



# Associations of job strain and family strain with risk of major depressive episode: A prospective cohort study in U.S. working men and women

Timothy A. Matthews<sup>a</sup>, Wendie Robbins<sup>b</sup>, Martin Preisig<sup>c</sup>, Roland von Känel<sup>d</sup>, Jian Li<sup>a,b,\*</sup>

<sup>a</sup> Department of Environmental Health Sciences, Fielding School of Public Health, University of California, Los Angeles, United States

<sup>b</sup> School of Nursing, University of California, Los Angeles, United States

<sup>c</sup> Department of Psychiatry, Center for Research in Psychiatric Epidemiology and Psychopathology, Lausanne University Hospital, University of Lausanne, Lausanne, Switzerland

<sup>d</sup> Department of Consultation-Liaison Psychiatry and Psychosomatic Medicine, University Hospital Zurich, University of Zurich, Zurich, Switzerland

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## ABSTRACT

**Background:** Studies assessing sex differences in the associations of psychosocial strain with depression have shown mixed and inconsistent results. Our objective was to examine prospective associations of job strain and family strain with risk of major depressive episode (MDE) among United States workers, as well as assess potential effect modification by sex.

**Methods:** Using data from the nationally representative and population-based Mid-life in the United States (MIDUS) study with a prospective cohort design and a 9-year follow-up period, the effects of job strain and family strain at baseline on risk of MDE within the 12 months prior to the follow-up assessment were examined in 1581 workers (805 men, 776 women) who were free from MDE within the 12 months prior to the baseline survey, by multivariate Poisson regression analysis.

**Results:** After adjustment for relevant covariates, there was evidence for effect modification by sex for the association between job strain and MDE but not for the association between family strain and MDE. Indeed, high job strain was prospectively associated with the risk of MDE (RR and 95% CI = 2.14 [1.14, 4.03]) in men but not in women. Moreover, high family strain was prospectively associated with a higher risk of MDE (RR and 95% CI = 1.57 [1.05, 2.37]) in the whole sample.

**Conclusion:** Family strain was associated with risk of MDE regardless of the sex of a person. In contrast, high job strain may involve an increased risk of developing MDE only in men but not in women.

## 1. Introduction

For decades, psychosocial factors and stress have been identified as important risk factors for depression [1,2]. With extensive and pervasive effects in the workplace regarding productivity loss and absenteeism, depression is a critical issue of occupational health significance [3]. Thus, a considerable body of research evidence substantiating associations between psychosocial work factors and depression has accumulated. Among them, job strain, defined as the combination of high job demands and low job control, has been demonstrated to have a significant influence on depression [4–7]. Interestingly, a growing body of literature has investigated differences in the associations of job strain with depression between men and women [6,8–17]. Studies conducted

thus far have shown mixed results; a number of studies reported that both sexes exhibit a similarly increased risk of depression when experiencing job strain [6,13,16], whereas several other studies found that the association of job strain with depression is stronger in men than in women [8,10–12,14]. A further three studies found a slightly stronger association between job strain and depression in women than in men [9,15,17]. Compared to job strain, family strain, which refers to family-related stress and familial conflict, has been far less investigated for its contribution to depression among the working-age population [18]. The limited evidence available suggests that family strain is strongly associated with depression, especially in women [19,20], and that family strain is a better predictor of mental health outcomes in women than in men [21]. In addition, many of these studies of strain and depression-

\* Corresponding author at: Department of Environmental Health Sciences, Fielding School of Public Health, School of Nursing, University of California, Los Angeles, 650 Charles E. Young Drive South, Los Angeles, CA 90095, United States.

E-mail address: [jianli2019@ucla.edu](mailto:jianli2019@ucla.edu) (J. Li).

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related outcomes did not use a clinical measure of depression [4], and instead reported depressive symptoms [6,12,13,17,22–24].

