 (9.2)	104 (7.1)	546 (24.6)
2+	1052 (13.8)	305 (14.5)	267 (12.7)	294 (14.8)	186 (12.8)	787 (35.4)
Unknown	33 (0.4)	0	10 (0.5)	5 (0.3)	18 (1.2)	33 (1.5)
Functional impairment						
No	5211 (68.2)	1421 (67.5)	1435 (68.5)	1343 (67.7)	1012 (69.4)	1325 (59.7)
Yes	2424 (31.7)	685 (32.5)	655 (31.3)	641 (32.3)	443 (30.4)	1988 (89.5)
Unknown	9 (0.1)	0	5 (0.2)	0	4 (0.3)	9 (0.4)

^a% sum for each variable is more than 100% because individuals can be included in multiple categories.

Table 3. Relative risk and 95% confidence intervals from longitudinal random-intercept negative binomial regression models assessing the relationship between psychosocial job quality and the number of days of sickness absence

	Model 1 (adjusted for time only)	Model 2 (within- and between-person terms)	Model 3 (adding socio-demographic covariates, childhood adversity and non-work events)	Model 4 (adding health covariates)	Model 5 (adding depression/anxiety)	Model 6 (adding neuroticism)
Original job quality score (0-3) ^a	1.23 (1.16–1.31)***					
Job quality deviation score		1.17 (1.08–1.27)***	1.15 (1.06–1.25)**	1.15 (1.06–1.25)**	1.12 (1.03–1.21)**	1.12 (1.03–1.21)**
Average job quality across waves		1.31 (1.20–1.43)***	1.21 (1.10–1.32)***	1.19 (1.09–1.30)***	1.06 (0.92–1.17)	1.04 (0.95–1.14)
Sex						
Male (ref.)			1.00	1.00	1.00	1.00
Female			1.28 (1.14–1.42)***	1.24 (1.11–1.39)***	1.22 (1.09–1.36)***	1.21 (1.08–1.35)**
Partner						
No partner			1.30 (1.15–1.46)***	1.29 (1.14–1.46)***	1.27 (1.11–1.44)***	1.26 (1.12–1.42)***
Having a partner (ref.)			1.00	1.00	1.00	1.00
Education completion						
Incomplete high school (ref.)			1.00	1.00	1.00	1.00
Completion of high school			0.99 (0.86–1.14)	1.00 (0.87–1.15)	1.01 (0.88–1.16)	1.01 (0.88–1.16)
Completion of tertiary study			0.98 (0.84–1.14)	1.00 (0.86–1.17)	1.04 (0.89–1.21)	1.04 (0.89–1.21)
Occupational skill level						
High (ref.)			1.00	1.00	1.00	1.00
Medium			1.03 (0.91–1.17)	1.03 (0.91–1.17)	1.02 (0.89–1.16)	1.01 (0.89–1.15)
Low			0.89 (0.76–1.04)	0.89 (0.76–1.04)	0.91 (0.78–1.07)	0.91 (0.78–1.06)
Parental responsibilities						
No (ref.)			1.00	1.00	1.00	1.00
Yes			1.02 (0.91–1.15)	1.03 (0.91–1.15)	1.02 (0.91–1.15)	1.02 (0.91–1.15)
Financial hardship						
No (ref.)			1.00	1.00	1.00	1.00
Yes			1.13 (1.00–1.29)	1.12 (0.99–1.28)	1.04 (0.92–1.19)	1.04 (0.92–1.19)*
Childhood adversity (wave 1)						
No (ref.)			1.00	1.00	1.00	1.00
Yes			1.32 (1.18–1.47)***	1.31 (1.17–1.46)***	1.25 (1.11–1.40)***	1.24 (1.11–1.38)***
Adverse non-work life events						

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0 (ref.)			1.00	1.00	1.00	1.00
1			1.10 (0.98–1.24)	1.09 (0.97–1.23)	1.07 (0.99–1.20)	1.06 (0.95–1.19)
≥2			1.47 (1.29–1.67)***	1.45 (1.27–1.65)***	1.34 (1.19–1.52)***	1.33 (1.17–1.52)***
Smoking status						
Never/past smoker (ref.)				1.00	1.00	1.00
Current smoker				1.02 (0.88–1.18)	1.00 (0.89–1.15)	1.00 (0.86–1.16)
Alcohol consumption						
No (ref.)				1.00	1.00	1.00
Yes				0.96 (0.79–1.17)	0.95 (0.77–1.15)	0.94 (0.78–1.14)
Moderate/vigorous physical exercise						
0 (ref.)				1.00	1.00	1.00
<1.5				1.03 (0.88–1.20)	1.04 (0.89–1.22)	1.06 (0.90–1.23)
1.5–3.0				1.10 (0.94–1.30)	1.10 (0.94–1.30)	1.12 (0.95–1.31)
3.1–5.5				0.93 (0.80–1.09)	0.96 (0.83–1.12)	0.97 (0.83–1.13)
>5.5				0.83 (0.70–0.98)*	0.87 (0.74–1.03)	0.88 (0.74–1.04)
Number of chronic physical health conditions						
0 (ref.)				1.00	1.00	1.00
1				1.02 (0.91–1.14)	1.00 (0.89–1.12)	1.00 (0.89–1.12)
≥ 2				1.35 (1.17–1.55)***	1.29 (1.11–1.48)***	1.29 (1.12–1.48)***
Depression/anxiety						
No (ref.)					1.00	1.00
Yes					1.92 (1.71–2.15)***	1.83 (1.62–2.06)***
Neuroticism						
0 (Low) (ref.)						1.00
1						1.08 (0.89–1.31)
2						1.08 (0.86–1.36)
3						1.09 (0.89–1.32)
4 (High)						1.26 (1.03–1.55)*
Survey wave						
1 (ref)	1.00	1.00	1.00	1.00	1.00	1.00
2	0.91 (0.80–1.03)	0.90 (0.79–1.03)	0.91 (0.80–1.04)	0.90 (0.79–1.03)	0.92 (0.81–1.05)	0.92 (0.81–1.05)
3	1.08 (0.96–1.23)	1.07 (0.95–1.22)	1.08 (0.94–1.23)	1.04 (0.91–1.19)	1.06 (0.94–1.21)	1.06 (0.92–1.21)
4	0.89 (0.77–1.02)	0.88 (0.76–1.02)	0.92 (0.78–1.08)	0.87 (0.74–1.02)	0.89 (0.77–1.05)	0.89 (0.75–1.05)

*p<0.05; **p<0.01; ***p<0.001. a – number of psychosocial job adversities.

Table 4. Odds ratios and 95% confidence intervals from longitudinal random-intercept logistic regression models assessing the relationship between psychosocial job quality and functional impairment

	Model 1 (adjusted for time only)	Model 2 (within- and between-person terms)	Model 3 (adding socio-demographic covariates, childhood adversity and non-work events)	Model 4 (adding health covariates)	Model 5 (adding depression/anxiety)	Model 6 (adding neuroticism)
Original job quality score (0-3) ^a	1.60 (1.47–1.74)***					
Job quality deviation score		1.30 (1.17–1.43)***	1.27 (1.15–1.41)***	1.28 (1.15–1.42)***	1.16 (1.04–1.30)**	1.17 (1.05–1.30)**
Average job quality across waves		2.50 (2.15–2.90)***	2.16 (1.87–2.49)***	2.14 (1.86–2.47)***	1.49 (1.32–1.71)***	1.34 (1.17–1.54)***
Sex						
Male (ref.)			1.00	1.00	1.00	1.00
Female			1.21 (1.02–1.43)*	1.17 (0.99–1.39)	1.11 (0.94–1.30)	1.05 (0.90–1.24)
Partner						
Having a partner (ref.)			1.26 (1.05–1.51)*	1.26 (1.05–1.51)*	1.26 (1.04–1.50)*	1.23 (1.03–1.47)*
No partner			1.00	1.00	1.00	1.00
Education completion						
Incomplete high school (ref.)			1.00	1.00	1.00	1.00
Completion of high school			0.97 (0.78–1.21)	0.98 (0.79–1.22)	1.01 (0.84–1.24)	1.00 (0.81–1.23)
Completion of tertiary study			1.21 (0.96–1.53)	1.27 (1.01–1.61)*	1.39 (1.11–1.74)**	1.38 (1.10–1.72)**
Occupational skill level						
High (ref.)			1.00	1.00	1.00	1.00
Medium			1.06 (0.89–1.27)	1.06 (0.89–1.26)	1.03 (0.86–1.23)	1.02 (0.86–1.21)
Low			0.75 (0.60–0.94)*	0.73 (0.59–0.91)**	0.78 (0.62–0.97)*	0.78 (0.62–0.97)*
Parental responsibilities						
No (ref.)			1.00	1.00	1.00	1.00
Yes			0.80 (0.68–0.94)**	0.82 (0.70–0.96)*	0.82 (0.70–0.96)*	0.81 (0.69–0.95)***
Financial hardship						
No (ref.)			1.00	1.00	1.00	1.00
Yes			1.92 (1.61–2.29)***	1.91 (1.60–2.28)***	1.59 (1.34–1.90)***	1.60 (1.34–1.91)***
Childhood adversity (wave 1)						
No (ref.)			1.00	1.00	1.00	1.00
Yes			1.81 (1.51–2.17)***	1.78 (1.49–2.13)***	1.54 (1.31–1.82)***	1.47 (1.24–1.74)***
Adverse non-work life events						

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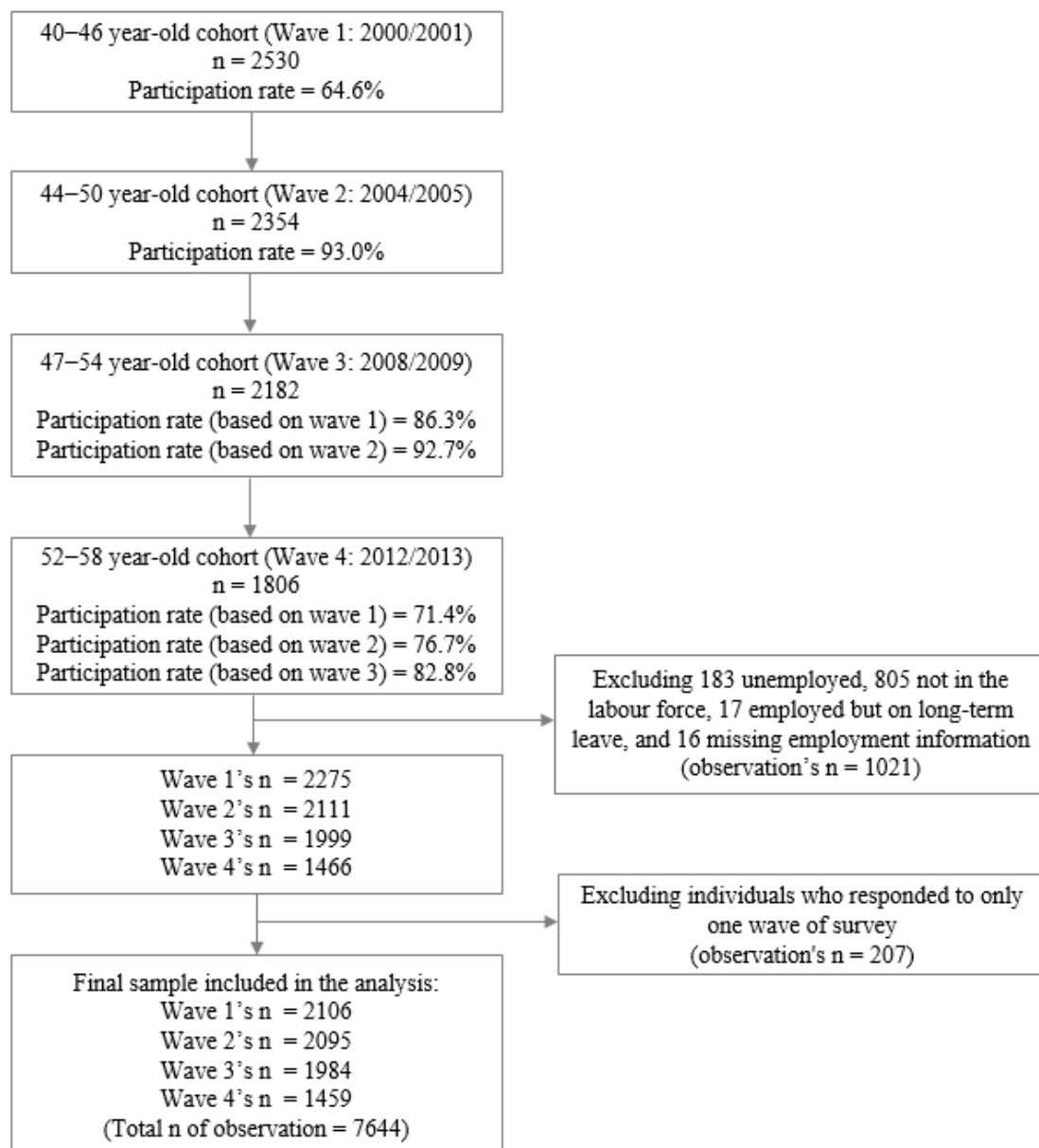
0 (ref.)			1.00	1.00	1.00	1.00
1			1.35 (1.17–1.57)***	1.33 (1.15–1.54)***	1.25 (1.07–1.45)**	1.24 (1.07–1.44)**
≥2			2.11 (1.77–2.51)***	2.07 (1.74–2.47)***	1.78 (1.49–2.12)***	1.76 (1.48–2.11)***
Smoking status						
Never/past smoker (ref.)				1.00	1.00	1.00
Current smoker				0.99 (0.79–1.22)	0.89 (0.71–1.09)	0.87 (0.71–1.08)
Alcohol consumption						
No (ref.)				1.00	1.00	1.00
Yes				1.19 (0.91–1.55)	1.17 (0.91–1.52)	1.13 (0.87–1.47)
Moderate/vigorous physical exercise						
0 (ref.)				1.00	1.00	1.00
<1·5				0.97 (0.79–1.20)	1.01 (0.81–1.25)	1.03 (0.83–1.27)
1·5–3·0				1.15 (0.92–1.43)	1.16 (0.91–1.45)	1.21 (0.97–1.51)
3·1–5·5				0.80 (0.65–0.99)*	0.87 (0.71–1.07)	0.90 (0.73–1.11)
>5·5				0.75 (0.59–0.93)*	0.83 (0.66–1.04)	0.86 (0.69–1.08)
Number of chronic physical health conditions						
0 (ref.)				1.00	1.00	1.00
1				1.27 (1.09–1.48)**	1.21 (1.04–1.41)*	1.22 (1.04–1.42)*
≥ 2				1.63 (1.33–1.99)***	1.53 (1.25–1.87)***	1.53 (1.25–1.87)***
Depression/anxiety						
No (ref.)					1.00	1.00
Yes					7.75 (6.51–9.14)***	6.68 (5.63–7.92)***
Neuroticism						
0 (Low) (ref.)						1.00
1						1.24 (0.94–1.63)
2						1.54 (1.11–2.12)**
3						1.82 (1.38–2.40)***
4 (High)						2.32 (1.72–3.11)***
Survey wave						
1 (ref.)	1.00	1.00	1.00	1.00	1.00	1.00
2	0.99 (0.85–1.16)	0.96 (0.82–1.12)	0.95 (0.81–1.11)	0.94 (0.80–1.10)	1.01 (0.86–1.19)	1.00 (0.85–1.18)
3	1.08 (0.92–1.26)	1.04 (0.88–1.21)	0.98 (0.82–1.16)	0.92 (0.77–1.09)	0.97 (0.81–1.16)	0.97 (0.81–1.16)
4	0.96 (0.80–1.15)	0.94 (0.79–1.12)	0.88 (0.72–1.08)	0.79 (0.64–0.98)*	0.85 (0.69–1.05)	0.83 (0.67–1.03)

*p<0.05; **p<0.01; ***p<0.001. a – number of psychosocial job adversities.

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3 **Figures**
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8 Figure 1. Study profile
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STROBE Statement—Checklist of items that should be included in reports of *cohort studies*

	Item No	Recommendation	Page No
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract (b) Provide in the abstract an informative and balanced summary of what was done and what was found	1&3 3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4-5
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	5-6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5-6
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up (b) For matched studies, give matching criteria and number of exposed and unexposed	6 NA
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	7-10
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	7-10
Bias	9	Describe any efforts to address potential sources of bias	6
Study size	10	Explain how the study size was arrived at	6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7-10
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding (b) Describe any methods used to examine subgroups and interactions (c) Explain how missing data were addressed (d) If applicable, explain how loss to follow-up was addressed (e) Describe any sensitivity analyses	11-12 NA 12 12 NA
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed (b) Give reasons for non-participation at each stage (c) Consider use of a flow diagram	6, 19 (Fig 1) 6 19 (Fig 1)
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders (b) Indicate number of participants with missing data for each variable of interest (c) Summarise follow-up time (eg, average and total amount)	12-13 12, 20-21 (Table 1) 6, 19 (Fig 1)
Outcome data	15*	Report numbers of outcome events or summary measures over time	11-12, 22 (Table 2)

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2			
3	Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included
4			12-13 (Tables 4-3)
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6			7-10
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10	Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses
11			NA
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13	Discussion		
14	Key results	18	Summarise key results with reference to study objectives
15			14
16	Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias
17			15-16
18	Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence
19			14-15
20	Generalisability	21	Discuss the generalisability (external validity) of the study results
21			15
22	Other information		
23	Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based
24			17
25			

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at <http://www.strobe-statement.org>.

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Poor psychosocial job conditions increase sickness absence: Evidence from the PATH Through Life Mid-Aged Cohort

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Poor psychosocial job conditions increase sickness absence: Evidence from the PATH Through Life Mid-Aged Cohort

Leach LS^{1*}, Milner A^{2*}, Too LS^{1,3}, Butterworth P^{1,4}

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Abstract

Objectives: Evidence is mounting that poor psychosocial job conditions increase sickness absence, but there is a need for further rigorous prospective research to isolate the influence of psychosocial job quality from other measured and unmeasured confounders. This study used four waves of prospective longitudinal data (spanning 12 years) to investigate the extent to which increases in poor psychosocial job quality are associated with greater relative risk of day of sickness absence.

Methods: Data were from the PATH Through Life cohort study (7644 observations from 2221 participants) and included multiple indicators of poor psychosocial job quality (i.e. a combination of low control, high demands, and high insecurity), days sickness absence in the past four weeks, and a wide range of potential confounders from across the lifecourse. The analyses adopted hybrid-regression estimations that isolated the effect of within-person change in psychosocial job quality on sickness absence over time.

