Abstract

Background: Industrial blue-collar workers face multiple work-related stressors, but evidence regarding the burden of mental illness among today's blue-collar men and women remains limited.

Methods: In this retrospective cohort study, we compared the health and employment records of 37,183 blue- and white-collar workers employed by a single U.S. aluminum manufacturer from 2003 - 2013. Using Cox proportional hazards regression, we modeled time to first episode of treated depression in blue- and white-collar men and women. Among cases, we modeled rates of monthly depression-related service utilization in blue- versus white-collar workers.

Results: Compared with their white-collar counterparts, blue-collar men were more likely to be treated for depression within study period (HR = 1.26, 95% CI 1.12- 1.41) as were blue-collar women **(**HR = 1.36, 1.16 – 1.59). Compared with white-collar men, blue-collar women were most likely to be treated for depression (HR = 3.20, 95% CI 2.96 – 3.47). In our analysis of monthly service utilization we found that blue-collar workers used depression-related services less frequently than their white-collar counterparts among both men (RR = 0.91, 95% CI 0.84 – 0.98) and women (RR = 0.82, 95% CI 0.77 – 0.88).

Conclusion: Blue-collar workers were more likely to experience depression than white-collar workers within the study period, and blue-collar women were most likely to be treated for depression as compared with white-collar men. However, blue-collar men and women utilized depression-related healthcare services less frequently than white-collar workers. In this insured population, these findings suggest that blue-collar workers may encounter barriers to care-seeking related mental illness other than their insurance status.

Keywords: Occupational class, manufacturing, depression, gender differences

Introduction

Increased risk of psychiatric distress is consistently observed among workers of lower occupational strata. [1-3] Similarly, prior research finds increased risk for depression and anxiety among industrial blue-collar workers as compared with white-collar workers who occupy a relatively higher social stratum. [4] Trends such as these may be explained by the fact that a predisposition towards mental illness may lead to downward social mobility into blue-collar jobs (i.e. "drift") or may preclude the attainment of socioeconomic position that otherwise might be expected (i.e. "selection"). Alternatively, aspects of blue-collar work may increase the risk of mental illness through an etiologic process or prolong the duration of symptoms. [5-7] These processes may work simultaneously to increase the burden of depresison among blue-collar workers, [2] although most longitudinal analyses of depression suggest socioeconomic position plays an etiologic role in the onset of depression. [8-11] Indeed, several aspects of blue-collar jobs – including physical demand; the monotonous, repetitive nature; oftentimes inflexible and demanding work hours; negative coworker interactions; and requirements to work quickly – as independent risk-factors for depression and anxiety. [12-16]

The existing literature on blue-collar workers' mental health faces at least two notable limitations, however. First, findings from present-day working-class populations remains scarce despite labor trends that have fundamentally altered the nature of blue-collar jobs over the past 30 years. In the United States, these trends include industry deregulation; technological innovations (computerization and automation); union decline and weakened institutional protections for workers; and an overall decline in manufacturing. [17-21] The net effect of these trends is that blue-collar jobs are increasingly scarce and decreasingly characterized by the benefits and statutory entitlements that once made them desirable.

Second, past research also largely fails to consider the mental health of women in industrial blue-collar jobs. Even within occupations, women often have different experiences with respect to pay, promotion, and assigned tasks as compared with men. [22,23] Women in blue-collar jobs may face a wide range of additional stressors including increased physical strain if tools and work arrangements are not optimized for female anthropometrics [22,24,25]; workplace-based sexual harassment and sex discrimination from managers and coworkers [26-29]; increased job insecurity and lack of control over work [28,30]; and greater conflict between work schedules and family obligations [31,32]. Careful study of female blue-collar workers' mental health should be further motivated by the fact that women now comprise a substantial proportion of the U.S. manufacturing workforce (approximately 29% in 2013), [33] and that in the general population, risk of mood disorders is approximately doubled in women as compared with men. [34-36]

In this retrospective cohort study, we characterize trends in depression by gender and occupational class among more than 37,000 men and women employed by a single U.S. aluminum manufacturer between 2003 and 2013. Because of substantive changes in blue-collar work in recent decades and the additional stressors faced by women in these jobs, our focus is on occupational class – which relates to social relations of ownership and control over productive assets – rather than occupational status, which refers to the ordering of persons along a continuum based on their socioeconomic attributes. To that end, white-collar workers constitute an appropriate comparison group insofar as their jobs are less likely to be characterized by isolation, temporal inflexibility, physical demand, or gender discrimination.

Our study had two primary scientific objectives. First, we modeled time to first episode of treated depression over the course of the study period among male and female blue- and white-collar workers. Second, among workers who experienced at least one episode of treated depression, we compared rates of monthly depression-related service utilization in blue- versus white-collar workers. We hypothesized *a priori* that – due to factors including selection, drift, and the wide range of stressors associated with blue-collar jobs – both male and female blue-collar workers would be more likely to experience depression and would utilize depression-related services more frequently than their counterparts in white-collar jobs.