Yet, there is no research evidence based on cohort data among workers in the United States (U.S.) examining prospective associations of job strain and family strain with clinical depression. The previous findings are inconsistent and demand clarification, and hence the aim of the present study is to provide evidence on sex differences in the relationship between job strain/family strain and risk of major depressive episode (MDE) within the 12 months prior to the follow-up in U.S. employed men and women. We hypothesize that both job strain and family strain are associated with increased risk of MDE; moreover, we assume that sex may modify the associations between strain and MDE, such that men with high job strain will exhibit a greater risk for MDE than women, and women with high family strain will have a higher risk for MDE than men. More importantly, these associations will be explored through the Mid-life in the United States (MIDUS) dataset, a large, nationally representative, population-based sample comprised of American workers across an extensive range of occupations [25,26]. The wide breadth of the MIDUS dataset with regard to demographic, occupational, familial, and clinical characteristics offers considerable research utility and gives this study distinct strength.

## 2. Methods

### 2.1. Study population

Data from the MIDUS II survey [25] and MIDUS III survey [26] were used for this current research study. The MIDUS study, initiated in 1994, is a nationally representative longitudinal study examining psychological, social, and behavioral factors and health among U.S. adults. The MIDUS II survey was carried out from 2004 to 2006, while MIDUS III

occurred from 2013 to 2014, providing a follow-up period of approximately 9 years. Data collection was primarily based on random digit dial (RDD) phone interviews and an extensive self-administered questionnaire (SAQ) assaying a wide range of variables. In total, 4963 people participated in the MIDUS II study, which was the baseline time-point for our epidemiological investigation, and 2313 reported that they were working. Among them, 2183 workers (94.4%) had complete data on variables used for the current analyses. During 2013–2014, 1727 participants with complete data were included in the follow-up survey (follow-up rate = 79.1%). We compared the baseline characteristics of this sample of 1727 participants with the sample available at baseline to identify attrition bias due to loss of participants during follow-up ( $N = 2183 - 1727 = 456$ ). Participants lost to follow-up were more likely to be a racial or ethnic minority, less educated, lower income, divorced or otherwise separated, and smokers. Importantly, however, there were no significant differences in job strain, family strain, or the prevalence of MDE (details available upon request). We excluded participants who had experienced MDE within the past 12 months at baseline to minimize reverse causation. The final sample size used for the current analysis was 1581 (see the process of sample size selection in Fig. 1). All participants provided written informed consent. This study was reviewed and approved for exemption by the University of California, Los Angeles Institutional Review Board (IRB#20–001044).

### 2.2. Measures

Job strain was defined as per Karasek's Job Demand-Control model, namely the combination of high job demands with low job control [27]. In the MIDUS II study (baseline), job demands were assessed using 5 items (example items were "How often do you have to work intensively?", and "How often do you have a lot of interruption?"). Job