Results: The results show that after adjusting for a wide range of factors, as well as unmeasured between-person differences in job quality, each additional psychosocial job adversity was associated with a 15% increase in the number of days of sickness absence. Increases in psychosocial job adversity were also related to functional impairment.

Conclusions: The results of this study strengthen existing research highlighting the importance of addressing poor psychosocial job quality as a risk factor for sickness absence.

Key words: sickness absence, job quality, psychosocial job stressors, functional limitations.

Article Summary

Strengths and limitations of this study

- Findings are based on robust longitudinal cohort data (spanning 12 years) with the original sample randomly selected from the population.
- Adjustments are made for a wide variety of personal, health and demographic predictors of sickness absence, including variables rarely controlled for in prior research (i.e. early life adversities and personality characteristics).
- The study adds information on number of days of sickness absence (rather than a binary outcome only) and replicates the results with functional impairment.
- The main weakness of this study is potential lack of generalisability due to the restricted geographical area from which the sample was recruited (in a city with a preponderance of more highly educated professionals and public servants) and the narrow midlife cohort (aged 40–44 at baseline).
- It is also important to note that both exposures and outcomes are self-reported and thus may be subject to residual reporting bias.

Introduction

Absence from work due to sickness is an important issue in public health. Previous studies have noted that sickness absence is predictive of chronic health conditions^{1,2} and mortality^{1,2}, as well as exit from the workforce³. The broader economic and social costs associated with sickness absence are substantial, running into the tens of billions of dollars for many countries^{4,5}. From a population health perspective, identifying the causes of sickness absence that are amenable to intervention is critical – to reduce both sickness absence and the subsequent adverse health-related consequences.

We know the causes of sickness absence are complex and inter-related, including factors connected to the nature of the illness, the industry a person is employed in, gender⁶, and income⁷. Given a broad range of factors contribute, there is still debate about the extent to which work-related environmental influences, and in particular *psychosocial job stressors* (such as low levels of job control, high job demands, and job insecurity), contribute to sickness absence^{4,8-11}. A 2012 longitudinal study based on the British Birth Cohort⁹ recommended a “life course” perspective, arguing the importance of taking childhood disadvantage, education, coping styles, and personality into consideration. The study concludes by stating that “a greater understanding of the ways in which occupational risk factors interact with individual vulnerabilities across the life-course is required” (p.1).

Building upon this 2012 cohort study, several other longitudinal studies have sought to investigate the contribution of psychosocial job quality to sickness absence whilst controlling for a broad range of possible influences. For example, Wang et al. (2014) analysed data from the Norwegian Hordaland Health Study and found that job strain was associated with long-term sickness absence (>16 days per year) one year later after adjusting for education,

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3 income, BMI, physical and mental health, and health-related behaviours ¹²; however this
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5 research did not adjust for early life adversities or personality characteristics. In addition, no
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7 information was included about how psychosocial job quality might influence number of
8
9 days of sickness absence (only a binary indicator of long sickness absence was included).
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11 This information is important as individual and organisational costs vary based on the length
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13 of sickness absence ^{3, 13, 14}. Other longitudinal research conducted in Australia by Milner et al.
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15 (2015) included a measure of days of sickness absence in the past 12 months and found that
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17 exposure to three or more psychosocial job adversities was associated with an 11% increase
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19 in days of sick leave ¹¹. However, this research made no adjustment for early life adversities
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21 or personality characteristics.
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29 The current study also examines psychosocial job conditions and sick leave in the Australian
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31 context - adopting an outcome measure of days of sickness absence over a brief 4-week
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33 period. Australia has a different system from most European countries (where much of the
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35 research on psychosocial job conditions and health originates). In Australia, paid sick leave is
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37 provided by employees rather than being government funded/supported and sick leave is
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39 accrued over time with an employer (in general, 10 days accrue per year for full-time workers
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41 and pro-rata for part-time workers).¹⁵ While the pool of available sick leave days accumulates
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43 with time with the same employer, if an employee changes employer they lose all their pre-
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45 existing sick leave entitlement. If employees do exhaust all of their accrued sick leave days
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47 they can utilise other leave or may be able to take unpaid leave. In addition, employers can
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49 ask employees to provide evidence (e.g. medical certificate from a health professional) for
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51 as little as 1 day or less off work. For further context, around 20% of Australian workers is
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53 employed on a casual basis and usually have no paid leave entitlements ¹⁶.
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3 This system affects the amount of paid sick leave Australian workers have and how sickness
4 absences are taken (as also explained in Lallukka et al. 2021¹⁷). The average frequency and
5 duration of sick leave in Australia is likely lower than in many European countries, although
6 exact figures are unknown as there are no national administrative records on sickness
7 absences in Australia. The current study adopts an outcome measure of days of sickness
8 absence over a brief 4-week period. While this is a short reference period compared to others
9 used in the existing literature, it reflects the lower levels of leave taken in the context of the
10 Australian system.
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24 The current study uses four waves of Australian cohort data (spanning 12 years) to examine
25 increases in psychosocial job adversity in association with increased days of sickness
26 absence. The analyses uniquely control for influences across the life course, from childhood
27 adversities to proximal adverse life events, as well as personality and health-related
28 conditions. In addition, hybrid analyses isolate and adjust for unmeasured differences in
29 psychosocial job quality between individuals. By controlling for a wide range of confounders,
30 and removing the influence of unmeasured differences between individuals (i.e. accounting
31 for person-related predisposition for reporting psychosocial job stressors), we increase
32 confidence in testing for a causal association between psychosocial job quality and sickness
33 absence. To complement days of sickness absence as an outcome, we also examine the effect
34 on functional impairment - defined as impairment at work due to physical/mental health
35 problems. Supplementary analyses were also conducted using the outcomes - a) any sickness
36 absence (no days, vs one or more days), and b) longer sickness absence (up to and including
37 4 days, vs 5 days or more (representing at least one working week)).
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Methods

Sample

Participants were from the PATH Through Life Project, a prospective community survey that commenced at the Australian National University in 1999 and has been jointly hosted by the ANU and the University of New South Wales since 2019. The survey focuses on individual health and well-being trajectories across the life course and the sample includes three cohorts (young, midlife, and older adults) randomly selected from the Australian Electoral Rolls of Australian Capital Territory and neighbouring Queanbeyan¹⁸. The current study was restricted to the midlife cohort who were assessed every four years from wave 1 in 2000/2001 to wave 4 in 2012/2013. The participation rate of this cohort at baseline was 65% (2,530 participants). Of those who participated at baseline, 93% completed the survey at wave 2, 86% at wave 3, and 71% at wave 4 (Figure 1). For the first three waves, participants were usually assessed in their own home or at the Australian National University. They were invited to complete a questionnaire using a laptop computer under the supervision of a trained interviewer. For the fourth wave, participants were invited to complete an online version of the questionnaire. All participants provided informed consent to participate at each wave of the study, and each wave of data collection was approved by the Human Research Ethics Committee of the Australian National University.

We excluded observations from participants when they were: (i) not employed; (ii) not in the labour force; (iii) employed but on long-term leave; or (iv) had missing data on employment status in each wave (Figure 1). We also excluded participants with less than two waves of data.

--- Please insert Figure 1 ---

Patient and Public Involvement

The PATH study is a general population study and was formed based on pilot testing in Canberra community. There has been a regular feedback process for participants to engage with the study development and findings. PATH has long-standing ties to the Canberra community, with the data forming the basis of several local government reports, as well as regular engagement with both local and national stakeholders.

Measures

Outcome variables – Days sickness absence and functional impairment

‘Days of sickness absence’ was generated based on two items: ‘In the last four weeks, have you stayed away from your work (or school or place of study) for more than half a day because of any illness or injury that you had?’ and ‘How many days in the last 4 weeks have you stayed away from your work (or school, or place of study)?’ The first item offered two response categories (‘yes’ and ‘no’). Those who responded ‘no’ to the first item were classified as having zero day of sickness absence. These two questions were combined to generate the number of days of sickness absence in a four-week period. Two binary measures were also included in supplementary analyses - a) any sickness absence (‘0’ = no days, vs ‘1’ = one or more days), and b) longer sickness absence (‘0’ = ≤ 4 days, vs ‘1’ = ≥ 5 days (representing at least one working week)).

‘Functional impairment’ (secondary outcome) was generated based on four questions from the Short-Form Health Survey (SF-12)¹⁹ that asked whether participants had problems with work or regular daily activities over the past four weeks due to their physical or mental health. Respondents were asked if they: a) accomplished less than you would like as a result of your physical health?, b) were limited in the kind of work or other activities undertook as a result of

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3 your physical health?, c) accomplished less than you would like as a result of any emotional
4 problems?, d) did not do work or other activities as carefully as usual as a result of any
5 emotional problems?’ Participants who reported ‘yes’ to any of these items were classified as
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8 having functional impairment due to physical/mental health problems while those who
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10 indicated ‘no’ to all items were classified as not having functional impairment.
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17 *Exposure variable - Psychosocial job quality*

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19 Three aspects of job quality were used to calculate a composite measure of exposure to poor
20 job quality – job control, job demands and job insecurity. Job control and job demands were
21 assessed using 19 items taken from the Whitehall II study²⁰. Fifteen items assessed job control
22 and four assessed job demands. These items offered four response categories: ‘3-often’, ‘2-
23 sometimes’, ‘1-rarely’, and ‘0-never’. Following the methodology used in previous studies²¹,
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22, average total scores for job control and job demands were calculated and these scores were
then dichotomised to identify the top 30% of respondents with the greatest job adversity (i.e.
low job control, high job demands). One item: ‘How secure do you feel about your job or career
future in your current workplace?’ (responses: ‘not at all secure’, ‘moderately secure’, ‘secure’,
‘extremely secure’) was used to assess job insecurity. Individuals who selected either of the
first two responses were classified as having ‘1’ high job insecurity while all else were
classified as ‘0’ low job insecurity.

As in our previous research,^{23, 24} we used a composite indicator approach to generate an
estimate of overall psychosocial job adversity based on the sum of the three individual
indicators (i.e. low control, high demands, and high job insecurity), providing a count of
adversities between 0 and 3. In the analyses, this job quality score was separated into two
variables to represent both the within-person variability over time and between-person

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3 averaged differences. To do this, a variable representing within-person variability was
4 calculated by subtracting the composite job quality score at each wave from the mean score
5 across all waves (i.e. a change or deviation score was calculated at each wave). The (time-
6 invariant) mean score for overall job quality across all waves was used to estimate between
7 person differences. This process of separating within and between-person components is
8 known as ‘demeaning’. Further details are provided in the statistical analyses section below.
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19 *Potential confounders*

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21 We adjusted for a range of variables that potentially confound the association of days of
22 sickness absence from work with psychosocial job quality^{12,25}. These variables included time-
23 invariant stable influences from baseline (i.e., gender, education, childhood adversity,
24 neuroticism) and time-varying measures from each wave that might co-vary with changes in
25 psychosocial job quality and sickness absence in the short term (i.e., partner status,
26 occupational skill level, parental responsibilities, non-work life events, financial hardship,
27 smoking status, alcohol consumption, physical exercise, chronic physical health conditions,
28 and common mental disorders).
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42 Educational attainment was grouped as ‘incompleted high school’, ‘completed high school’,
43 and ‘completed tertiary study’. Partner status included two categories: ‘no partner’ and
44 ‘partnered’ (i.e. currently married or living with a partner). Occupational skill level consisted
45 of three categories: ‘high’ (managers/administrators/professionals); ‘medium’ (associate
46 professionals/tradespersons/advanced clerical and service workers); and ‘low’ (intermediate
47 production and transport workers/elementary clerical, sales and service workers/labourers).
48 Parental responsibilities were coded based on having a youngest child aged under 15 years.
49 Financial hardship was derived from the item: ‘Have you or your family had to go without
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3 things you really needed in the last year because you were short of money?'. Respondents were
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5 considered to have financial hardship if they responded 'yes, often' or 'yes, sometimes'.
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10 For childhood adversity, participants were asked about childhood experiences up to the age of
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12 16 years and were categorised as having childhood adversity if they responded 'yes' to any of
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14 eight items (taken from the Parental Bonding Instrument ²⁶, the British National Survey of
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16 Health and Development ²⁷, the US National Comorbidity Survey ²⁸, or an open-ended question
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18 ²⁹). These items covered neglect, authoritarian upbringing, witnessing physical/sexual abuse,
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20 as well as verbal abuse, psychological abuse, physical abuse, physical punishment, and sexual
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22 abuse by a parent.
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28 Adverse life events were measured using an extended version of the List of Threatening
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30 Experiences Questionnaire ³⁰. Analyses included nine items about non-work adverse events in
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32 the past six months: serious illness/injury/assault, death of a close family member or friend,
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34 relationship separation, serious problems within close relationships, financial crisis, legal
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36 problems, and loss of something valuable. The number of life events were summed and divided
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38 into three categories: none, one, or two or more events.
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44 Smoking status was grouped into never/past smoker and current smoker. Hazardous/harmful
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46 alcohol consumption ³¹ was derived from the Alcohol Use Disorders Identification Test ³² and
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48 classified into 'yes' and 'no'. The hours respondents engaged in moderate or vigorous physical
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50 exercise per week was assessed by items from the Whitehall II study ³³ and categorized into
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52 five groups (0, < 1.5, 1.5–3, 3.1 – 5.5, > 5.5 hours). A variety of chronic physical health
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54 conditions such as heart problems, hypertension, cancer, arthritis, thyroid problems, epilepsy,
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3 asthma, diabetes, and stroke were coded as a summary variable representing the experience of
4 none, one, or two or more of these conditions.
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10 Depression and anxiety were assessed using the Goldberg Anxiety and Depression scales ³⁴.
11 Each scale comprises nine binary items ('yes' or 'no'); total scale score 0-9. Binary scores
12 representing likely depression and generalized anxiety disorder diagnosis were calculated
13 based on validated cut-points assessed against diagnosis from a structured diagnostic interview
14 (i.e. ≥ 5 on the depression scale and ≥ 7 on the anxiety scale) ³⁵. A binary measure of common
15 mental disorder at Wave 4 was then generated based on the presence of a likely depressive
16 and/or anxiety disorder.
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29 Neuroticism (the tendency to experience negative emotion) was included as a covariate as this
30 personality trait may influence self-reported job quality and sickness absence/functional
31 impairment and thus inflate the observed association. The measure of neuroticism was from
32 the Eysenck Personality Questionnaire ³⁶, and the scale total was categorised into quintiles.
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41 *Statistical analysis*

42 The association between job quality and days of sickness absence was assessed using a
43 longitudinal random-intercept negative binomial regression model with two levels, where
44 occasion clustered within individuals. There was overdispersion in the sickness absence
45 variable and hence a negative binomial distribution was chosen. This model fitted a fixed
46 (average) regression slope for the number of sickness absence days over time while permitting
47 the intercept to vary (to reflect the different initial number of sickness absence days for
48 individuals). Coefficients were transformed into relative risks (RRs). To assess the association
49 between job quality and functional impairment (a binary variable), we used a longitudinal
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4 random-intercept logistic regression model. Coefficients were transformed into odds ratios
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7 (ORs). A final series of supplementary analyses also used longitudinal regression models to
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10 test the associations between: a) job quality and any sickness absence (0 days, vs 1 or more
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13 days) and b) job quality and a longer period of sickness absence (≤ 4 days, vs ≥ 5 days).
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16 Further supplementary analyses also included psychosocial job quality as a categorical variable
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19 to confirm a dose-response relationship with days of sickness absence (whereby each additional
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22 job adversity is associated with an increase in the number of sickness absence days taken).
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27 In all models (sickness absence and functional impairment) associations with job quality were
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29 examined with hybrid-regression estimations that differentiated between- and within-
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31 individual associations. The hybrid model is an extension of a random effects model with
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33 demeaning³⁷, in which both the person mean values of the exposure (capturing the between-
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35 individual effect) and the person deviation scores from their mean (capturing the within-
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37 individual effect) are included as regressors³⁸. The between-person association compared the
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39 risk of sickness absence between different individuals' based on their average level of job
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41 quality over time. The within-person association compared the risk of sickness absence across
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43 individuals' own changing levels of psychosocial job quality by controlling for all time-
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45 invariant factors, both observable and unobservable³⁷.
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52 In all models, an initial simple model included the original/raw measure of job quality (range
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54 0-3). The following model then separated the within-person (i.e. deviation score) and between-
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56 person (i.e. average score) components of the job quality measure. Relevant covariates across
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58 the lifecourse were then entered into subsequent models. Model 3 included sociodemographic
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3 covariates (some assessed at baseline and other more proximal factors assessed at wave three),
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5 childhood adversity, and recent non-work adverse life events. Followed by health-related
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7 covariates (smoking status, alcohol consumption, exercise and chronic health conditions)
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10 (model 4), depression/anxiety (model 5), and neuroticism (model 6).
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15 The proportion of observations with missing data on all variables was low, ranging from 0%
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17 to 1.5%. Our analyses were based on observations with no missing data (complete analyses).
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19 All analyses were conducted using StataSE 14 ³⁹.
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24 **Results**