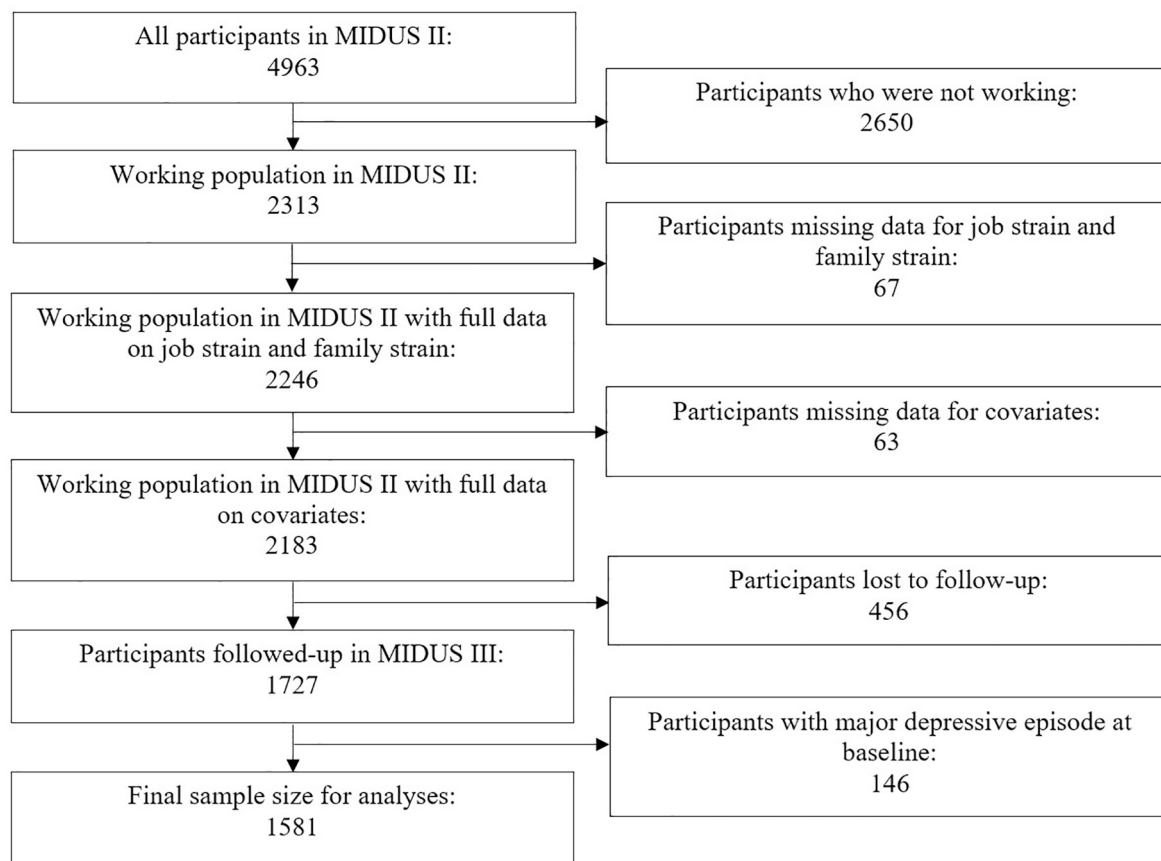


Fig. 1. Sample size selection.

control was measured with 9 items, including 3-item skill discretion (example item was “How often do you learn new things at work?”) and 6-item decision authority (example items were “How often do you have a choice in deciding how you do your tasks at work?”, and “How often do you have a say in decisions about your work?”). Responses for job demands and job control were measured using a 5-point Likert scale (1 = never, 5 = all of the time). The questions for job demands and job control in the MIDUS II study are similar to those of the standard Job Content Questionnaire (JCQ) developed by Karasek [28], and have been used in prior analyses of the MIDUS II study data [29]. Job demands and control were dichotomized into high and low levels by their median scores (15 and 34, respectively) [28], and binary job strain was hence operationalized as the combination of both high job demands and low job control. Additionally, the base-10 logarithmic transformed ratio between job demands and job control (weighted by item numbers) scores was used as an alternative measure of job strain as a continuous variable [30]. This latter procedure has the advantage of placing inverse strain of the same magnitude at the same distance from 1 (when demands and control are equal).

Family strain at baseline was assessed with 4 questions about familial stressors, asking “How often do members of your family (1) make too many demands on you, (2) criticize you, (3) let you down when you are counting on them, and (4) get on your nerves?” Responses for family strain were measured with a 4-point Likert scale (1 = never, 4 = often). The average sum score of the four questions represented the continuous measure of family strain (range = 1–4). This family strain scale was validated based on the MIDUS sample [18,21]. Additionally, binary family strain was dichotomized at the upper quartile of the continuous measure (which was 2.5), creating groups for High and Low family strain.

MDE in the past year was measured with the 19-item Composite International Diagnostic Interview Short Form (CIDI-SF), a validated scale shown to have high specificity and sensitivity [31]. An affirmative diagnosis of MDE requires the simultaneous presence of either depressed mood or anhedonia for most of the day, nearly every day, and four or more symptoms (such as fatigue, appetite change, insomnia) for a period of at least 2 weeks. Information on MDE was collected in both MIDUS II (baseline) and III (follow-up) surveys. As cases of MDE that occurred during the 12 months prior to the baseline evaluation were removed from our analyses, occurrence of MDE within the 12 months prior to the follow-up was the outcome variable in our current study.

Several sociodemographic factors and health-related behaviors collected at baseline were included, including sex, age (< 46; 46 to 55; and ≥ 56 years old), race (white; and non-white), marital status (married; never married; and others), education (high school or less; some college; university or more), household annual income (< \$60,000; \$60,000 to \$99,999; ≥ \$100,000), current smoking (no; and yes), alcohol consumption (no drinking; moderate drinking – up to two drinks per day for men and one drink per day for women; heavy drinking – more than moderate drinking) [32,33], and frequency of vigorous leisure-time physical exercise (low – never; moderate – once a week to once a month; high – several times a week).

### 2.3. Statistical analysis

First, descriptive statistics were generated. Relative frequencies were examined for characteristics of the study sample, and the Chi-square test was applied to compare the differences of the covariates with categorical measures between men and women. Second, we applied the Chi-square test to compare the differences of job strain and family strain at baseline, as well as MDE at follow-up between men and women. Third, the prospective associations of job strain and family strain at baseline with risk of MDE within the 12 months prior to the follow-up were estimated using Poisson regression with a log-link function and empirical (robust) variance, and the results were expressed as risk ratios (RRs) with 95% confidence intervals (CIs) [34]. Job strain and family strain were

entered together in the regression models to mutually adjust for each other. Then, multivariable models were calculated in three steps: Model I was adjusted for age and sex; further adjustment for race, marital status, education, and household income was added in Model II; and Model III additionally adjusted for smoking, alcohol consumption, and physical exercise. In line with an approach adopted by a recent study assessing sex differences in psychiatric conditions [35], we examined effect modification by sex between strain variables and MDE. Following recent methodological recommendations, we conducted analyses of effect modification of job strain and family strain on MDE by sex, including measures of effect modification on additive and multiplicative scales and calculating relative excess risk due to interaction (RERI) and the ratio of RRs, respectively [36]. In addition to the binary measures of job strain and family strain, we also conducted sensitivity analyses with continuous measures of job strain and family strain, and RRs were reported for an increase by 1 standard deviation (SD) (details available upon request). All analyses were conducted using the SAS 9.4 software package.

### 3. Results

The characteristics of the study sample at baseline are shown in Table 1, and sex differences in independent and dependent variables are given in Table 2. The sample of 1581 participants was predominantly middle-aged, with the majority of participants falling into the age category of 46–55. The sample consisted of roughly equal numbers of males and females. Most participants were white, and more men were married than women. The majority of participants had at least some college education, and men had higher levels of education and higher household income. Most participants (88%) were non-smokers and no obvious sex difference was observed for smoking. However, women had a higher likelihood of being engaged in low physical exercise. At baseline, women scored slightly higher than men on job strain, but the differences were not significant; in contrast, family strain was significantly higher in women than men. At follow-up, 6.57% of women and 5.09% of men were diagnosed with MDE.

Table 3 displays the results of the Poisson regression analyses for the entire sample. The analyses demonstrated a significant association between high family strain and MDE (fully-adjusted RR and 95% CI = 1.57 [1.05, 2.37]). The association of high job strain with MDE was non-significant (fully-adjusted RR and 95% CI = 1.23 [0.78, 1.94]).

In Table 4, findings of effect modification of job strain and family strain on MDE by sex are presented. The analyses revealed that, for job strain, the measure of effect modification by sex on the additive scale indicated a significant RERI (fully-adjusted RERI and 95% CI = 0.93 [0.14, 1.72],  $p = 0.02$ ), while the measure of effect modification by sex on the multiplicative scale showed a significant ratio of RRs (fully-adjusted ratio of RRs and 95% CI = 2.83 [1.16, 6.93],  $p = 0.02$ ). Indeed, a significant association between high job strain and elevated risk of MDE was observed among men (fully-adjusted RR and 95% CI = 2.14 [1.14, 4.03]) but not women (fully-adjusted RR and 95% CI = 0.76 [0.40, 1.43]). For family strain, the measures of effect modification by sex were not significant on either the additive or multiplicative scale. Moreover, the continuous measures of job strain and family strain exhibited a similar pattern of associations compared with information based on binary measures (details available upon request).