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26 Descriptive characteristics at baseline (aged 40-46) are shown in Table 1. There was an equal
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28 split of males and females. The majority of the sample had completed a tertiary degree
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30 (40.4%), were working in high-skilled occupations (53.3%), and had parental responsibilities
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32 (65.8%). Data on the key exposure and outcome can be seen in Table 2. Across all waves
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34 41.7% of participants reported exposure to one job stressor, and close to 80% reported
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36 exposure to one job stressor across any wave. The overall mean of job quality was 0.87 (SD =
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38 0.81). Across all waves, 8.4% of people reported taking one day and 13.8% reported taking 2
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40 or more days of sickness absence in a four-week period. In any wave, 24.6% reported one
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42 day of sickness absence in a four-week period, and 35.4% reported an average of two or more
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44 days in a four-week period. The mean of sickness absence days was 0.77 (SD = 2.61).
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47 Functional impairment was reported in 31.7% of people across all waves (up to 89.5% across
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49 any wave of data). Univariate tests of association showed that the physical and mental health
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51 variables (i.e. number of chronic health conditions, anxiety and/or depression, functional
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53 impairment) were all significantly associated with days of sickness absence ($p < .001$).
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8 Table 3 shows the findings for the association between job quality and sickness absence over
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10 time for the original/raw measure of job quality as well as the separated within-person (i.e.
11 deviation score) and between-person (i.e. average score) components. Model 1 shows that
12 each additional job adversity is associated with a 23% increase in the number of days of
13 sickness absence (RR 1.23, 95% CI 1.16-1.31). Model 2 shows that this represents both
14 within-person change in the number of job adversities experienced (RR 1.17, 95% CI 1.08-
15 1.27) and averaged differences in job quality between people (RR 1.31, 95% CI 1.20-1.43).
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17 When adjusting for socio-demographic factors, adverse life events, health behaviours, and
18 other unmeasured between person differences in model 4, the results show that each
19 additional experience of job adversity is associated with a 15% increase in the number of
20 days of sickness absence. In the final model also adjusting for depression, anxiety and
21 neuroticism, there continues to be a 12% increase in days of sickness absence attributable to
22 each additional exposure to poor quality work.
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Results for functional outcomes can be seen in Table 4. These results reflect a similar pattern
of results to those displayed in Table 3. Model 1 shows that each additional job adversity
(combining variation both within and between people) is associated with a 60% increase in
the odds of functional impairment (OR 1.60, 95% CI 1.47-1.74). Model 2 shows that this
represents both within-person change in the number of adversities experienced (OR 1.30,
95% CI 1.17-1.43) and averaged differences in job quality between people (OR 2.50, 95% CI

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3 2.15-2.90). In the final model (6) adjusting for all covariates, each additional job adversity
4 continues to be associated with a 17% increase in the odds of functional impairment.
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11 Supplementary analyses (see Tables S1, S2 and S3) adopted different operationalisations of
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13 the key sickness absence and job quality variables to explore the robustness of the findings.
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18 Tables S1 and S2 show that after adjusting for all covariates each additional exposure to poor
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20 quality work was associated with a 14% increase in the odds of taking any sickness absence
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22 within the last 4-week period and a 33% increase in the odds of taking sickness absence of at
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24 least 5 days. The final supplementary analyses (Table S3) included the psychosocial job
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26 quality measure as a categorical variable. The increase in the co-efficients with each
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28 additional job adversity provides support for a dose-response relationship whereby each
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30 additional job adversity is associated with an increase in the number of sickness absence days
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32 taken.
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42 **Discussion**

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44 This study found that when the number of psychosocial job adversities people experienced
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46 increased this change was accompanied by significantly greater sickness absence. This was
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48 found to be the case after controlling for childhood adversity, a range of individual health and
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50 personality variables, socio-demographic factors, and job characteristics. This suggests the
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52 importance of not only person-related factors in the frequency of sickness absence, but also
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54 job-related factors. Results for functional outcomes are similar, indicating that there are
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56 comparable mechanisms explaining both sickness absence and functional health problems.
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3 Given that sickness absence generally indicates poor health, and that our findings were
4 replicated with functional impairment and in supplementary analyses, our findings can be
5 interpreted as an indication that poor psychosocial job conditions impact adversely on health.
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7 However, we also note that there continues to be a within-person association after we control
8 for mental health and chronic health conditions, suggesting there are also other motivations
9 for taking time off from work in the context of psychosocial adversities at work – such as
10 potentially using sick leave as a coping mechanism or preventative health behaviour ⁴⁰.

11
12 The current results align with other studies finding that job strain ⁴¹ and low decision latitude
13 ⁹ are predictors of sickness absence, including previous longitudinal research that has
14 specifically examined changes in working conditions in association with changes in sickness
15 absence ^{11, 42}. For example, research from the British Whitehall II study (2006) compared
16 groups who did and did not change their psychosocial job conditions (across two follow-up
17 periods) and controlled for sex, age, occupational status, baseline health, alcohol, smoking
18 and BMI ⁴³. The results showed that decreased decision latitude, increased job demands and
19 decreased social support all predicted a greater risk of sickness absence (both short spells ≤ 7
20 days and long spells > 7 days). More recently, Milner et al. (2015) used longitudinal fixed
21 effects models to show that increases in psychosocial adversities were associated with
22 increases in days of sickness absence over 12 months¹¹. This latter study controlled for time-
23 varying factors including age, household structure and income, job permanency, occupational
24 skill level, educational attainment, and presence of a long-term health condition or disability.

25
26 Expanding on prior research, the hybrid model in the current study allowed us to control for a
27 broader range of both time-varying and time-invariant predictors across the lifecourse and to
28 examine the influence of both time-varying and time-invariant components of psychosocial
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3 job quality. The results predicting days of sickness absence within a 4-week period showed
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5 that while between-person comparisons of average levels of job quality were associated with
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7 sickness absence in the initial models, it was *within-person* change in job quality that
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9 remained uniquely associated in the final fully adjusted model. These within-person specific
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11 results add strength to the argument that job quality is an independent causal predictor of
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13 sickness absence^{10, 43}.
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16 17 18 19 *Limitations and strengths*

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21 The limitations of this paper include the restricted geographical area from which the sample
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23 was recruited - the cities of Canberra and Queanbeyan, in Australia. As Canberra is a city that
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25 includes many professionals and public servants, (baseline sample comprised of 53%
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27 professionals)¹⁸, the findings may not be generalisable to samples taken from more
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29 disadvantaged communities. Second, as the study only included data from the path midlife
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31 cohort (aged 40–44 at baseline), the results may differ in other age groups. We reduced the
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33 likelihood of dependent misclassification by controlling for person-specific factors that could
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35 influence both sickness absence and reporting of psychosocial job stressors. In saying this, it
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37 is important to note that both exposures and outcomes are self-reported, and may still be
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39 subject to residual reporting bias. Lastly, while the 4-week reference period for days of
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41 sickness absence is a briefer outcome than is commonly used in this area of research, it is
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43 appropriate for the Australian context (and the results were replicated using a binary measure
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45 of ≥ 5 day's sickness absence in supplementary analyses).
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53 Important study strengths include the longitudinal design (which facilitated the hybrid
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55 modelling), and the adjustment for a wide variety of personal, health and demographic
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57 predictors of sickness absence, including variables rarely controlled for in prior research (i.e.
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3 early life adversities and personality characteristics). In terms of outcomes, our study adds
4 information on number of days of sickness absence (rather than a binary outcome only) and
5 replicates the results with functional impairment. A final strength is that PATH has a
6 relatively large sample size that has been randomly selected from the population.
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14 *Conclusion*

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16 The results of this study suggest that increases in psychosocial job adversity (i.e. high job
17 demands, low job control and job insecurity) are accompanied by increases in sickness
18 absence, and that this effect is not explained by differences or changes in other
19 sociodemographic factors, physical or mental health status, childhood or recent adverse life
20 events or personality. The findings highlight the importance of addressing poor job quality as
21 a risk factor for sickness absence.
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33 **Contributorship statement**

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35 PB oversaw the study and contributed the key job quality measures to the PATH study. LL and
36 AM wrote the first draft of the manuscript and LL wrote revised versions. LST performed the
37 statistical analyses and all authors (LST, PB, AM and LL) interpreted the findings. All authors
38 revised the draft and LL, LST and PB contributed to the final version of manuscript. We would
39 like to note that AM passed away in 2019. Although she has not approved the final submitted
40 version of the paper, the paper closely aligns with the original drafts AM contributed to.
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51 **Competing interests**

52 None to declare.
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58 **Funding**

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4 Council (973302, 179805, 418139, 1156849), and the Australian Government Agency — Safe
5 Work Australia (Grant# N/A). It is currently managed by both the ANU and the University of
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Data availability statement

Data may be obtained from a third party and are not publicly available. PATH is not a publicly available dataset and so it is not possible to gain access to the de-identified data without developing a genuine, scientifically-based collaboration with a PATH investigator. The PATH investigators welcome research that complements the aims of the PATH study and optimises the use of the data, please contact us (info@pathstudy.org.au) to discuss your research proposal. For further information about the study see <http://www.pathstudy.org.au/>

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43 **Ethics approval**

44
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Tables

Table 1. Sample characteristics at baseline (n = 2106)

Sample characteristic	n	%
Sex		
Male	1052	49.9
Female	1054	50.1
Partner status		
No partner	414	19.7
Having a partner	1692	80.3
Education completion		
Incomplete high school	561	26.6
Completion of high school	695	33.0
Completion of tertiary study	850	40.4
Occupational skill level		
High	1122	53.3
Medium	564	26.8
Low	420	19.9
Parental responsibilities		
No	720	34.2
Yes	1386	65.8
Childhood adversities		
No	1476	70.1
Yes	622	29.5
Unknown	8	0.4
Financial hardship		
No	1620	76.9
Yes	482	22.9
Unknown	4	0.2
Smoking status		
Never/past smoker	1729	82.1
Current smoker	377	17.9
Hazardous/harmful alcohol consumption		
No	1978	93.9
Yes	128	6.1
Moderate/vigorous physical exercise (hours spent in the last week)		
0	406	19.3
<1.5	444	21.1
1.5–3.0	357	17.0
3.1–5.5	514	24.4
>5.5	385	18.3
Average hours spent in the last week (mean, SD)	3.58	5.95
Number of chronic physical health conditions		
0	1195	56.7
1	704	33.4
≥ 2	207	9.8

Number of adverse non-work life events		
0	1072	50.9
1	617	29.3
≥ 2	417	19.8
Depression/anxiety		
No	1563	74.2
Yes	532	25.3
Unknown	11	0.5
Neuroticism (mean, SD)	3.91	3.17

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Table 2. Descriptive statistics on exposures and outcome at each wave

	All waves (n = 7644)	Wave 1 (n = 2106)	Wave 2 (n = 2095)	Wave 3 (n = 1984)	Wave 4 (n = 1459)	Any wave^a (persons = 2221)
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Job quality (number of job adversities)						
0	2834 (37.1)	683 (32.4)	825 (39.4)	785 (39.6)	541 (37.1)	1464 (65.9)
1	3190 (41.7)	892 (42.4)	863 (41.2)	833 (42.0)	602 (41.3)	1717 (77.3)
2	1357 (17.8)	436 (20.7)	351 (16.8)	313 (15.8)	257 (17.6)	931 (41.9)
3	242 (3.2)	95 (4.5)	52 (2.5)	51 (2.6)	44 (3.0)	205 (9.2)
Unknown	21 (0.3)	0	4 (0.2)	2 (0.1)	15 (1.0)	21 (1.0)
Number of days of sickness absence						
0	5916 (77.4)	1616 (76.7)	1647 (78.6)	1502 (75.7)	1151 (78.9)	2133 (96.0)
1	643 (8.4)	185 (8.8)	171 (8.2)	183 (9.2)	104 (7.1)	546 (24.6)
2+	1052 (13.8)	305 (14.5)	267 (12.7)	294 (14.8)	186 (12.8)	787 (35.4)
Unknown	33 (0.4)	0	10 (0.5)	5 (0.3)	18 (1.2)	33 (1.5)
Functional impairment						
No	5211 (68.2)	1421 (67.5)	1435 (68.5)	1343 (67.7)	1012 (69.4)	1325 (59.7)
Yes	2424 (31.7)	685 (32.5)	655 (31.3)	641 (32.3)	443 (30.4)	1988 (89.5)
Unknown	9 (0.1)	0	5 (0.2)	0	4 (0.3)	9 (0.4)

^a0% sum for each variable is more than 100% because individuals can be included in multiple categories.

Table 3. Relative risk and 95% confidence intervals from longitudinal random-intercept negative binomial regression models assessing the relationship between psychosocial job quality and the number of days of sickness absence

	Model 1 (adjusted for time only)	Model 2 (within- and between-person terms)	Model 3 (adding socio-demographic covariates, childhood adversity and non-work events)	Model 4 (adding health covariates)	Model 5 (adding depression/anxiety)	Model 6 (adding neuroticism)
Original job quality score (0-3) ^a	1.23 (1.16–1.31)***					
Job quality deviation score		1.17 (1.08–1.27)***	1.15 (1.06–1.25)**	1.15 (1.06–1.25)**	1.12 (1.03–1.21)**	1.12 (1.03–1.21)**
Average job quality across waves		1.31 (1.20–1.43)***	1.21 (1.10–1.32)***	1.19 (1.09–1.30)***	1.06 (0.97–1.17)	1.04 (0.95–1.14)
Sex						
Male (ref.)			1.00	1.00	1.00	1.00
Female			1.28 (1.14–1.42)***	1.24 (1.11–1.39)***	1.22 (1.09–1.36)***	1.21 (1.08–1.35)**
Partner						
Having a partner (ref.)			1.00	1.00	1.00	1.00
No partner			1.30 (1.15–1.46)***	1.29 (1.14–1.46)***	1.27 (1.13–1.44)***	1.26 (1.12–1.42)***
Education completion						
Incomplete high school (ref.)			1.00	1.00	1.00	1.00
Completion of high school			0.99 (0.86–1.14)	1.00 (0.87–1.15)	1.01 (0.88–1.16)	1.01 (0.88–1.16)
Completion of tertiary study			0.98 (0.84–1.14)	1.00 (0.86–1.17)	1.04 (0.89–1.21)	1.04 (0.89–1.21)
Occupational skill level						
High (ref.)			1.00	1.00	1.00	1.00
Medium			1.03 (0.91–1.17)	1.03 (0.91–1.17)	1.02 (0.89–1.16)	1.01 (0.89–1.15)
Low			0.89 (0.76–1.04)	0.89 (0.76–1.04)	0.91 (0.78–1.07)	0.91 (0.78–1.06)
Parental responsibilities						
No (ref.)			1.00	1.00	1.00	1.00
Yes			1.02 (0.91–1.15)	1.03 (0.91–1.15)	1.02 (0.91–1.15)	1.02 (0.91–1.15)
Financial hardship						
No (ref.)			1.00	1.00	1.00	1.00
Yes			1.13 (1.00–1.29)	1.12 (0.99–1.28)	1.04 (0.92–1.19)	1.04 (0.92–1.19)*
Childhood adversity (wave 1)						
No (ref.)			1.00	1.00	1.00	1.00
Yes			1.32 (1.18–1.47)***	1.31 (1.17–1.46)***	1.25 (1.12–1.40)***	1.24 (1.11–1.38)***
Adverse non-work life events						
0 (ref.)			1.00	1.00	1.00	1.00

1			1.10 (0.98–1.24)	1.09 (0.97–1.23)	1.07 (0.95–1.20)	1.06 (0.95–1.19)
2	≥2		1.47 (1.29–1.67)***	1.45 (1.27–1.65)***	1.34 (1.18–1.52)***	1.33 (1.17–1.52)***
3						
4	Smoking status					
5	Never/past smoker (ref.)			1.00	1.00	1.00
6	Current smoker			1.02 (0.88–1.18)	1.00 (0.86–1.15)	1.00 (0.86–1.16)
7						
8	Alcohol consumption					
9	No (ref.)			1.00	1.00	1.00
10	Yes			0.96 (0.79–1.17)	0.95 (0.78–1.15)	0.94 (0.78–1.14)
11						
12	Moderate/vigorous physical exercise					
13	0 (ref.)			1.00	1.00	1.00
14	<1.5			1.03 (0.88–1.20)	1.04 (0.89–1.22)	1.06 (0.90–1.23)
15	1.5–3.0			1.10 (0.94–1.30)	1.10 (0.94–1.30)	1.12 (0.95–1.31)
16	3.1–5.5			0.93 (0.80–1.09)	0.96 (0.82–1.12)	0.97 (0.83–1.13)
17	>5.5			0.83 (0.70–0.98)*	0.87 (0.74–1.03)	0.88 (0.74–1.04)
18						
19	Number of chronic physical health conditions					
20	0 (ref.)			1.00	1.00	1.00
21	1			1.02 (0.91–1.14)	1.00 (0.89–1.12)	1.00 (0.89–1.12)
22	≥ 2			1.35 (1.17–1.55)***	1.29 (1.13–1.48)***	1.29 (1.12–1.48)***
23						
24	Depression/anxiety					
25	No (ref.)				1.00	1.00
26	Yes				1.92 (1.61–2.15)***	1.83 (1.62–2.06)***
27						
28	Neuroticism					
29	0 (Low) (ref.)					1.00
30	1					1.08 (0.89–1.31)
31	2					1.08 (0.86–1.36)
32	3					1.09 (0.89–1.32)
33	4 (High)					1.26 (1.03–1.55)*
34						
35	Survey wave					
36	1 (ref)	1.00	1.00	1.00	1.00	1.00
37	2	0.91 (0.80–1.03)	0.90 (0.79–1.03)	0.91 (0.80–1.04)	0.90 (0.79–1.03)	0.92 (0.81–1.05)
38	3	1.08 (0.96–1.23)	1.07 (0.95–1.22)	1.08 (0.94–1.23)	1.04 (0.91–1.19)	1.06 (0.92–1.21)
39	4	0.89 (0.77–1.02)	0.88 (0.76–1.02)	0.92 (0.78–1.08)	0.87 (0.74–1.02)	0.89 (0.75–1.05)

*p<0.05; **p<0.01; ***p<0.001. a – number of psychosocial job adversities.

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Table 4. Odds ratios and 95% confidence intervals from longitudinal random-intercept logistic regression models assessing the relationship between psychosocial job quality and functional impairment

	Model 1 (adjusted for time only)	Model 2 (within- and between-person terms)	Model 3 (adding socio-demographic covariates, childhood adversity and non-work events)	Model 4 (adding health covariates)	Model 5 (adding depression/anxiety)	Model 6 (adding neuroticism)
Original job quality score (0-3) ^a	1.60 (1.47–1.74)***					
Job quality deviation score		1.30 (1.17–1.43)***	1.27 (1.15–1.41)***	1.28 (1.15–1.42)***	1.16 (1.05–1.30)**	1.17 (1.05–1.30)**
Average job quality across waves		2.50 (2.15–2.90)***	2.16 (1.87–2.49)***	2.14 (1.86–2.47)***	1.49 (1.40–1.71)***	1.34 (1.17–1.54)***
Sex						
Male (ref.)			1.00	1.00	1.00	1.00
Female			1.21 (1.02–1.43)*	1.17 (0.99–1.39)	1.11 (0.95–1.30)	1.05 (0.90–1.24)
Partner						
Having a partner			1.00	1.00	1.00	1.00
No partner			1.26 (1.05–1.51)*	1.26 (1.05–1.51)*	1.26 (1.05–1.50)*	1.23 (1.03–1.47)*
Education completion						
Incomplete high school (ref.)			1.00	1.00	1.00	1.00
Completion of high school			0.97 (0.78–1.21)	0.98 (0.79–1.22)	1.01 (0.82–1.24)	1.00 (0.81–1.23)
Completion of tertiary study			1.21 (0.96–1.53)	1.27 (1.01–1.61)*	1.39 (1.12–1.74)**	1.38 (1.10–1.72)**
Occupational skill level						
High (ref.)			1.00	1.00	1.00	1.00
Medium			1.06 (0.89–1.27)	1.06 (0.89–1.26)	1.03 (0.87–1.23)	1.02 (0.86–1.21)
Low			0.75 (0.60–0.94)*	0.73 (0.59–0.91)**	0.78 (0.63–0.97)*	0.78 (0.62–0.97)*
Parental responsibilities						
No (ref.)			1.00	1.00	1.00	1.00
Yes			0.80 (0.68–0.94)**	0.82 (0.70–0.96)*	0.82 (0.70–0.96)*	0.81 (0.69–0.95)***
Financial hardship						
No (ref.)			1.00	1.00	1.00	1.00
Yes			1.92 (1.61–2.29)***	1.91 (1.60–2.28)***	1.59 (1.43–1.90)***	1.60 (1.34–1.91)***
Childhood adversity (wave 1)						
No (ref.)			1.00	1.00	1.00	1.00
Yes			1.81 (1.51–2.17)***	1.78 (1.49–2.13)***	1.54 (1.40–1.82)***	1.47 (1.24–1.74)***
Adverse non-work life events						
0 (ref.)			1.00	1.00	1.00	1.00
1			1.35 (1.17–1.57)***	1.33 (1.15–1.54)***	1.25 (1.08–1.45)**	1.24 (1.07–1.44)**

≥2			2.11 (1.77–2.51)***	2.07 (1.74–2.47)***	1.78 (1.49–2.12)***	1.76 (1.48–2.11)***
Smoking status						
Never/past smoker (ref.)				1.00	1.00	1.00
Current smoker				0.99 (0.79–1.22)	0.89 (0.72–1.09)	0.87 (0.71–1.08)
Alcohol consumption						
No (ref.)				1.00	1.00	1.00
Yes				1.19 (0.91–1.55)	1.17 (0.90–1.52)	1.13 (0.87–1.47)
Moderate/vigorous physical exercise						
0 (ref.)				1.00	1.00	1.00
<1·5				0.97 (0.79–1.20)	1.01 (0.81–1.25)	1.03 (0.83–1.27)
1·5–3·0				1.15 (0.92–1.43)	1.16 (0.92–1.45)	1.21 (0.97–1.51)
3·1–5·5				0.80 (0.65–0.99)*	0.87 (0.71–1.07)	0.90 (0.73–1.11)
>5·5				0.75 (0.59–0.93)*	0.83 (0.66–1.04)	0.86 (0.69–1.08)
Number of chronic physical health conditions						
0 (ref.)				1.00	1.00	1.00
1				1.27 (1.09–1.48)**	1.21 (1.04–1.41)*	1.22 (1.04–1.42)*
≥ 2				1.63 (1.33–1.99)***	1.53 (1.25–1.87)***	1.53 (1.25–1.87)***
Depression/anxiety						
No (ref.)					1.00	1.00
Yes					7.75 (6.07–9.14)***	6.68 (5.63–7.92)***
Neuroticism						
0 (Low) (ref.)						1.00
1						1.24 (0.94–1.63)
2						1.54 (1.11–2.12)**
3						1.82 (1.38–2.40)***
4 (High)						2.32 (1.72–3.11)***
Survey wave						
1 (ref.)	1.00	1.00	1.00	1.00	1.00	1.00
2	0.99 (0.85–1.16)	0.96 (0.82–1.12)	0.95 (0.81–1.11)	0.94 (0.80–1.10)	1.01 (0.85–1.19)	1.00 (0.85–1.18)
3	1.08 (0.92–1.26)	1.04 (0.88–1.21)	0.98 (0.82–1.16)	0.92 (0.77–1.09)	0.97 (0.81–1.16)	0.97 (0.81–1.16)
4	0.96 (0.80–1.15)	0.94 (0.79–1.12)	0.88 (0.72–1.08)	0.79 (0.64–0.98)*	0.85 (0.69–1.05)	0.83 (0.67–1.03)

*p<0.05; **p<0.01; ***p<0.001. a – number of psychosocial job adversities.

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Figures

Figure 1. Study profile

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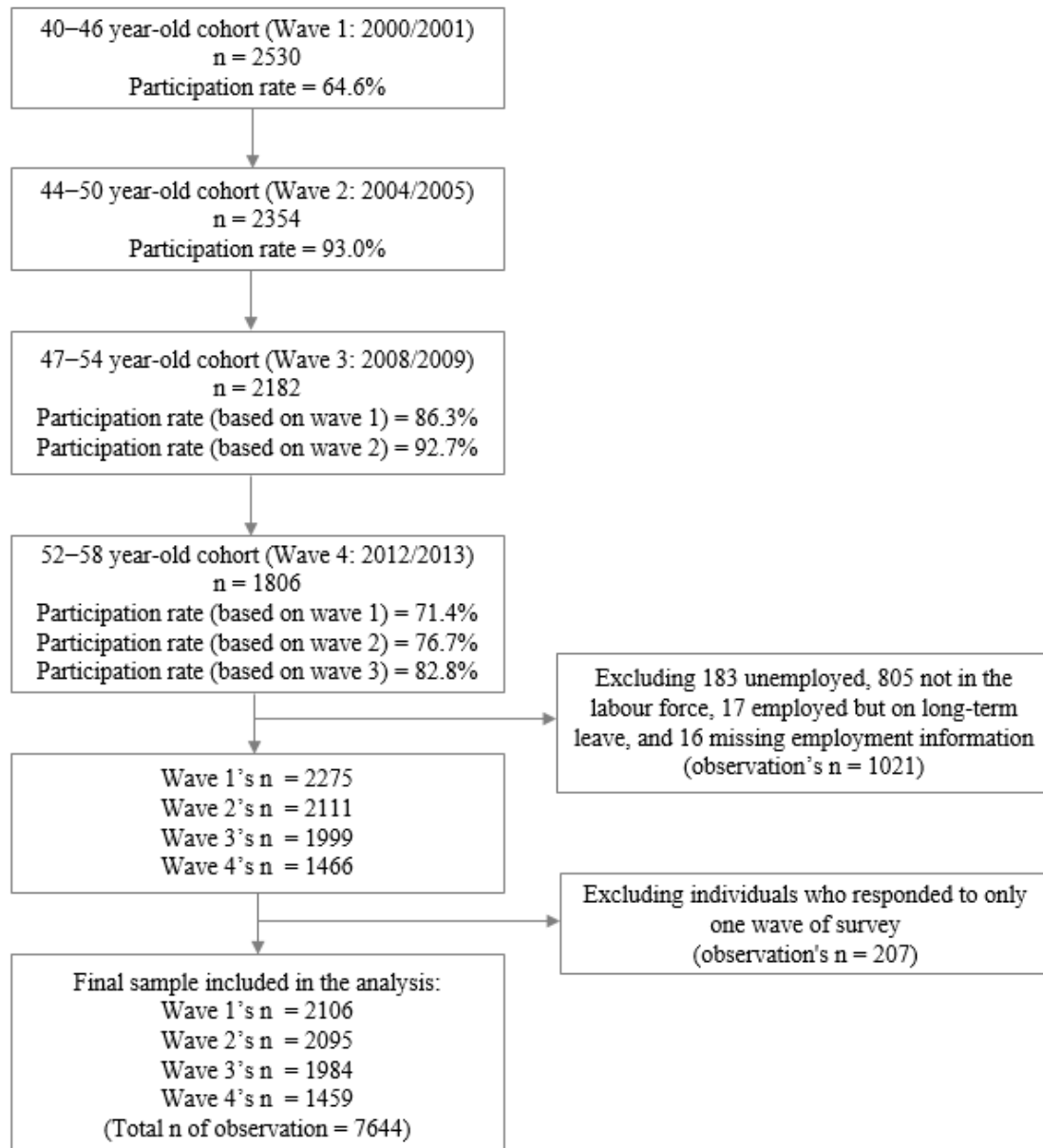


Table S1. Odds ratios and 95% confidence intervals from longitudinal random-intercept logistic regression models assessing the relationship between psychosocial job quality and any sickness absence.

	Model 1 (adjusted for time only)	Model 2 (within- and between-person terms)	Model 3 (adding socio-demographic covariates, childhood adversity and non-work events)	Model 4 (adding health covariates)	Model 5 (adding depression/anxiety)	Model 6 (adding neuroticism)
Original job quality score (0-3) ^a	1.27 (1.17–1.37)***					
Job quality deviation score		1.20 (1.08–1.33)**	1.18 (1.06–1.31)**	1.18 (1.06–1.32)**	1.14 (1.02–1.26)**	1.14 (1.02–1.27)**
Average job quality across waves		1.37 (1.21–1.56)***	1.24 (1.09–1.42)**	1.24 (1.09–1.41)**	1.08 (0.95–1.23)	1.05 (0.91–1.19)
Sex						
Male (ref.)			1.00	1.00	1.00	1.00
Female			1.36 (1.17–1.59)***	1.32 (1.13–1.55)**	1.30 (1.12–1.52)**	1.28 (1.10–1.50)
Partner						
Having a partner			1.00	1.00	1.00	1.00
No partner (ref.)			1.41 (1.19–1.67)***	1.41 (1.18–1.67)***	1.38 (1.17–1.64)***	1.37 (1.16–1.63)
Education completion						
Incomplete high school (ref.)			1.00	1.00	1.00	1.00
Completion of high school			1.00 (0.82–1.22)	0.99 (0.81–1.21)	1.00 (0.82–1.22)	1.00 (0.82–1.22)
Completion of tertiary study			0.97 (0.78–1.20)	0.98 (0.79–1.22)	1.03 (0.83–1.27)	1.02 (0.83–1.27)
Occupational skill level						
High (ref.)			1.00	1.00	1.00	1.00
Medium			1.03 (0.86–1.22)	1.03 (0.87–1.23)	1.03 (0.87–1.22)	1.02 (0.86–1.22)
Low			0.87 (0.71–1.08)	0.87 (0.71–1.08)	0.91 (0.73–1.12)	0.90 (0.73–1.12)
Parental responsibilities						
No (ref.)			1.00	1.00	1.00	1.00
Yes			1.06 (0.90–1.24)	1.07 (0.91–1.25)	1.06 (0.91–1.25)	1.06 (0.91–1.24)
Financial hardship						
No (ref.)			1.00	1.00	1.00	1.00
Yes			1.28 (1.07–1.53)**	1.26 (1.05–1.51)**	1.17 (0.98–1.41)	1.17 (0.97–1.40)
Childhood adversity (wave 1)						
No (ref.)			1.00	1.00	1.00	1.00
Yes			1.41 (1.20–1.65)***	1.40 (1.19–1.64)***	1.31 (1.12–1.54)**	1.29 (1.10–1.52)*
Adverse non-work life events						

0 (ref.)			1.00	1.00	1.00	1.00
1			1.11 (0.96–1.28)	1.09 (0.94–1.26)	1.06 (0.91–1.23)	1.05 (0.91–1.24)
≥2			1.63 (1.36–1.96)***	1.60 (1.34–1.93)***	1.49 (1.24–1.79)***	1.48 (1.23–1.78)***
Smoking status						
Never/past smoker (ref.)				1.00	1.00	1.00
Current smoker				0.97 (0.79–1.20)	0.94 (0.76–1.15)	0.94 (0.76–1.15)
Alcohol consumption						
No (ref.)				1.00	1.00	1.00
Yes				0.94 (0.72–1.22)	0.92 (0.71–1.20)	0.92 (0.71–1.19)
Moderate/vigorous physical exercise						
0 (ref.)				1.00	1.00	1.00
<1.5				1.08 (0.87–1.32)	1.09 (0.88–1.34)	1.10 (0.90–1.36)
1.5–3.0				1.19 (0.96–1.49)	1.20 (0.97–1.50)	1.22 (0.98–1.52)
3.1–5.5				0.94 (0.76–1.15)	0.97 (0.79–1.20)	0.98 (0.80–1.21)
>5.5				0.83 (0.66–1.03)	0.87 (0.70–1.09)	0.89 (0.71–1.10)
Number of chronic physical health conditions						
0 (ref.)				1.00	1.00	1.00
1				1.00 (0.86–1.16)	0.98 (0.84–1.14)	0.98 (0.84–1.14)
≥ 2				1.48 (1.22–1.79)***	1.42 (1.17–1.72)***	1.41 (1.16–1.71)***
Depression/anxiety						
No (ref.)					1.00	1.00
Yes					2.19 (1.67–2.56)***	2.06 (1.75–2.43)***
Neuroticism						
0 (Low) (ref.)						1.00
1						1.13 (0.87–1.46)
2						1.13 (0.82–1.54)
3						1.13 (0.87–1.47)
4 (High)						1.41 (1.06–1.87)**
Survey wave						
1 (ref.)	1.00	1.00	1.00	1.00	1.00	1.00
2	0.89 (0.75–1.04)	0.88 (0.75–1.03)	0.89 (0.75–1.05)	0.87 (0.74–1.03)	0.90 (0.76–1.06)	0.90 (0.76–1.06)
3	1.10 (0.94–1.29)	1.09 (0.93–1.28)	1.08 (0.91–1.29)	1.05 (0.88–1.25)	1.07 (0.90–1.28)	1.07 (0.89–1.27)
4	0.84 (0.70–1.01)	0.84 (0.70–1.00)	0.88 (0.72–1.08)	0.81 (0.66–1.01)	0.84 (0.68–1.05)	0.84 (0.68–1.04)

*p<0.05; **p<0.01; ***p<0.001. a – number of psychosocial job adversities.

Table S2. Odds ratios and 95% confidence intervals from longitudinal random-intercept logistic regression models assessing the relationship between psychosocial job quality and longer sickness absence (≥ 5 days).

	Model 1 (adjusted for time only)	Model 2 (within- and between-person terms)	Model 3 (adding socio-demographic covariates, childhood adversity and non-work events)	Model 4 (adding health covariates)	Model 5 (adding depression/anxiety)	Model 6 (adding neuroticism)
Original job quality score (0-3) ^a	1.53 (1.34–1.76)***					
Job quality deviation score		1.47 (1.22–1.79)***	1.40 (1.15–1.70)***	1.39 (1.14–1.69)***	1.33 (1.09–1.62)**	1.33 (1.09–1.62)**
Average job quality across waves		1.60 (1.31–1.94)***	1.37 (1.12–1.67)***	1.36 (1.12–1.66)**	1.17 (0.96–1.43)	1.18 (0.96–1.45)
Sex						
Male (ref.)			1.00	1.00	1.00	1.00
Female			1.06 (.83–1.36)	1.04 (0.81–1.33)	1.02 (0.79–1.30)	1.02 (0.80–1.32)
Partner						
Having a partner			1.00	1.00	1.00	1.00
No partner (ref.)			1.24 (.94–1.64)	1.22 (.92–1.61)	1.21 (0.89–1.30)	1.21 (0.91–1.59)
Education completion						
Incomplete high school (ref.)			1.00	1.00	1.00	1.00
Completion of high school			0.80 (0.59–1.09)	0.82 (0.61–1.11)	0.82 (0.60–1.11)	0.83 (0.61–1.13)
Completion of tertiary study			0.73 (0.52–1.02)	0.78 (0.56–1.10)	0.81 (0.58–1.14)	0.83 (0.59–1.18)
Occupational skill level						
High (ref.)			1.00	1.00	1.00	1.00
Medium			1.10 (0.81–1.48)	1.08 (0.80–1.46)	1.07 (0.80–1.45)	1.09 (0.92–1.59)
Low			1.02 (0.72–1.45)	0.97 (0.69–1.38)	1.00 (0.70–1.42)	1.02 (0.71–1.45)
Parental responsibilities						
No (ref.)			1.00	1.00	1.00	1.00
Yes			1.17 (0.89–1.55)	1.20 (0.91–1.58)	1.21 (0.92–1.60)	1.21 (0.92–1.59)
Financial hardship						
No (ref.)			1.00	1.00	1.00	1.00
Yes			1.57 (1.19–2.08)***	1.51 (1.14–1.99)**	1.37 (1.03–1.82)*	1.38 (1.04–1.83)*
Childhood adversity (wave 1)						
No (ref.)			1.00	1.00	1.00	1.00
Yes			1.57 (1.23–2.01)***	1.56 (1.22–1.99)***	1.46 (1.14–1.87)**	1.46 (1.14–1.86)**
Adverse non-work life events						

0 (ref.)			1.00	1.00	1.00	1.00
1			1.62 (1.23–2.13)***	1.58 (1.20–2.07)**	1.53 (1.16–2.01)**	1.53 (1.16–2.01)**
≥2			2.51 (1.86–3.39)***	2.44 (1.80–3.30)***	2.23 (1.64–3.02)***	2.24 (1.65–3.04)***
Smoking status						
Never/past smoker (ref.)				1.00	1.00	1.00
Current smoker				1.17 (0.85–1.61)	1.14 (0.83–1.57)	1.15 (0.84–1.58)
Alcohol consumption						
No (ref.)				1.00	1.00	1.00
Yes				1.22 (0.81–1.85)	1.21 (0.80–1.83)	1.20 (0.79–1.82)
Moderate/vigorous physical exercise						
0 (ref.)				1.00	1.00	1.00
<1.5				0.96 (0.67–1.36)	0.97 (0.68–1.38)	0.97 (0.68–1.38)
1.5–3.0				0.84 (0.57–1.24)	0.84 (0.57–1.24)	0.83 (0.56–1.23)
3.1–5.5				0.79 (0.56–1.14)	0.83 (0.58–1.19)	0.83 (0.58–1.19)
>5.5				0.81 (0.56–1.17)	0.86 (0.59–1.25)	0.85 (0.59–1.24)
Number of chronic physical health conditions						
0 (ref.)				1.00	1.00	1.00
1				1.04 (0.79–1.36)	1.01 (0.77–1.33)	1.01 (0.76–1.32)
≥ 2				1.37 (1.00–1.87)*	1.29 (0.94–1.77)	1.28 (0.93–1.76)
Depression/anxiety						
No (ref.)					1.00	1.00
Yes					2.21 (1.61–2.86)***	2.22 (1.69–2.93)***
Neuroticism						
0 (Low) (ref.)						1.00
1						0.67 (0.43–1.05)
2						1.04 (0.64–1.69)
3						0.77 (0.50–1.19)
4 (High)						0.81 (0.83–1.83)
Survey wave						
1 (ref.)	1.00	1.00	1.00	1.00	1.00	1.00
2	0.91 (0.66–1.25)	0.90 (0.66–1.24)	0.94 (0.68–1.31)	0.93 (0.67–1.30)	0.97 (0.70–1.35)	0.97 (0.70–1.35)
3	1.23 (0.91–1.66)	1.22 (0.90–1.65)	1.28 (0.92–1.77)	1.23 (0.88–1.71)	1.28 (0.92–1.78)	1.27 (0.91–1.77)
4	1.06 (0.75–1.49)	1.05 (0.75–1.48)	1.24 (0.85–1.82)	1.17 (0.79–1.73)	1.23 (0.83–1.83)	1.24 (0.83–1.83)

*p<0.05; **p<0.01; ***p<0.001. a – number of psychosocial job adversities.