### 4. Discussion

In modern societies, depression in working populations is a serious problem due to its impacts on healthcare (medical costs), human resources, and manpower (productivity losses), with an economic burden amounting to billions of dollars per year [3,37]. The purpose of this study was to examine the contribution of psychosocial factors at work and at home to the development of MDE in U.S. workers, and to explore potential sex differences in these relationships. To the best of our

**Table 1**  
Characteristics of the study sample at baseline.

Variables (N, %)	Total sample (N = 1581)	Men (N = 805)	Women (N = 776)	p
Age (years)				0.28
<46	479 (30.30)	234 (29.07)	245 (31.57)	
46–55	596 (37.70)	299 (37.14)	297 (38.28)	
≥56	506 (32.01)	272 (33.79)	234 (30.15)	
Race				0.62
White	1474 (93.23)	753 (93.54)	721 (92.91)	
Non-white	107 (6.77)	52 (6.46)	55 (7.09)	
Marital status				<0.01
Married	1195 (75.59)	646 (80.25)	549 (70.75)	
Never married	141 (8.92)	72 (8.94)	69 (8.89)	
Others	245 (15.50)	87 (10.81)	158 (20.36)	
Education				<0.01
High school or less	376 (23.78)	178 (22.11)	198 (25.51)	
Some college	435 (27.51)	203 (25.22)	232 (29.90)	
University or more	770 (48.70)	424 (52.67)	346 (44.59)	
Household income (annual US dollars)				<0.01
<60,000	572 (36.18)	239 (26.69)	333 (42.91)	
60,000–99,999	497 (31.44)	275 (34.16)	222 (28.61)	
≥100,000	512 (32.48)	291 (35.15)	221 (28.48)	
Current smoking				0.96
No	1384 (87.54)	705 (87.58)	679 (87.50)	
Yes	197 (12.46)	100 (12.42)	97 (12.50)	
Alcohol consumption				0.73
Low or Moderate	1538 (97.28)	782 (97.14)	756 (97.42)	
Heavy	43 (2.72)	23 (2.86)	20 (2.58)	
Physical exercise				<0.01
Low	365 (23.09)	158 (19.63)	207 (26.68)	
Moderate	542 (34.28)	299 (37.14)	243 (31.31)	
High	674 (42.63)	348 (43.23)	326 (42.01)	

Differences were determined by Chi-square test.

knowledge, this is the first scientific report investigating such issues using prospective cohort data from a large and nationally representative study among U.S. working men and women. Using the classic measure of job strain based on Karasek's demand-control model [27] and a family strain measure based on a well-established MIDUS scale [18,21], we found that collectively, family strain at baseline was significantly associated with MDE at 9-year follow-up, while job strain was not. Interestingly, effect modification by sex suggested that job strain at baseline was prospectively associated with a greater than twofold elevated risk of MDE nine years later in men only, whereas sex did not significantly modify the associations between family strain and MDE. Therefore, our hypothesis was partially supported by the findings. Taken together, this evidence implies subtle sex differences between men and women in relation to psychosocial stress exposure and risk of MDE.

The finding that family strain was significantly associated with MDE in the aggregate sample adds to the body of literature evidencing a role of familial stressors in mental health among modern working families [38–40]. Current theories linking stress and health emphasize the

**Table 2**  
Levels of job strain and family strain at baseline and major depressive episode at follow-up.

Variables (N, %)	Total sample (N = 1581)	Men (N = 805)	Women (N = 776)	p
Job strain at baseline				0.10
Low	1218 (77.04)	634 (78.76)	584 (75.26)	
High	363 (22.96)	171 (21.24)	192 (24.74)	
Family strain at baseline				<0.01
Low	1196 (75.65)	643 (79.88)	553 (71.26)	
High	385 (24.35)	162 (20.12)	223 (28.74)	
Major depressive episode at follow-up				0.21
Low	1489 (94.18)	764 (94.91)	725 (93.43)	
High	92 (5.82)	41 (5.09)	51 (6.57)	

Differences were determined by Chi-square test.