Table S3. Odds ratios and 95% confidence intervals from longitudinal random-intercept negative binomial regression models assessing the relationship between psychosocial job quality categories 0-3 and the number of days of sickness absence

	Model 1 (adjusted for time only)	Model 2 (within- and between-person terms)	Model 3 (adding socio-demographic covariates, childhood adversity and non-work events)	Model 4 (adding health covariates)	Model 5 (adding depression/anxiety)	Model 6 (adding neuroticism)
Original job quality score						
0	1.00	1.00	1.00	1.00	1.00	1.00
1	1.14 (0.98-1.32)	1.07 (0.91-1.27)	1.08 (0.92-1.27)	1.08 (0.92-1.28)	1.06 (0.90-1.25)	1.06 (0.90-1.25)
2	1.58 (1.31-1.91)**	1.42 (1.13-1.78)**	1.39 (1.20-1.75)**	1.39 (1.10-1.75)**	1.28 (1.02-1.62)*	1.29 (1.02-1.62)**
3	2.16 (1.53-3.06)**	1.84 (1.23-2.74)**	1.68 (1.12-2.51)**	1.73 (1.15-2.59)**	1.52 (1.01-2.28)*	1.54 (1.02-2.31)**
Average job quality across waves		1.15 (0.97-1.36)	1.06 (0.90-1.25)	1.05 (0.89-1.24)	0.95 (0.81-1.12)	0.92 (0.78-1.09)
Sex						
Male (ref.)			1.00	1.00	1.00	1.00
Female			1.37 (1.17-1.59)***	1.32 (1.13-1.55)***	1.31 (1.12-1.52)**	1.28 (1.10-1.50)**
Partner						
Having a partner			1.00	1.00	1.00	1.00
No partner (ref.)			1.41 (1.19-1.68)***	1.41 (1.19-1.67)***	1.38 (1.17-1.64)***	1.37 (1.16-1.63)***
Education completion						
Incomplete high school (ref.)			1.00	1.00	1.00	1.00
Completion of high school			1.00 (0.82-1.22)	0.99 (0.81-1.21)	1.00 (0.82-1.22)	1.00 (0.82-1.22)
Completion of tertiary study			0.97 (0.79-1.21)	0.99 (0.79-1.22)	1.03 (0.83-1.27)	1.03 (0.83-1.27)
Occupational skill level						
High (ref.)			1.00	1.00	1.00	1.00
Medium			1.03 (0.87-1.22)	1.03 (0.87-1.23)	1.03 (0.87-1.22)	1.02 (0.86-1.22)
Low			0.87 (0.72-1.45)	0.87 (0.71-1.08)	0.91 (0.73-1.12)	0.90 (0.73-1.11)
Parental responsibilities						
No (ref.)			1.00	1.00	1.00	1.00
Yes			1.06 (0.91-1.24)	1.07 (0.91-1.25)	1.07 (0.91-1.25)	1.06 (0.91-1.24)
Financial hardship						
No (ref.)			1.00	1.00	1.00	1.00
Yes			1.28 (1.06-1.53)**	1.26 (1.05-1.51)**	1.17 (0.97-1.40)	1.17 (0.97-1.40)
Childhood adversity (wave 1)						

No (ref.)			1.00	1.00	1.00	1.00
Yes			1.40 (1.19–1.65)***	1.39 (1.18–1.63)***	1.31 (1.12–1.54)**	1.29 (1.10–1.51)**
Adverse non-work life events						
0 (ref.)			1.00	1.00	1.00	1.00
1			1.11 (0.96–1.28)	1.09 (0.94–1.26)	1.06 (0.91–1.23)**	1.05 (0.91–1.22)
≥2			1.63 (1.36–1.96)***	1.60 (1.34–1.92)***	1.49 (1.24–1.79)***	1.48 (1.23–1.77)***
Smoking status						
Never/past smoker (ref.)				1.00	1.00	1.00
Current smoker				0.97 (0.79–1.19)	0.94 (0.76–1.15)	0.94 (0.76–1.15)
Alcohol consumption						
No (ref.)				1.00	1.00	1.00
Yes				0.94 (0.73–1.22)	0.93 (0.71–1.20)	0.92 (0.71–1.20)
Moderate/vigorous physical exercise						
0 (ref.)				1.00	1.00	1.00
<1-5				1.08 (0.88–1.33)	1.09 (0.89–1.34)	1.11 (0.90–1.36)
1-5-3-0				1.19 (0.96–1.49)	1.20 (0.97–1.50)	1.22 (0.98–1.52)
3-1-5-5				0.94 (0.76–1.15)	0.97 (0.79–1.19)	0.98 (0.80–1.21)
>5-5				0.83 (0.66–1.03)	0.87 (0.70–1.09)	0.88 (0.71–1.10)
Number of chronic physical health conditions						
0 (ref.)				1.00	1.00	1.00
1				1.00 (0.86–1.16)	0.98 (0.84–1.14)	0.98 (0.84–1.14)
≥ 2				1.48 (1.22–1.79)***	1.42 (1.17–1.72)***	1.41 (0.16–1.71)***
Depression/anxiety						
No (ref.)					1.00	1.00
Yes					2.18 (1.76–2.55)***	2.05 (1.74–2.42)***
Neuroticism						
0 (Low) (ref.)						1.00
1						1.13 (0.87–1.47)
2						1.13 (0.83–1.55)
3						1.14 (0.87–1.48)
4 (High)						1.42 (1.07–1.88)*
Survey wave						
1 (ref.)	1.00	1.00	1.00	1.00	1.00	1.00

2	0.89 (0.75–1.04)	0.88 (0.75–1.03)	0.89 (0.75–1.05)	0.87 (0.74–1.03)	0.90 (0.75–1.06)	0.90 (0.76–1.06)
3	1.10 (0.94–1.29)	1.09 (0.93–1.28)	1.09 (0.91–1.29)	1.05 (0.88–1.25)	1.07 (0.90–1.28)	1.07 (0.89–1.27)
4	0.84 (0.70–1.01)	0.84 (0.70–1.00)	0.88 (0.72–1.08)	0.81 (0.66–1.01)	0.84 (0.68–1.05)	0.84 (0.68–1.04)

*p<0.05; **p<0.01; ***p<0.001. a – number of psychosocial job adversities.

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STROBE Statement—Checklist of items that should be included in reports of *cohort studies*

	Item No	Recommendation	Page No
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract (b) Provide in the abstract an informative and balanced summary of what was done and what was found	1&3 3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4-5
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	5-6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5-6
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up (b) For matched studies, give matching criteria and number of exposed and unexposed	6 NA
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	7-10
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	7-10
Bias	9	Describe any efforts to address potential sources of bias	6
Study size	10	Explain how the study size was arrived at	6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7-10
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding (b) Describe any methods used to examine subgroups and interactions (c) Explain how missing data were addressed (d) If applicable, explain how loss to follow-up was addressed (e) Describe any sensitivity analyses	11-12 NA 12 12 NA
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed (b) Give reasons for non-participation at each stage (c) Consider use of a flow diagram	6, 19 (Fig 1) 6 19 (Fig 1)
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders (b) Indicate number of participants with missing data for each variable of interest (c) Summarise follow-up time (eg, average and total amount)	12-13 12, 20-21 (Table 1) 6, 19 (Fig 1)
Outcome data	15*	Report numbers of outcome events or summary measures over time	11-12, 22 (Table 2)

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2			
3	Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included
4			12-13 (Tables 4-3)
5			
6			7-10
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8			
9			
10	Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses
11			NA
12			
13	Discussion		
14	Key results	18	Summarise key results with reference to study objectives
15			14
16	Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias
17			15-16
18	Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence
19			14-15
20	Generalisability	21	Discuss the generalisability (external validity) of the study results
21			15
22	Other information		
23	Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based
24			17
25			

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at <http://www.strobe-statement.org>.

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Poor psychosocial job conditions increase sickness absence: Evidence from the PATH Through Life Mid-Aged Cohort

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Poor psychosocial job conditions increase sickness absence: Evidence from the PATH Through Life Mid-Aged Cohort

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Abstract

Objectives: Evidence is mounting that poor psychosocial job conditions increase sickness absence, but there is a need for further rigorous prospective research to isolate the influence of psychosocial job quality from other measured and unmeasured confounders. This study used four waves of prospective longitudinal data (spanning 12 years) to investigate the extent to which increases in poor psychosocial job quality are associated with greater relative risk of day of sickness absence.

Design: Prospective cohort study.

Setting: Data was from the Australian PATH Through Life cohort study. The analyses adopted hybrid-regression estimations that isolated the effect of within-person change in psychosocial job quality on sickness absence over time.

Participants: Participants were from a midlife cohort aged 40-44 at baseline (7644 observations from 2221 participants).

Primary outcome measure: Days sickness absence in the past four weeks.

Results: The results show that after adjusting for a wide range of factors, as well as unmeasured between-person differences in job quality, each additional psychosocial job adversity was associated with a 12% increase in the number of days of sickness absence (Relative Risk Ratio: 1.12, 95% CI:1.03–1.21). Increases in psychosocial job adversity were also related to greater functional impairment (Relative Risk Ratio: 1.17 (1.05–1.30).

Conclusion: The results of this study strengthen existing research highlighting the importance of addressing poor psychosocial job quality as a risk factor for sickness absence.

Key words: sickness absence, job quality, psychosocial job stressors, functional limitations.

Article Summary

Strengths and limitations of this study

- Findings are based on robust longitudinal cohort data (spanning 12 years) with the original sample randomly selected from the population.
- Adjustments are made for a wide variety of personal, health and demographic predictors of sickness absence, including variables rarely controlled for in prior research (i.e. early life adversities and personality characteristics).
- The main weakness of this study is potential lack of generalisability due to the restricted geographical area from which the sample was recruited (in a city with a preponderance of more highly educated professionals and public servants) and the narrow midlife cohort (aged 40–44 at baseline).
- It is also important to note that both exposures and outcomes are self-reported and thus may be subject to residual reporting bias.

Introduction

Absence from work due to sickness is an important issue in public health. Previous studies have noted that sickness absence is predictive of chronic health conditions^{1,2} and mortality^{1,2}, as well as exit from the workforce³. The broader economic and social costs associated with sickness absence are substantial, running into the tens of billions of dollars for many countries^{4,5}. From a population health perspective, identifying the causes of sickness absence that are amenable to intervention is critical – to reduce both sickness absence and the subsequent adverse health-related consequences.

We know the causes of sickness absence are complex and inter-related, including factors connected to the nature of the illness, the industry a person is employed in, gender⁶, and income⁷. Given a broad range of factors contribute, there is still debate about the extent to which work-related environmental influences, and in particular *psychosocial job stressors* (such as low levels of job control, high job demands, and job insecurity), contribute to sickness absence^{4,8-11}. A 2012 longitudinal study based on the British Birth Cohort⁹ recommended a “life course” perspective, arguing the importance of taking childhood disadvantage, education, coping styles, and personality into consideration. The study concludes by stating that “a greater understanding of the ways in which occupational risk factors interact with individual vulnerabilities across the life-course is required” (p.1).

Building upon this 2012 cohort study, several other longitudinal studies have sought to investigate the contribution of psychosocial job quality to sickness absence whilst controlling for a broad range of possible influences. For example, Wang et al. (2014) analysed data from the Norwegian Hordaland Health Study and found that job strain was associated with long-term sickness absence (>16 days per year) one year later after adjusting for education,

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3 income, BMI, physical and mental health, and health-related behaviours ¹²; however this
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5 research did not adjust for early life adversities or personality characteristics. In addition, no
6
7 information was included about how psychosocial job quality might influence number of
8
9 days of sickness absence (only a binary indicator of long sickness absence was included).
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11 This information is important as individual and organisational costs vary based on the length
12
13 of sickness absence ^{3, 13, 14}. Other longitudinal research conducted in Australia by Milner et al.
14
15 (2015) included a measure of days of sickness absence in the past 12 months and found that
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17 exposure to three or more psychosocial job adversities was associated with an 11% increase
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19 in days of sick leave ¹¹. However, this research made no adjustment for early life adversities
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21 or personality characteristics.
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29 The current study also examines psychosocial job conditions and sick leave in the Australian
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31 context - adopting an outcome measure of days of sickness absence over a brief 4-week
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33 period. Australia has a different system from most European countries (where much of the
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35 research on psychosocial job conditions and health originates). In Australia, paid sick leave is
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37 provided by employers rather than being government funded/supported and sick leave is
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39 accrued over time with an employer (in general, 10 days accrue per year for full-time workers
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41 and pro-rata for part-time workers).¹⁵ While the pool of available sick leave days accumulates
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43 with time with the same employer, if an employee changes employer they lose all their pre-
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45 existing sick leave entitlement. If employees do exhaust all of their accrued sick leave days
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47 they can utilise other leave or may be able to take unpaid leave. In addition, employers can
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49 ask employees to provide evidence (e.g. medical certificate from a health professional) for as
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51 little as 1 day or less off work. For further context, around 20% of Australian workers is
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53 employed on a casual basis and usually have no paid leave entitlements ¹⁶.
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3 This system affects the amount of paid sick leave Australian workers have and how sickness
4 absences are taken (as also explained in Lallukka et al. 2021¹⁷). The average frequency and
5 duration of sick leave in Australia is likely lower than in many European countries, although
6 exact figures are unknown as there are no national administrative records on sickness
7 absences in Australia. The current study adopts an outcome measure of days of sickness
8 absence over a brief 4-week period. While this is a short reference period compared to others
9 used in the existing literature, it reflects the lower levels of leave taken in the context of the
10 Australian system.
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24 The current study uses four waves of Australian cohort data (spanning 12 years) to examine
25 increases in psychosocial job adversity in association with increased days of sickness
26 absence. The analyses uniquely control for influences across the life course, from childhood
27 adversities to proximal adverse life events, as well as personality and health-related
28 conditions. In addition, hybrid analyses isolate and adjust for unmeasured differences in
29 psychosocial job quality between individuals. By controlling for a wide range of confounders,
30 and removing the influence of unmeasured differences between individuals (i.e. accounting
31 for person-related predisposition for reporting psychosocial job stressors), we increase
32 confidence in testing for a causal association between psychosocial job quality and sickness
33 absence. To complement days of sickness absence as an outcome, we also examine the effect
34 on functional impairment - defined as impairment at work due to physical/mental health
35 problems. Supplementary analyses were also conducted using the outcomes - a) any sickness
36 absence (no days, vs one or more days), and b) longer sickness absence (up to and including
37 4 days, vs 5 days or more (representing at least one working week)).
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Methods

Sample

Participants were from the PATH Through Life Project, a prospective community survey that commenced at the Australian National University (ANU) in 1999 and has been jointly hosted by the ANU and the University of New South Wales since 2019. The survey focuses on individual health and well-being trajectories across the life course and the sample includes three cohorts (young, midlife, and older adults) randomly selected from the Australian Electoral Rolls of Australian Capital Territory and neighbouring Queanbeyan¹⁸. The current study was restricted to the midlife cohort who were assessed every four years from wave 1 in 2000/2001 to wave 4 in 2012/2013. The participation rate of this cohort at baseline was 65% (2,530 participants). Of those who participated at baseline, 93% completed the survey at wave 2, 86% at wave 3, and 71% at wave 4 (Figure 1). For the first three waves, participants were usually assessed in their own home or at the Australian National University. They were invited to complete a questionnaire using a laptop computer under the supervision of a trained interviewer. For the fourth wave, participants were invited to complete an online version of the questionnaire. All participants provided informed consent to participate at each wave of the study, and each wave of data collection was approved by the Human Research Ethics Committee of the Australian National University.

We excluded observations from participants when they were: (i) not employed; (ii) not in the labour force; (iii) employed but on long-term leave; or (iv) had missing data on employment status in each wave (Figure 1). We also excluded participants with less than two waves of data.

--- Please insert Figure 1 ---

Patient and Public Involvement

The PATH study is a general population study and was formed based on pilot testing in Canberra community. There has been a regular feedback process for participants to engage with the study development and findings. PATH has long-standing ties to the Canberra community, with the data forming the basis of several local government reports, as well as regular engagement with both local and national stakeholders.

Measures

Outcome variables – Days sickness absence and functional impairment

‘Days of sickness absence’ was generated based on two items: ‘In the last four weeks, have you stayed away from your work (or school or place of study) for more than half a day because of any illness or injury that you had?’ and ‘How many days in the last 4 weeks have you stayed away from your work (or school, or place of study)?’ The first item offered two response categories (‘yes’ and ‘no’). Those who responded ‘no’ to the first item were classified as having zero day of sickness absence. These two questions were combined to generate the number of days of sickness absence in a four-week period. Two binary measures were also included in supplementary analyses - a) any sickness absence (‘0’ = no days, vs ‘1’ = one or more days), and b) longer sickness absence (‘0’ = ≤ 4 days, vs ‘1’ = ≥ 5 days (representing at least one working week)).

‘Functional impairment’ (secondary outcome) was generated based on four questions from the Short-Form Health Survey (SF-12)¹⁹ that asked whether participants had problems with work or regular daily activities over the past four weeks due to their physical or mental health. Respondents were asked if they: a) accomplished less than you would like as a result of your physical health?, b) were limited in the kind of work or other activities undertook as a result of

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3 your physical health?, c) accomplished less than you would like as a result of any emotional
4 problems?, d) did not do work or other activities as carefully as usual as a result of any
5 emotional problems?’ Participants who reported ‘yes’ to any of these items were classified as
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8 having functional impairment due to physical/mental health problems while those who
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10 indicated ‘no’ to all items were classified as not having functional impairment.
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17 *Exposure variable - Psychosocial job quality*

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19 Three aspects of job quality were used to calculate a composite measure of exposure to poor
20 job quality – job control, job demands and job insecurity. Job control and job demands were
21 assessed using 19 items taken from the Whitehall II study²⁰. Fifteen items assessed job control
22 and four assessed job demands. These items offered four response categories: ‘3-often’, ‘2-
23 sometimes’, ‘1-rarely’, and ‘0-never’. Following the methodology used in previous studies²¹,
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22, average total scores for job control and job demands were calculated and these scores were
then dichotomised to identify the top 30% of respondents with the greatest job adversity (i.e.
low job control, high job demands). One item: ‘How secure do you feel about your job or career
future in your current workplace?’ (responses: ‘not at all secure’, ‘moderately secure’, ‘secure’,
‘extremely secure’) was used to assess job insecurity. Individuals who selected either of the
first two responses were classified as having ‘1’ high job insecurity while all else were
classified as ‘0’ low job insecurity.

As in our previous research,^{23, 24} we used a composite indicator approach to generate an
estimate of overall psychosocial job adversity based on the sum of the three individual
indicators (i.e. low control, high demands, and high job insecurity), providing a count of
adversities between 0 and 3. In the analyses, this job quality score was separated into two
variables to represent both the within-person variability over time and between-person

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3 averaged differences. To do this, a variable representing within-person variability was
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5 calculated by subtracting the composite job quality score at each wave from the mean score
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7 across all waves (i.e. a change or deviation score was calculated at each wave). The (time-
8
9 invariant) mean score for overall job quality across all waves was used to estimate between
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11 person differences. This process of separating within and between-person components is
12
13 known as ‘demeaning’. Further details are provided in the statistical analyses section below.
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19 *Potential confounders*

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21 We adjusted for a range of variables that potentially confound the association of days of
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23 sickness absence from work with psychosocial job quality^{12,25}. These variables included time-
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25 invariant stable influences from baseline (i.e., gender, education, childhood adversity,
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27 neuroticism) and time-varying measures from each wave that might co-vary with changes in
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29 psychosocial job quality and sickness absence in the short term (i.e., partner status,
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31 occupational skill level, parental responsibilities, non-work life events, financial hardship,
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33 smoking status, alcohol consumption, physical exercise, chronic physical health conditions,
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35 and common mental disorders).
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42 Educational attainment was grouped as ‘incompleted high school’, ‘completed high school’,
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44 and ‘completed tertiary study’. Partner status included two categories: ‘no partner’ and
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46 ‘partnered’ (i.e. currently married or living with a partner). Occupational skill level consisted
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48 of three categories: ‘high’ (managers/administrators/professionals); ‘medium’ (associate
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50 professionals/tradespersons/advanced clerical and service workers); and ‘low’ (intermediate
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52 production and transport workers/elementary clerical, sales and service workers/labourers).
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54 Parental responsibilities were coded based on having a youngest child aged under 15 years.
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56 Financial hardship was derived from the item: ‘Have you or your family had to go without
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3 things you really needed in the last year because you were short of money?'. Respondents were
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5 considered to have financial hardship if they responded 'yes, often' or 'yes, sometimes'.
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10 For childhood adversity, participants were asked about childhood experiences up to the age of
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12 16 years and were categorised as having childhood adversity if they responded 'yes' to any of
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14 eight items (taken from the Parental Bonding Instrument ²⁶, the British National Survey of
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16 Health and Development ²⁷, the US National Comorbidity Survey ²⁸, or an open-ended question
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18 ²⁹). These items covered neglect, authoritarian upbringing, witnessing physical/sexual abuse,
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20 as well as verbal abuse, psychological abuse, physical abuse, physical punishment, and sexual
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22 abuse by a parent.
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28 Adverse life events were measured using an extended version of the List of Threatening
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30 Experiences Questionnaire ³⁰. Analyses included nine items about non-work adverse events in
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32 the past six months: serious illness/injury/assault, death of a close family member or friend,
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34 relationship separation, serious problems within close relationships, financial crisis, legal
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36 problems, and loss of something valuable. The number of life events were summed and divided
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38 into three categories: none, one, or two or more events.
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44 Smoking status was grouped into never/past smoker and current smoker. Hazardous/harmful
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46 alcohol consumption ³¹ was derived from the Alcohol Use Disorders Identification Test ³² and
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48 classified into 'yes' and 'no'. The hours respondents engaged in moderate or vigorous physical
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50 exercise per week was assessed by items from the Whitehall II study ³³ and categorized into
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52 five groups (0, < 1.5, 1.5–3, 3.1 – 5.5, > 5.5 hours). A variety of chronic physical health
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54 conditions such as heart problems, hypertension, cancer, arthritis, thyroid problems, epilepsy,
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3 asthma, diabetes, and stroke were coded as a summary variable representing the experience of
4 none, one, or two or more of these conditions.
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10 Depression and anxiety were assessed using the Goldberg Anxiety and Depression scales ³⁴.
11 Each scale comprises nine binary items ('yes' or 'no'); total scale score 0-9. Binary scores
12 representing likely depression and generalized anxiety disorder diagnosis were calculated
13 based on validated cut-points assessed against diagnosis from a structured diagnostic interview
14 (i.e. ≥ 5 on the depression scale and ≥ 7 on the anxiety scale) ³⁵. A binary measure of common
15 mental disorder at Wave 4 was then generated based on the presence of a likely depressive
16 and/or anxiety disorder.
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29 Neuroticism (the tendency to experience negative emotion) was included as a covariate as this
30 personality trait may influence self-reported job quality and sickness absence/functional
31 impairment and thus inflate the observed association. The measure of neuroticism was from
32 the Eysenck Personality Questionnaire ³⁶, and the scale total was categorised into quintiles.
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41 *Statistical analysis*

42 The association between job quality and days of sickness absence was assessed using a
43 longitudinal random-intercept negative binomial regression model with two levels, where
44 occasion clustered within individuals. There was overdispersion in the sickness absence
45 variable and hence a negative binomial distribution was chosen. This model fitted a fixed
46 (average) regression slope for the number of sickness absence days over time while permitting
47 the intercept to vary (to reflect the different initial number of sickness absence days for
48 individuals). Coefficients were transformed into relative risks (RRs). To assess the association
49 between job quality and functional impairment (a binary variable), we used a longitudinal
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4 random-intercept logistic regression model. Coefficients were transformed into odds ratios
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7 (ORs). A final series of supplementary analyses also used longitudinal regression models to
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10 test the associations between: a) job quality and any sickness absence (0 days, vs 1 or more
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13 days) and b) job quality and a longer period of sickness absence (≤ 4 days, vs ≥ 5 days).
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16 Further supplementary analyses also included psychosocial job quality as a categorical variable
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19 to confirm a dose-response relationship with days of sickness absence (whereby each additional
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22 job adversity is associated with an increase in the number of sickness absence days taken).
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27 In all models (sickness absence and functional impairment) associations with job quality were
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29 examined with hybrid-regression estimations that differentiated between- and within-
30
31 individual associations. The hybrid model is an extension of a random effects model with
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33 demeaning³⁷, in which both the person mean values of the exposure (capturing the between-
34
35 individual effect) and the person deviation scores from their mean (capturing the within-
36
37 individual effect) are included as regressors³⁸. The between-person association compared the
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39 risk of sickness absence between different individuals' based on their average level of job
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41 quality over time. The within-person association compared the risk of sickness absence across
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43 individuals' own changing levels of psychosocial job quality by controlling for all time-
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45 invariant factors, both observable and unobservable³⁷.
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52 In all models, an initial simple model included the original/raw measure of job quality (range
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54 0-3). The following model then separated the within-person (i.e. deviation score) and between-
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56 person (i.e. average score) components of the job quality measure. Relevant covariates across
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58 the lifecourse were then entered into subsequent models. Model 3 included sociodemographic
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3 covariates (some assessed at baseline and other more proximal factors assessed at wave three),
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5 childhood adversity, and recent non-work adverse life events. Followed by health-related
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7 covariates (smoking status, alcohol consumption, exercise and chronic health conditions)
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10 (model 4), depression/anxiety (model 5), and neuroticism (model 6).
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14 The proportion of observations with missing data on all variables was low, ranging from 0%
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16 to 1.5%. Our analyses were based on observations with no missing data (complete analyses).
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18 All analyses were conducted using StataSE 14 ³⁹.
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24 **Results**

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26 Descriptive characteristics at baseline (aged 40-44) are shown in Table 1. There was an equal
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28 split of males and females. The majority of the sample had completed a tertiary degree
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30 (40.4%), were working in high-skilled occupations (53.3%), and had parental responsibilities
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32 (65.8%). Data on the key exposure and outcome can be seen in Table 2. Across all waves
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34 41.7% of participants reported exposure to one job stressor, and close to 80% reported
35
36 exposure to one job stressor across any wave. The overall mean of job quality was 0.87 (SD =
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38 0.81). Across all waves, 8.4% of people reported taking one day and 13.8% reported taking 2
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40 or more days of sickness absence in a four-week period. In any wave, 24.6% reported one
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42 day of sickness absence in a four-week period, and 35.4% reported an average of two or more
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44 days in a four-week period. The mean of sickness absence days was 0.77 (SD = 2.61).
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47 Functional impairment was reported in 31.7% of people across all waves (up to 89.5% across
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49 any wave of data). Univariate tests of association showed that the physical and mental health
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51 variables (i.e. number of chronic health conditions, anxiety and/or depression, functional
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53 impairment) were all significantly associated with days of sickness absence ($p < .001$).
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3 --- Please insert Tables 1 and 2---
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8 Table 3 shows the findings for the association between job quality and sickness absence over
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10 time for the original/raw measure of job quality as well as the separated within-person (i.e.
11 deviation score) and between-person (i.e. average score) components. Model 1 shows that
12 each additional job adversity is associated with a 23% increase in the number of days of
13 sickness absence (RR 1.23, 95% CI 1.16-1.31). Model 2 shows that this represents both
14 within-person change in the number of job adversities experienced (RR 1.17, 95% CI 1.08-
15 1.27) and averaged differences in job quality between people (RR 1.31, 95% CI 1.20-1.43).
16
17 When adjusting for socio-demographic factors, adverse life events, health behaviours, and
18 other unmeasured between person differences in model 4, the results show that each
19 additional experience of job adversity is associated with a 15% increase in the number of
20 days of sickness absence. In the final model also adjusting for depression, anxiety and
21 neuroticism, there continues to be a 12% increase in days of sickness absence attributable to
22 each additional exposure to poor quality work.
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41 --- Please insert Table 3---
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45 Results for functional outcomes can be seen in Table 4. These results reflect a similar pattern
46 of results to those displayed in Table 3. Model 1 shows that each additional job adversity
47 (combining variation both within and between people) is associated with a 60% increase in
48 the odds of functional impairment (OR 1.60, 95% CI 1.47-1.74). Model 2 shows that this
49 represents both within-person change in the number of adversities experienced (OR 1.30,
50 95% CI 1.17-1.43) and averaged differences in job quality between people (OR 2.50, 95% CI
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3 2.15-2.90). In the final model (6) adjusting for all covariates, each additional job adversity
4 continues to be associated with a 17% increase in the odds of functional impairment.
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11 Supplementary analyses (see Tables S1, S2 and S3) adopted different operationalisations of
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13 the key sickness absence and job quality variables to explore the robustness of the findings.
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18 Tables S1 and S2 show that after adjusting for all covariates each additional exposure to poor
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20 quality work was associated with a 14% increase in the odds of taking any sickness absence
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22 within the last 4-week period and a 33% increase in the odds of taking sickness absence of at
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24 least 5 days. The final supplementary analyses (Table S3) included the psychosocial job
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26 quality measure as a categorical variable. The increase in the co-efficients with each
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28 additional job adversity provides support for a dose-response relationship whereby each
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30 additional job adversity is associated with an increase in the number of sickness absence days
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32 taken.
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42 **Discussion**

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44 This study found that when the number of psychosocial job adversities people experienced
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46 increased this change was accompanied by significantly greater sickness absence. This was
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48 found to be the case after controlling for childhood adversity, a range of individual health and
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50 personality variables, socio-demographic factors, and job characteristics. This suggests the
51
52 importance of not only person-related factors in the frequency of sickness absence, but also
53
54 job-related factors. Results for functional outcomes are similar, indicating that there are
55
56 comparable mechanisms explaining both sickness absence and functional health problems.
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3 Given that sickness absence generally indicates poor health, and that our findings were
4 replicated with functional impairment and in supplementary analyses, our findings can be
5 interpreted as an indication that poor psychosocial job conditions impact adversely on health.
6
7 However, we also note that there continues to be a within-person association after we control
8 for mental health and chronic health conditions, suggesting there are also other motivations
9 for taking time off from work in the context of psychosocial adversities at work – such as
10 potentially using sick leave as a coping mechanism or preventative health behaviour ⁴⁰.

11
12 The current results align with other studies finding that job strain ⁴¹ and low decision latitude
13 ⁹ are predictors of sickness absence, including previous longitudinal research that has
14 specifically examined changes in working conditions in association with changes in sickness
15 absence ^{11, 42}. For example, research from the British Whitehall II study (2006) compared
16 groups who did and did not change their psychosocial job conditions (across two follow-up
17 periods) and controlled for sex, age, occupational status, baseline health, alcohol, smoking
18 and BMI ⁴³. The results showed that decreased decision latitude, increased job demands and
19 decreased social support all predicted a greater risk of sickness absence (both short spells ≤ 7
20 days and long spells > 7 days). More recently, Milner et al. (2015) used longitudinal fixed
21 effects models to show that increases in psychosocial adversities were associated with
22 increases in days of sickness absence over 12 months¹¹. This latter study controlled for time-
23 varying factors including age, household structure and income, job permanency, occupational
24 skill level, educational attainment, and presence of a long-term health condition or disability.

25
26 Expanding on prior research, the hybrid model in the current study allowed us to control for a
27 broader range of both time-varying and time-invariant predictors across the lifecourse and to
28 examine the influence of both time-varying and time-invariant components of psychosocial
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2
3 job quality. The results predicting days of sickness absence within a 4-week period showed
4
5 that while between-person comparisons of average levels of job quality were associated with
6
7 sickness absence in the initial models, it was *within-person* change in job quality that
8
9 remained uniquely associated in the final fully adjusted model. These within-person specific
10
11 results add strength to the argument that job quality is an independent causal predictor of
12
13 sickness absence^{10, 43}.
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16 17 18 19 *Limitations and strengths*

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21 The limitations of this paper include the restricted geographical area from which the sample
22
23 was recruited - the cities of Canberra and Queanbeyan, in Australia. As Canberra is a city that
24
25 includes many professionals and public servants, (baseline sample comprised of 53%
26
27 professionals)¹⁸, the findings may not be generalisable to samples taken from more
28
29 disadvantaged communities. Second, as the study only included data from the path midlife
30
31 cohort (aged 40–44 at baseline), the results may differ in other age groups. We reduced the
32
33 likelihood of dependent misclassification by controlling for person-specific factors that could
34
35 influence both sickness absence and reporting of psychosocial job stressors. In saying this, it
36
37 is important to note that both exposures and outcomes are self-reported, and may still be
38
39 subject to residual reporting bias. Lastly, while the 4-week reference period for days of
40
41 sickness absence is a briefer outcome than is commonly used in this area of research, it is
42
43 appropriate for the Australian context (and the results were replicated using a binary measure
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45 of ≥ 5 day's sickness absence in supplementary analyses).
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53 Important study strengths include the longitudinal design (which facilitated the hybrid
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55 modelling), and the adjustment for a wide variety of personal, health and demographic
56
57 predictors of sickness absence, including variables rarely controlled for in prior research (i.e.
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3 early life adversities and personality characteristics). In terms of outcomes, our study adds
4 information on number of days of sickness absence (rather than a binary outcome only) and
5 replicates the results with functional impairment. A final strength is that PATH has a
6 relatively large sample size that has been randomly selected from the population.
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14 *Conclusion*

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16 The results of this study suggest that increases in psychosocial job adversity (i.e. high job
17 demands, low job control and job insecurity) are accompanied by increases in sickness
18 absence, and that this effect is not explained by differences or changes in other
19 sociodemographic factors, physical or mental health status, childhood or recent adverse life
20 events or personality. The findings highlight the importance of addressing poor job quality as
21 a risk factor for sickness absence.
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33 **Contributorship statement**

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35 PB oversaw the study and contributed the key job quality measures to the PATH study. LL and
36 AM wrote the first draft of the manuscript and LL wrote revised versions. LST performed the
37 statistical analyses and all authors (LST, PB, AM and LL) interpreted the findings. All authors
38 revised the draft and LL, LST and PB contributed to the final version of manuscript. We would
39 like to note that AM passed away in 2019. Although she has not approved the final submitted
40 version of the paper, the paper closely aligns with the original drafts AM contributed to.
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51 **Competing interests**

52 None to declare.
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4 Council (973302, 179805, 418139, 1156849), and the Australian Government Agency — Safe
5 Work Australia (Grant# N/A). It is currently managed by both the ANU and the University of
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Data availability statement

Data may be obtained from a third party and are not publicly available. PATH is not a publicly available dataset and so it is not possible to gain access to the de-identified data without developing a genuine, scientifically-based collaboration with a PATH investigator. The PATH investigators welcome research that complements the aims of the PATH study and optimises the use of the data, please contact us (info@pathstudy.org.au) to discuss your research proposal. For further information about the study see <http://www.pathstudy.org.au/>

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43 **Ethics approval**

44
45 The PATH Through Life Project was approved by the Australian National University Human
46 Research Ethics Committee: #M9807; #2002/190; #2006/314 and #2010/542.
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Tables

Table 1. Sample characteristics at baseline (n = 2106)

Sample characteristic	n	%
Sex		
Male	1052	49.9
Female	1054	50.1
Partner status		
No partner	414	19.7
Having a partner	1692	80.3
Education completion		
Incomplete high school	561	26.6
Completion of high school	695	33.0
Completion of tertiary study	850	40.4
Occupational skill level		
High	1122	53.3
Medium	564	26.8
Low	420	19.9
Parental responsibilities		
No	720	34.2
Yes	1386	65.8
Childhood adversities		
No	1476	70.1
Yes	622	29.5
Unknown	8	0.4
Financial hardship		
No	1620	76.9
Yes	482	22.9
Unknown	4	0.2
Smoking status		
Never/past smoker	1729	82.1
Current smoker	377	17.9
Hazardous/harmful alcohol consumption		
No	1978	93.9
Yes	128	6.1
Moderate/vigorous physical exercise (hours spent in the last week)		
0	406	19.3
<1.5	444	21.1
1.5–3.0	357	17.0
3.1–5.5	514	24.4
>5.5	385	18.3
Average hours spent in the last week (mean, SD)	3.58	5.95
Number of chronic physical health conditions		
0	1195	56.7
1	704	33.4
≥ 2	207	9.8

Number of adverse non-work life events		
0	1072	50.9
1	617	29.3
≥ 2	417	19.8
Depression/anxiety		
No	1563	74.2
Yes	532	25.3
Unknown	11	0.5
Neuroticism (mean, SD)	3.91	3.17

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Table 2. Descriptive statistics on exposures and outcome at each wave

	All waves (n = 7644)	Wave 1 (n = 2106)	Wave 2 (n = 2095)	Wave 3 (n = 1984)	Wave 4 (n = 1459)	Any wave^a (persons = 2221)
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Job quality (number of job adversities)						
0	2834 (37.1)	683 (32.4)	825 (39.4)	785 (39.6)	541 (37.1)	1464 (65.9)
1	3190 (41.7)	892 (42.4)	863 (41.2)	833 (42.0)	602 (41.3)	1717 (77.3)
2	1357 (17.8)	436 (20.7)	351 (16.8)	313 (15.8)	257 (17.6)	931 (41.9)
3	242 (3.2)	95 (4.5)	52 (2.5)	51 (2.6)	44 (3.0)	205 (9.2)
Unknown	21 (0.3)	0	4 (0.2)	2 (0.1)	15 (1.0)	21 (1.0)
Number of days of sickness absence						
0	5916 (77.4)	1616 (76.7)	1647 (78.6)	1502 (75.7)	1151 (78.9)	2133 (96.0)
1	643 (8.4)	185 (8.8)	171 (8.2)	183 (9.2)	104 (7.1)	546 (24.6)
2+	1052 (13.8)	305 (14.5)	267 (12.7)	294 (14.8)	186 (12.8)	787 (35.4)
Unknown	33 (0.4)	0	10 (0.5)	5 (0.3)	18 (1.2)	33 (1.5)
Functional impairment						
No	5211 (68.2)	1421 (67.5)	1435 (68.5)	1343 (67.7)	1012 (69.4)	1325 (59.7)
Yes	2424 (31.7)	685 (32.5)	655 (31.3)	641 (32.3)	443 (30.4)	1988 (89.5)
Unknown	9 (0.1)	0	5 (0.2)	0	4 (0.3)	9 (0.4)

^a0% sum for each variable is more than 100% because individuals can be included in multiple categories.