**Table 3**  
Associations of job strain and family strain with risk of major depressive episode (RRs and 95% CIs) (N = 1581).

		Model I	Model II	Model III
Job strain	Low	1.00	1.00	1.00
	High	1.21 (0.77, 1.90)	1.17 (0.74, 1.86)	1.23 (0.78, 1.94)
Family strain	Low	1.00	1.00	1.00
	High	1.59 (1.05, 2.40) *	1.56 (1.03, 2.38) *	1.57 (1.05, 2.37) *

CI, confidence interval; RR, risk ratio.

Poisson regression, \*p < 0.05.

Model I: adjustment for age and sex at baseline.

Model II: Model I + additional adjustment for race, marital status, education, and household income at baseline.

Model III: Model II + additional adjustment for smoking, alcohol consumption, and physical exercise at baseline.

process of stress proliferation; for instance, social stressors such as family strain may multiply over time – or even across generations – in a form of proliferation that “disruptively spreads to important social relationships and adversely affects the lives of others in those relationships” [39,40]. Critically, the influence of chronic strains on mental health outcomes, including depression, has been shown to be greater than that of even traumatic events such as extreme threats to physical or psychological wellbeing [40]. Though, in the U.S. sample used for our study, working women experienced higher family strain than men, we did not observe significant effect modification by sex in the association of family strain with MDE, suggesting men were also affected by family strain in terms of negative familial relations, to some extent. The differential associations of job strain with risk of MDE among male and female workers suggest sex differences in the effects of psychosocial exposures on mental health. These results are consistent with previous findings that job strain is associated with an increased risk of depression in male workers more than in female workers [8,10–12,14]. However, they contrast with results from other studies of sex differences in job strain and depression, which found either no differences attributable to sex [6,13,16] or that women were more severely affected by job strain [9,15,17]. Several studies of psychosocial work factors may offer potential explanations regarding the observed sex differences. While the representation of women in the labor market has increased markedly in modern times, traditional sex roles remain in play; men are expected to be the breadwinners of the household, while women are expected to care for the family as housekeepers [41]. Men are more likely than women to opt for highly competitive occupations [42], subjecting them to higher

**Table 4**

Modification of the effect of job strain and family strain at baseline on major depressive episode at follow-up by sex (RRs and 95% CIs).

	Job strain		Effect of job strain within strata of sex
	Low	High	
Women (N = 776)	1.00	0.76 (0.40, 1.43) <i>p</i> = 0.39	0.76 (0.40, 1.43) <i>p</i> = 0.39
Men (N = 805)	0.60 (0.37, 0.98) <i>p</i> = 0.04	1.29 (0.72, 2.31) <i>p</i> = 0.39	2.14 (1.14, 4.03) <i>p</i> = 0.02
	Family strain		Effect of family strain within strata of sex
	Low	High	
Men (N = 805)	1.00	1.12 (0.55, 2.27) <i>p</i> = 0.76	1.12 (0.55, 2.27) <i>p</i> = 0.76
Women (N = 776)	1.03 (0.63, 1.70) <i>p</i> = 0.89	2.01 (1.17, 3.44) <i>p</i> = 0.01	1.94 (1.14, 3.30) <i>p</i> = 0.01

CI, confidence interval; RERI, relative excess risk due to interaction; RR, risk ratio.

Effect of job strain: Measure of effect modification by sex on additive scale: RERI (95% CI) = 0.93 (0.14, 1.72); *p* = 0.02.

Measure of effect modification by sex on multiplicative scale: ratio of RRs (95% CI) = 2.83 (1.16, 6.93); *p* = 0.02.

Effect of family strain: Measure of effect modification by sex on additive scale: RERI (95% CI) = 0.86 (−0.25, 1.96); *p* = 0.13.

Measure of effect modification by sex on multiplicative scale: ratio of RRs (95% CI) = 1.74 (0.72, 4.18); *p* = 0.22.

RRs were adjusted for age, race, marital status, education, household income, smoking, alcohol consumption, and physical exercise at baseline.

stress levels at work, and males are also more likely to experience a higher degree of work-related engagement (or over-engagement) [43] than women — for instance, the 2015 American Time Use Survey commissioned by the U.S. Bureau of Labor Statistics found that on average, men worked longer hours than women [44]. The mechanistic pathways that may lead to observed associations of job strain and family strain with depression are hypothesized to span multiple psychophysiological domains, including dysregulation of the hypothalamic-pituitary-adrenal axis, inflammatory processes, social isolation, and sleep disturbances [45]. Such perturbations can be chronic in nature and may exacerbate over time with persistent exposure.

This study exhibits strengths that are founded on the population and measures used in the MIDUS study. The MIDUS study sample was large, nationally representative, and featured a broad and diverse range of occupations, increasing confidence in the generalizability of the results. Furthermore, the study featured robust measures evidenced to be valid and reliable; the exposure measures of job strain and family strain were based on established scales [18,21,27], and the outcome measure of MDE was based on the strongly substantiated WHO CIDI-SF [31]. The use of the WHO CIDI-SF allowed for the examination of MDE as an outcome, as opposed to other studies which assessed depressive symptoms [6,12,13,17,22–24].

This study has several limitations. Most importantly, while the WHO CIDI-SF has high sensitivity and specificity [31], the interview questions only captured participants who experienced MDE during the past 12 months, whereas lifetime history of depression and the number of episodes of depression were not assessed. Although we excluded participants with MDE at baseline, the included participants may have experienced depressive episode prior to the past 12 months, but not within the past 12 months — we were unable to assess whether the included participants were truly free from MDE at baseline. Therefore, it seems difficult distinguishing incidence, relapse, or recurrence of MDE during the 9-year window preceding the follow-up survey. Furthermore, as other studies found that accounting for depressive symptoms at baseline attenuated associations between strain and clinical depression

[4], we constructed an additional regression model to adjust for psychological distress at baseline, which was measured by the Kessler Psychological Distress Scale (K6) [46], given the fact that routine scales for depressive symptoms such as CES-D and PHQ-9 were not included in the MIDUS II survey. As expected, a similar pattern of association attenuation was observed (details available upon request). Finally, information on the exposures of job strain and family strain was measured at baseline, and we cannot account for changes in these exposures during the 9-year follow up period between the measures of exposure and outcome, resulting in potential exposure misclassification bias. Although applying multiple measures of job strain across follow-up survey waves has been found to offer more precise estimates of risk [6], systematic reviews and meta-analyses have reported that single measures of job strain at baseline are also effective in predicting the risk of depression, with “no systematic differences in study-specific risk estimates by length of follow-up” [4].

The findings from this study demonstrate that family strain was associated with elevated risk of MDE, in a large sample of U.S. workers. Effect modification analyses by sex further indicated that job strain was associated with risk of MDE in men but not in women. The results of this study implicate job strain and family strain as potential key determinants of mental health and as independent risk factors for MDE. Job strain posits a promising locus of the psychosocial work environment to emphasize for workplace stress reduction interventions and health promotion programs targeting workers' mental health [47]. The efficacy of such programs may be improved by the intentional consideration of sex roles and settings beyond the workplace, as seen in integrated work-family balance interventions with the capacity to broadly address the impacts of psychosocial factors [48].

#### Statement of ethics

This study was reviewed and approved for exemption by the University of California, Los Angeles Institutional Review Board (IRB#20–001044).

#### Author contributions

J.L. conceived the research question and study design. T.A.M. prepared the data. T.A.M. and J.L. conducted the statistical analyses. T.A.M. and J.L. wrote the draft of the manuscript. W.R., M.P., and R.K. substantially contributed to the line of argumentation and revision of the manuscript. All authors read and approved the final version of the manuscript.

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#### Declaration of Competing Interest

The authors have no competing interests to report.

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