Table 3. Relative risk and 95% confidence intervals from longitudinal random-intercept negative binomial regression models assessing the relationship between psychosocial job quality and the number of days of sickness absence

	Model 1 (adjusted for time only)	Model 2 (within- and between-person terms)	Model 3 (adding socio-demographic covariates, childhood adversity and non-work events)	Model 4 (adding health covariates)	Model 5 (adding depression/anxiety)	Model 6 (adding neuroticism)
Original job quality score (0-3) ^a	1.23 (1.16–1.31)***					
Job quality deviation score		1.17 (1.08–1.27)***	1.15 (1.06–1.25)**	1.15 (1.06–1.25)**	1.12 (1.03–1.21)**	1.12 (1.03–1.21)**
Average job quality across waves		1.31 (1.20–1.43)***	1.21 (1.10–1.32)***	1.19 (1.09–1.30)***	1.06 (0.97–1.17)	1.04 (0.95–1.14)
Sex						
Male (ref.)			1.00	1.00	1.00	1.00
Female			1.28 (1.14–1.42)***	1.24 (1.11–1.39)***	1.22 (1.09–1.36)***	1.21 (1.08–1.35)**
Partner						
Having a partner (ref.)			1.00	1.00	1.00	1.00
No partner			1.30 (1.15–1.46)***	1.29 (1.14–1.46)***	1.27 (1.13–1.44)***	1.26 (1.12–1.42)***
Education completion						
Incomplete high school (ref.)			1.00	1.00	1.00	1.00
Completion of high school			0.99 (0.86–1.14)	1.00 (0.87–1.15)	1.01 (0.88–1.16)	1.01 (0.88–1.16)
Completion of tertiary study			0.98 (0.84–1.14)	1.00 (0.86–1.17)	1.04 (0.89–1.21)	1.04 (0.89–1.21)
Occupational skill level						
High (ref.)			1.00	1.00	1.00	1.00
Medium			1.03 (0.91–1.17)	1.03 (0.91–1.17)	1.02 (0.89–1.16)	1.01 (0.89–1.15)
Low			0.89 (0.76–1.04)	0.89 (0.76–1.04)	0.91 (0.78–1.07)	0.91 (0.78–1.06)
Parental responsibilities						
No (ref.)			1.00	1.00	1.00	1.00
Yes			1.02 (0.91–1.15)	1.03 (0.91–1.15)	1.02 (0.91–1.15)	1.02 (0.91–1.15)
Financial hardship						
No (ref.)			1.00	1.00	1.00	1.00
Yes			1.13 (1.00–1.29)	1.12 (0.99–1.28)	1.04 (0.92–1.19)	1.04 (0.92–1.19)*
Childhood adversity (wave 1)						
No (ref.)			1.00	1.00	1.00	1.00
Yes			1.32 (1.18–1.47)***	1.31 (1.17–1.46)***	1.25 (1.12–1.40)***	1.24 (1.11–1.38)***
Adverse non-work life events						
0 (ref.)			1.00	1.00	1.00	1.00

1			1.10 (0.98–1.24)	1.09 (0.97–1.23)	1.07 (0.95–1.20)	1.06 (0.95–1.19)
2	≥2		1.47 (1.29–1.67)***	1.45 (1.27–1.65)***	1.34 (1.18–1.52)***	1.33 (1.17–1.52)***
3						
4	Smoking status					
5	Never/past smoker (ref.)			1.00	1.00	1.00
6	Current smoker			1.02 (0.88–1.18)	1.00 (0.86–1.15)	1.00 (0.86–1.16)
7						
8	Alcohol consumption					
9	No (ref.)			1.00	1.00	1.00
10	Yes			0.96 (0.79–1.17)	0.95 (0.78–1.15)	0.94 (0.78–1.14)
11						
12	Moderate/vigorous physical exercise					
13	0 (ref.)			1.00	1.00	1.00
14	<1.5			1.03 (0.88–1.20)	1.04 (0.89–1.22)	1.06 (0.90–1.23)
15	1.5–3.0			1.10 (0.94–1.30)	1.10 (0.94–1.30)	1.12 (0.95–1.31)
16	3.1–5.5			0.93 (0.80–1.09)	0.96 (0.82–1.12)	0.97 (0.83–1.13)
17	>5.5			0.83 (0.70–0.98)*	0.87 (0.74–1.03)	0.88 (0.74–1.04)
18						
19	Number of chronic physical health conditions					
20	0 (ref.)			1.00	1.00	1.00
21	1			1.02 (0.91–1.14)	1.00 (0.89–1.12)	1.00 (0.89–1.12)
22	≥ 2			1.35 (1.17–1.55)***	1.29 (1.13–1.48)***	1.29 (1.12–1.48)***
23						
24	Depression/anxiety					
25	No (ref.)				1.00	1.00
26	Yes				1.92 (1.61–2.15)***	1.83 (1.62–2.06)***
27						
28	Neuroticism					
29	0 (Low) (ref.)					1.00
30	1					1.08 (0.89–1.31)
31	2					1.08 (0.86–1.36)
32	3					1.09 (0.89–1.32)
33	4 (High)					1.26 (1.03–1.55)*
34						
35	Survey wave					
36	1 (ref)	1.00	1.00	1.00	1.00	1.00
37	2	0.91 (0.80–1.03)	0.90 (0.79–1.03)	0.91 (0.80–1.04)	0.90 (0.79–1.03)	0.92 (0.81–1.05)
38	3	1.08 (0.96–1.23)	1.07 (0.95–1.22)	1.08 (0.94–1.23)	1.04 (0.91–1.19)	1.06 (0.92–1.21)
39	4	0.89 (0.77–1.02)	0.88 (0.76–1.02)	0.92 (0.78–1.08)	0.87 (0.74–1.02)	0.89 (0.75–1.05)

*p<0.05; **p<0.01; ***p<0.001. a – number of psychosocial job adversities.

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Table 4. Odds ratios and 95% confidence intervals from longitudinal random-intercept logistic regression models assessing the relationship between psychosocial job quality and functional impairment

	Model 1 (adjusted for time only)	Model 2 (within- and between-person terms)	Model 3 (adding socio-demographic covariates, childhood adversity and non-work events)	Model 4 (adding health covariates)	Model 5 (adding depression/anxiety)	Model 6 (adding neuroticism)
Original job quality score (0-3) ^a	1.60 (1.47–1.74)***					
Job quality deviation score		1.30 (1.17–1.43)***	1.27 (1.15–1.41)***	1.28 (1.15–1.42)***	1.16 (1.05–1.30)**	1.17 (1.05–1.30)**
Average job quality across waves		2.50 (2.15–2.90)***	2.16 (1.87–2.49)***	2.14 (1.86–2.47)***	1.49 (1.40–1.71)***	1.34 (1.17–1.54)***
Sex						
Male (ref.)			1.00	1.00	1.00	1.00
Female			1.21 (1.02–1.43)*	1.17 (0.99–1.39)	1.11 (0.95–1.30)	1.05 (0.90–1.24)
Partner						
Having a partner			1.00	1.00	1.00	1.00
No partner			1.26 (1.05–1.51)*	1.26 (1.05–1.51)*	1.26 (1.05–1.50)*	1.23 (1.03–1.47)*
Education completion						
Incomplete high school (ref.)			1.00	1.00	1.00	1.00
Completion of high school			0.97 (0.78–1.21)	0.98 (0.79–1.22)	1.01 (0.82–1.24)	1.00 (0.81–1.23)
Completion of tertiary study			1.21 (0.96–1.53)	1.27 (1.01–1.61)*	1.39 (1.12–1.74)**	1.38 (1.10–1.72)**
Occupational skill level						
High (ref.)			1.00	1.00	1.00	1.00
Medium			1.06 (0.89–1.27)	1.06 (0.89–1.26)	1.03 (0.87–1.23)	1.02 (0.86–1.21)
Low			0.75 (0.60–0.94)*	0.73 (0.59–0.91)**	0.78 (0.63–0.97)*	0.78 (0.62–0.97)*
Parental responsibilities						
No (ref.)			1.00	1.00	1.00	1.00
Yes			0.80 (0.68–0.94)**	0.82 (0.70–0.96)*	0.82 (0.70–0.96)*	0.81 (0.69–0.95)***
Financial hardship						
No (ref.)			1.00	1.00	1.00	1.00
Yes			1.92 (1.61–2.29)***	1.91 (1.60–2.28)***	1.59 (1.43–1.90)***	1.60 (1.34–1.91)***
Childhood adversity (wave 1)						
No (ref.)			1.00	1.00	1.00	1.00
Yes			1.81 (1.51–2.17)***	1.78 (1.49–2.13)***	1.54 (1.40–1.82)***	1.47 (1.24–1.74)***
Adverse non-work life events						
0 (ref.)			1.00	1.00	1.00	1.00
1			1.35 (1.17–1.57)***	1.33 (1.15–1.54)***	1.25 (1.08–1.45)**	1.24 (1.07–1.44)**

≥2			2.11 (1.77–2.51)***	2.07 (1.74–2.47)***	1.78 (1.49–2.12)***	1.76 (1.48–2.11)***
Smoking status						
Never/past smoker (ref.)				1.00	1.00	1.00
Current smoker				0.99 (0.79–1.22)	0.89 (0.72–1.09)	0.87 (0.71–1.08)
Alcohol consumption						
No (ref.)				1.00	1.00	1.00
Yes				1.19 (0.91–1.55)	1.17 (0.90–1.52)	1.13 (0.87–1.47)
Moderate/vigorous physical exercise						
0 (ref.)				1.00	1.00	1.00
<1·5				0.97 (0.79–1.20)	1.01 (0.81–1.25)	1.03 (0.83–1.27)
1·5–3·0				1.15 (0.92–1.43)	1.16 (0.92–1.45)	1.21 (0.97–1.51)
3·1–5·5				0.80 (0.65–0.99)*	0.87 (0.71–1.07)	0.90 (0.73–1.11)
>5·5				0.75 (0.59–0.93)*	0.83 (0.66–1.04)	0.86 (0.69–1.08)
Number of chronic physical health conditions						
0 (ref.)				1.00	1.00	1.00
1				1.27 (1.09–1.48)**	1.21 (1.04–1.41)*	1.22 (1.04–1.42)*
≥ 2				1.63 (1.33–1.99)***	1.53 (1.25–1.87)***	1.53 (1.25–1.87)***
Depression/anxiety						
No (ref.)					1.00	1.00
Yes					7.75 (6.07–9.14)***	6.68 (5.63–7.92)***
Neuroticism						
0 (Low) (ref.)						1.00
1						1.24 (0.94–1.63)
2						1.54 (1.11–2.12)**
3						1.82 (1.38–2.40)***
4 (High)						2.32 (1.72–3.11)***
Survey wave						
1 (ref.)	1.00	1.00	1.00	1.00	1.00	1.00
2	0.99 (0.85–1.16)	0.96 (0.82–1.12)	0.95 (0.81–1.11)	0.94 (0.80–1.10)	1.01 (0.85–1.19)	1.00 (0.85–1.18)
3	1.08 (0.92–1.26)	1.04 (0.88–1.21)	0.98 (0.82–1.16)	0.92 (0.77–1.09)	0.97 (0.81–1.16)	0.97 (0.81–1.16)
4	0.96 (0.80–1.15)	0.94 (0.79–1.12)	0.88 (0.72–1.08)	0.79 (0.64–0.98)*	0.85 (0.69–1.05)	0.83 (0.67–1.03)

*p<0.05; **p<0.01; ***p<0.001. a – number of psychosocial job adversities.

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Figures

Figure 1. Study profile

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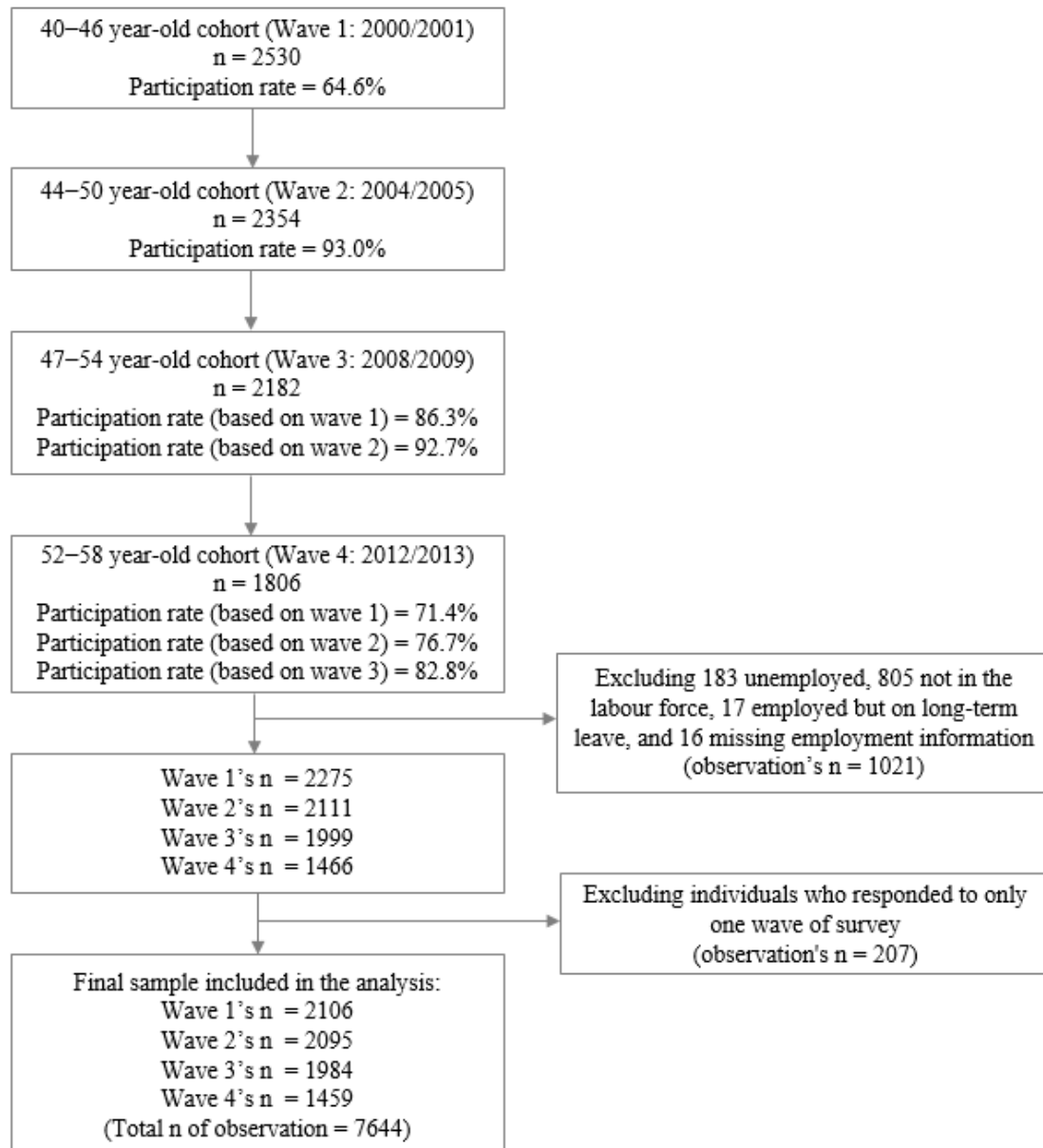


Table S1. Odds ratios and 95% confidence intervals from longitudinal random-intercept logistic regression models assessing the relationship between psychosocial job quality and any sickness absence.

	Model 1 (adjusted for time only)	Model 2 (within- and between-person terms)	Model 3 (adding socio-demographic covariates, childhood adversity and non-work events)	Model 4 (adding health covariates)	Model 5 (adding depression/anxiety)	Model 6 (adding neuroticism)
Original job quality score (0-3) ^a	1.27 (1.17–1.37)***					
Job quality deviation score		1.20 (1.08–1.33)**	1.18 (1.06–1.31)**	1.18 (1.06–1.32)**	1.14 (1.02–1.26)**	1.14 (1.02–1.27)**
Average job quality across waves		1.37 (1.21–1.56)***	1.24 (1.09–1.42)**	1.24 (1.09–1.41)**	1.08 (0.95–1.23)	1.05 (0.91–1.19)
Sex						
Male (ref.)			1.00	1.00	1.00	1.00
Female			1.36 (1.17–1.59)***	1.32 (1.13–1.55)**	1.30 (1.12–1.52)**	1.28 (1.10–1.50)
Partner						
Having a partner			1.00	1.00	1.00	1.00
No partner (ref.)			1.41 (1.19–1.67)***	1.41 (1.18–1.67)***	1.38 (1.17–1.64)***	1.37 (1.16–1.63)
Education completion						
Incomplete high school (ref.)			1.00	1.00	1.00	1.00
Completion of high school			1.00 (0.82–1.22)	0.99 (0.81–1.21)	1.00 (0.82–1.22)	1.00 (0.82–1.22)
Completion of tertiary study			0.97 (0.78–1.20)	0.98 (0.79–1.22)	1.03 (0.83–1.27)	1.02 (0.83–1.27)
Occupational skill level						
High (ref.)			1.00	1.00	1.00	1.00
Medium			1.03 (0.86–1.22)	1.03 (0.87–1.23)	1.03 (0.87–1.22)	1.02 (0.86–1.22)
Low			0.87 (0.71–1.08)	0.87 (0.71–1.08)	0.91 (0.73–1.12)	0.90 (0.73–1.12)
Parental responsibilities						
No (ref.)			1.00	1.00	1.00	1.00
Yes			1.06 (0.90–1.24)	1.07 (0.91–1.25)	1.06 (0.91–1.25)	1.06 (0.91–1.24)
Financial hardship						
No (ref.)			1.00	1.00	1.00	1.00
Yes			1.28 (1.07–1.53)**	1.26 (1.05–1.51)**	1.17 (0.98–1.41)	1.17 (0.97–1.40)
Childhood adversity (wave 1)						
No (ref.)			1.00	1.00	1.00	1.00
Yes			1.41 (1.20–1.65)***	1.40 (1.19–1.64)***	1.31 (1.12–1.54)**	1.29 (1.10–1.52)*
Adverse non-work life events						

0 (ref.)			1.00	1.00	1.00	1.00
1			1.11 (0.96–1.28)	1.09 (0.94–1.26)	1.06 (0.91–1.23)	1.05 (0.91–1.24)
≥2			1.63 (1.36–1.96)***	1.60 (1.34–1.93)***	1.49 (1.24–1.79)***	1.48 (1.23–1.78)***
Smoking status						
Never/past smoker (ref.)				1.00	1.00	1.00
Current smoker				0.97 (0.79–1.20)	0.94 (0.76–1.15)	0.94 (0.76–1.15)
Alcohol consumption						
No (ref.)				1.00	1.00	1.00
Yes				0.94 (0.72–1.22)	0.92 (0.71–1.20)	0.92 (0.71–1.19)
Moderate/vigorous physical exercise						
0 (ref.)				1.00	1.00	1.00
<1.5				1.08 (0.87–1.32)	1.09 (0.88–1.34)	1.10 (0.90–1.36)
1.5–3.0				1.19 (0.96–1.49)	1.20 (0.97–1.50)	1.22 (0.98–1.52)
3.1–5.5				0.94 (0.76–1.15)	0.97 (0.79–1.20)	0.98 (0.80–1.21)
>5.5				0.83 (0.66–1.03)	0.87 (0.70–1.09)	0.89 (0.71–1.10)
Number of chronic physical health conditions						
0 (ref.)				1.00	1.00	1.00
1				1.00 (0.86–1.16)	0.98 (0.84–1.14)	0.98 (0.84–1.14)
≥ 2				1.48 (1.22–1.79)***	1.42 (1.17–1.72)***	1.41 (1.16–1.71)***
Depression/anxiety						
No (ref.)					1.00	1.00
Yes					2.19 (1.67–2.56)***	2.06 (1.75–2.43)***
Neuroticism						
0 (Low) (ref.)						1.00
1						1.13 (0.87–1.46)
2						1.13 (0.82–1.54)
3						1.13 (0.87–1.47)
4 (High)						1.41 (1.06–1.87)**
Survey wave						
1 (ref.)	1.00	1.00	1.00	1.00	1.00	1.00
2	0.89 (0.75–1.04)	0.88 (0.75–1.03)	0.89 (0.75–1.05)	0.87 (0.74–1.03)	0.90 (0.76–1.06)	0.90 (0.76–1.06)
3	1.10 (0.94–1.29)	1.09 (0.93–1.28)	1.08 (0.91–1.29)	1.05 (0.88–1.25)	1.07 (0.90–1.28)	1.07 (0.89–1.27)
4	0.84 (0.70–1.01)	0.84 (0.70–1.00)	0.88 (0.72–1.08)	0.81 (0.66–1.01)	0.84 (0.68–1.05)	0.84 (0.68–1.04)

*p<0.05; **p<0.01; ***p<0.001. a – number of psychosocial job adversities.

Table S2. Odds ratios and 95% confidence intervals from longitudinal random-intercept logistic regression models assessing the relationship between psychosocial job quality and longer sickness absence (≥ 5 days).

	Model 1 (adjusted for time only)	Model 2 (within- and between-person terms)	Model 3 (adding socio-demographic covariates, childhood adversity and non-work events)	Model 4 (adding health covariates)	Model 5 (adding depression/anxiety)	Model 6 (adding neuroticism)
Original job quality score (0-3) ^a	1.53 (1.34–1.76)***					
Job quality deviation score		1.47 (1.22–1.79)***	1.40 (1.15–1.70)***	1.39 (1.14–1.69)***	1.33 (1.09–1.62)**	1.33 (1.09–1.62)**
Average job quality across waves		1.60 (1.31–1.94)***	1.37 (1.12–1.67)***	1.36 (1.12–1.66)**	1.17 (0.96–1.43)	1.18 (0.96–1.45)
Sex						
Male (ref.)			1.00	1.00	1.00	1.00
Female			1.06 (.83–1.36)	1.04 (0.81–1.33)	1.02 (0.79–1.30)	1.02 (0.80–1.32)
Partner						
Having a partner			1.00	1.00	1.00	1.00
No partner (ref.)			1.24 (.94–1.64)	1.22 (.92–1.61)	1.21 (0.89–1.30)	1.21 (0.91–1.59)
Education completion						
Incomplete high school (ref.)			1.00	1.00	1.00	1.00
Completion of high school			0.80 (0.59–1.09)	0.82 (0.61–1.11)	0.82 (0.60–1.11)	0.83 (0.61–1.13)
Completion of tertiary study			0.73 (0.52–1.02)	0.78 (0.56–1.10)	0.81 (0.58–1.14)	0.83 (0.59–1.18)
Occupational skill level						
High (ref.)			1.00	1.00	1.00	1.00
Medium			1.10 (0.81–1.48)	1.08 (0.80–1.46)	1.07 (0.80–1.45)	1.09 (0.92–1.59)
Low			1.02 (0.72–1.45)	0.97 (0.69–1.38)	1.00 (0.70–1.42)	1.02 (0.71–1.45)
Parental responsibilities						
No (ref.)			1.00	1.00	1.00	1.00
Yes			1.17 (0.89–1.55)	1.20 (0.91–1.58)	1.21 (0.92–1.60)	1.21 (0.92–1.59)
Financial hardship						
No (ref.)			1.00	1.00	1.00	1.00
Yes			1.57 (1.19–2.08)***	1.51 (1.14–1.99)**	1.37 (1.03–1.82)*	1.38 (1.04–1.83)*
Childhood adversity (wave 1)						
No (ref.)			1.00	1.00	1.00	1.00
Yes			1.57 (1.23–2.01)***	1.56 (1.22–1.99)***	1.46 (1.14–1.87)**	1.46 (1.14–1.86)**
Adverse non-work life events						

0 (ref.)			1.00	1.00	1.00	1.00
1			1.62 (1.23–2.13)***	1.58 (1.20–2.07)**	1.53 (1.16–2.01)**	1.53 (1.16–2.01)**
≥2			2.51 (1.86–3.39)***	2.44 (1.80–3.30)***	2.23 (1.64–3.02)***	2.24 (1.65–3.04)***
Smoking status						
Never/past smoker (ref.)				1.00	1.00	1.00
Current smoker				1.17 (0.85–1.61)	1.14 (0.83–1.57)	1.15 (0.84–1.58)
Alcohol consumption						
No (ref.)				1.00	1.00	1.00
Yes				1.22 (0.81–1.85)	1.21 (0.80–1.83)	1.20 (0.79–1.82)
Moderate/vigorous physical exercise						
0 (ref.)				1.00	1.00	1.00
<1.5				0.96 (0.67–1.36)	0.97 (0.68–1.38)	0.97 (0.68–1.38)
1.5–3.0				0.84 (0.57–1.24)	0.84 (0.57–1.24)	0.83 (0.56–1.23)
3.1–5.5				0.79 (0.56–1.14)	0.83 (0.58–1.19)	0.83 (0.58–1.19)
>5.5				0.81 (0.56–1.17)	0.86 (0.59–1.25)	0.85 (0.59–1.24)
Number of chronic physical health conditions						
0 (ref.)				1.00	1.00	1.00
1				1.04 (0.79–1.36)	1.01 (0.77–1.33)	1.01 (0.76–1.32)
≥ 2				1.37 (1.00–1.87)*	1.29 (0.94–1.77)	1.28 (0.93–1.76)
Depression/anxiety						
No (ref.)					1.00	1.00
Yes					2.21 (1.61–2.86)***	2.22 (1.69–2.93)***
Neuroticism						
0 (Low) (ref.)						1.00
1						0.67 (0.43–1.05)
2						1.04 (0.64–1.69)
3						0.77 (0.50–1.19)
4 (High)						0.81 (0.83–1.83)
Survey wave						
1 (ref.)	1.00	1.00	1.00	1.00	1.00	1.00
2	0.91 (0.66–1.25)	0.90 (0.66–1.24)	0.94 (0.68–1.31)	0.93 (0.67–1.30)	0.97 (0.70–1.35)	0.97 (0.70–1.35)
3	1.23 (0.91–1.66)	1.22 (0.90–1.65)	1.28 (0.92–1.77)	1.23 (0.88–1.71)	1.28 (0.92–1.78)	1.27 (0.91–1.77)
4	1.06 (0.75–1.49)	1.05 (0.75–1.48)	1.24 (0.85–1.82)	1.17 (0.79–1.73)	1.23 (0.83–1.83)	1.24 (0.83–1.83)

*p<0.05; **p<0.01; ***p<0.001. a – number of psychosocial job adversities.

Table S3. Odds ratios and 95% confidence intervals from longitudinal random-intercept negative binomial regression models assessing the relationship between psychosocial job quality categories 0-3 and the number of days of sickness absence

	Model 1 (adjusted for time only)	Model 2 (within- and between-person terms)	Model 3 (adding socio-demographic covariates, childhood adversity and non-work events)	Model 4 (adding health covariates)	Model 5 (adding depression/anxiety)	Model 6 (adding neuroticism)
Original job quality score						
0	1.00	1.00	1.00	1.00	1.00	1.00
1	1.14 (0.98-1.32)	1.07 (0.91-1.27)	1.08 (0.92-1.27)	1.08 (0.92-1.28)	1.06 (0.90-1.25)	1.06 (0.90-1.25)
2	1.58 (1.31-1.91)**	1.42 (1.13-1.78)**	1.39 (1.20-1.75)**	1.39 (1.10-1.75)**	1.28 (1.02-1.62)*	1.29 (1.02-1.62)**
3	2.16 (1.53-3.06)**	1.84 (1.23-2.74)**	1.68 (1.12-2.51)**	1.73 (1.15-2.59)**	1.52 (1.01-2.28)*	1.54 (1.02-2.31)**
Average job quality across waves		1.15 (0.97-1.36)	1.06 (0.90-1.25)	1.05 (0.89-1.24)	0.95 (0.81-1.12)	0.92 (0.78-1.09)
Sex						
Male (ref.)			1.00	1.00	1.00	1.00
Female			1.37 (1.17-1.59)***	1.32 (1.13-1.55)***	1.31 (1.12-1.52)**	1.28 (1.10-1.50)**
Partner						
Having a partner			1.00	1.00	1.00	1.00
No partner (ref.)			1.41 (1.19-1.68)***	1.41 (1.19-1.67)***	1.38 (1.17-1.64)***	1.37 (1.16-1.63)***
Education completion						
Incomplete high school (ref.)			1.00	1.00	1.00	1.00
Completion of high school			1.00 (0.82-1.22)	0.99 (0.81-1.21)	1.00 (0.82-1.22)	1.00 (0.82-1.22)
Completion of tertiary study			0.97 (0.79-1.21)	0.99 (0.79-1.22)	1.03 (0.83-1.27)	1.03 (0.83-1.27)
Occupational skill level						
High (ref.)			1.00	1.00	1.00	1.00
Medium			1.03 (0.87-1.22)	1.03 (0.87-1.23)	1.03 (0.87-1.22)	1.02 (0.86-1.22)
Low			0.87 (0.72-1.45)	0.87 (0.71-1.08)	0.91 (0.73-1.12)	0.90 (0.73-1.11)
Parental responsibilities						
No (ref.)			1.00	1.00	1.00	1.00
Yes			1.06 (0.91-1.24)	1.07 (0.91-1.25)	1.07 (0.91-1.25)	1.06 (0.91-1.24)
Financial hardship						
No (ref.)			1.00	1.00	1.00	1.00
Yes			1.28 (1.06-1.53)**	1.26 (1.05-1.51)**	1.17 (0.97-1.40)	1.17 (0.97-1.40)
Childhood adversity (wave 1)						

No (ref.)			1.00	1.00	1.00	1.00
Yes			1.40 (1.19–1.65)***	1.39 (1.18–1.63)***	1.31 (1.12–1.54)**	1.29 (1.10–1.51)**
Adverse non-work life events						
0 (ref.)			1.00	1.00	1.00	1.00
1			1.11 (0.96–1.28)	1.09 (0.94–1.26)	1.06 (0.91–1.23)**	1.05 (0.91–1.22)
≥2			1.63 (1.36–1.96)***	1.60 (1.34–1.92)***	1.49 (1.24–1.79)***	1.48 (1.23–1.77)***
Smoking status						
Never/past smoker (ref.)				1.00	1.00	1.00
Current smoker				0.97 (0.79–1.19)	0.94 (0.76–1.15)	0.94 (0.76–1.15)
Alcohol consumption						
No (ref.)				1.00	1.00	1.00
Yes				0.94 (0.73–1.22)	0.93 (0.71–1.20)	0.92 (0.71–1.20)
Moderate/vigorous physical exercise						
0 (ref.)				1.00	1.00	1.00
<1-5				1.08 (0.88–1.33)	1.09 (0.89–1.34)	1.11 (0.90–1.36)
1-5-3-0				1.19 (0.96–1.49)	1.20 (0.97–1.50)	1.22 (0.98–1.52)
3-1-5-5				0.94 (0.76–1.15)	0.97 (0.79–1.19)	0.98 (0.80–1.21)
>5-5				0.83 (0.66–1.03)	0.87 (0.70–1.09)	0.88 (0.71–1.10)
Number of chronic physical health conditions						
0 (ref.)				1.00	1.00	1.00
1				1.00 (0.86–1.16)	0.98 (0.84–1.14)	0.98 (0.84–1.14)
≥ 2				1.48 (1.22–1.79)***	1.42 (1.17–1.72)***	1.41 (0.16–1.71)***
Depression/anxiety						
No (ref.)					1.00	1.00
Yes					2.18 (1.76–2.55)***	2.05 (1.74–2.42)***
Neuroticism						
0 (Low) (ref.)						1.00
1						1.13 (0.87–1.47)
2						1.13 (0.83–1.55)
3						1.14 (0.87–1.48)
4 (High)						1.42 (1.07–1.88)*
Survey wave						
1 (ref.)	1.00	1.00	1.00	1.00	1.00	1.00

2	0.89 (0.75–1.04)	0.88 (0.75–1.03)	0.89 (0.75–1.05)	0.87 (0.74–1.03)	0.90 (0.75–1.06)	0.90 (0.76–1.06)
3	1.10 (0.94–1.29)	1.09 (0.93–1.28)	1.09 (0.91–1.29)	1.05 (0.88–1.25)	1.07 (0.90–1.28)	1.07 (0.89–1.27)
4	0.84 (0.70–1.01)	0.84 (0.70–1.00)	0.88 (0.72–1.08)	0.81 (0.66–1.01)	0.84 (0.68–1.05)	0.84 (0.68–1.04)

*p<0.05; **p<0.01; ***p<0.001. a – number of psychosocial job adversities.

For peer review only

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STROBE Statement—Checklist of items that should be included in reports of *cohort studies*

	Item No	Recommendation	Page No
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract (b) Provide in the abstract an informative and balanced summary of what was done and what was found	1&3 3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4-5
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	5-6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5-6
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up (b) For matched studies, give matching criteria and number of exposed and unexposed	6 NA
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	7-10
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	7-10
Bias	9	Describe any efforts to address potential sources of bias	6
Study size	10	Explain how the study size was arrived at	6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7-10
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding (b) Describe any methods used to examine subgroups and interactions (c) Explain how missing data were addressed (d) If applicable, explain how loss to follow-up was addressed (e) Describe any sensitivity analyses	11-12 NA 12 12 NA
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed (b) Give reasons for non-participation at each stage (c) Consider use of a flow diagram	6, 19 (Fig 1) 6 19 (Fig 1)
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders (b) Indicate number of participants with missing data for each variable of interest (c) Summarise follow-up time (eg, average and total amount)	12-13 12, 20-21 (Table 1) 6, 19 (Fig 1)
Outcome data	15*	Report numbers of outcome events or summary measures over time	11-12, 22 (Table 2)

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2			
3	Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included
4			12-13 (Tables 4-3)
5			
6			7-10
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9			
10	Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses
11			NA
12			
13	Discussion		
14	Key results	18	Summarise key results with reference to study objectives
15			14
16	Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias
17			15-16
18	Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence
19			14-15
20	Generalisability	21	Discuss the generalisability (external validity) of the study results
21			15
22	Other information		
23	Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based
24			17
25			

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at <http://www.strobe-statement.org>.