Methods

Study Population and Design

We conducted a retrospective cohort study of workers employed by a single firm at one of 32 U.S. aluminum plants between January 1, 2003 and December 31, 2013. Study data were comprised of distinct administrative datasets. Individual records were deterministically linked across datasets with a unique, encrypted identifier. Complete medical claims data were available for workers enrolled in their local preferred provider organization (PPO) health insurance plan. We therefore examined health and employment records for all personnel who were actively employed and enrolled in their local PPO plan for at least one month throughout the study period (approximately 97% of workers). Plan characteristics have for this study population have been described in detail previously. Briefly, local PPO plans were identical with respect to coverage, including psychiatric services, and differed only with respect to family coverage and deductible rates. [37]

Follow-up for each worker extended from the date they first became eligible for insurance (on or after January 1, 2003) until either the end of eligibility or December 31, 2013. We restricted our cohort to workers between the ages of 18 and 65 at the start of follow-up. To ensure that retirees were excluded from our analysis, we further restricted our sample to workers hired after January 1, 1975 with activity in their employment records within three years of the date they first became eligible.

Occupational Class

Occupational class was ascertained from company personnel files. Consistent with previous analysis of these data, we classified hourly workers as blue-collar and salaried employees as white-collar. [38,39]

Depression Measures

We created two separate measures of depression using primary outpatient diagnostic codes from the International Classification of Diseases, Ninth Revisions (ICD-9) and records of filled prescriptions from medical claims. We included ICD-9 codes 293.84, 296.2 – 296.3, 300.00 – 300.02, 309 and 311 and prescriptions for antidepressants including selective serotonin reuptake inhibitors (SSRI), selective norepinephrine reuptake inhibitors (SNRI), tricyclic antidepressants (TCAs), and monoamine oxidase inhibitors (MAOIs).

First, we created a case definition for treated depression, which included all workers with at least two depression-related outpatient visits *or* two prescribed antidepressants within 365 days at any point throughout the study period. We defined the date of the first episode of treated depression as the date of the second prescribed antidepressant *or* the second depression-related outpatient visit (whichever came first). We intended this case definition to be sufficiently flexible so as to capture workers who were being actively treated for depression through pharmacotherapy, but were not being billed with a depression-specific ICD-9 code by their provider. Because study data lacked additional information regarding workers' past histories of mental illness, we were unable to differentiate between new-onset versus preexisting disease. Our measure therefore corresponds to the date of the first observed episode of treated depression within the study period.

Second, we calculated rates of monthly depression-related service utilization among the cases. For each case, we summed all months in which there was a depression-related outpatient visit or prescription, and divided this sum by the total duration of PPO eligibility in years. Because prescriptions varied in duration, we assumed that prescriptions lasting between 45 and 75 days were equivalent to two consecutive months of depression-related service utilization, and prescriptions lasting 75 to 95 days were equivalent to three consecutive months of service utilization. The final rate measure summarized the average number of months per year in which each case utilized depression-related services and was bounded between zero and 12 months per year. Any rate that exceeded the upper bound – which occurred for a small fraction of cases when prescriptions extended into periods of non-eligibility – was truncated at 12 months per year.

Covariates

Basic demographic characteristics (gender, age, race/ethnicity), plant location, and calendar year were derived from company personnel files. We created categorical variables for gender, race/ethnicity (white, Black, Hispanic, and other) and a set of indicator variables for plant location and calendar year. Using eligibility files, we measured the number of dependent children (i.e. children younger than 18) listed on their insurance policy for each worker for each year of follow-up. We created a categorical variable with levels zero, one, two, and three or more dependent children. We ascertained whether workers had a dependent spouse on their insurance policy for each year of follow-up using eligibility files.

We further characterized our study population by summarizing additional employment characteristics derived from personnel files, including whether workers were hired after the study period commenced (i.e. "new hires"); tenure at baseline for workers hired prior to the study period began; and annual wages at the start of follow-up, which we ascertained using W2 data. These variables were were not included in any multivariable analyses since they are temporally preceded by occupational status and therefore cannot confound the association between blue-collar status and depression.

Analysis of Gender, Occupational Class, and Treated Depression

We first modeled time to first episode of treated depression among blue- versus white-collar workers separately for men and women. Next, we conducted a pooled analysis of male and female workers in which we examined the time to first episode of treated depression among blue-collar women, blue-collar men, and white-collar women as compared with white-collar men.

For both analyses, we used Cox proportional hazards regression with attained age as the underlying time scale. Age of entry was defined as age at the start of follow-up for each worker (on or after January 1, 2003). We allowed for changes in occupational class over the course of follow-up with time-varying exposure variables. We adjusted for potential confounders, including race/ethnicity, dependent spouse, and number of dependent children. We accounted for regional differences in mental health provider network with fixed effects for plant location. Secular trends in mental healthcare utilization (i.e. before and after the Great Recession) have been studied previously in this study population. [40] In this analysis, we accounted for secular trends in mental healthcare utilization with fixed effects for calendar year.

Analysis of Monthly Depression-Related Service Utilization

Next, we modeled the rate ratio for monthly depression-related service utilization among blue- and white-collar workers for men and women separately. We used generalized linear models (GLM) with the gamma family and log link. Gamma regression is an alternative to linear regression with log transformation that is appropriate for positive, right-skewed, and continuous outcomes as was the case for our rate measure. [41] Regression models were simultaneously adjusted for age, age squared, calendar year, race/ethnicity, number of dependent children, marital status, and plant location. Age was mean-centered and rescaled such that model coefficients correspond to the change in utilization rates for a 10-year increase in age. Values for all covariates were taken at the start of follow-up.

To account for non-independence of workers within plant locations (i.e. clustering), we used a cluster bootstrap approach to estimate 95% confidence intervals and resampled at the level of the plant location in all analyses. All statistical analyses were performed with R version 3.2.3. This study was approved by the Institutional Review Boards at the University of California, Berkeley and Stanford Univeristy.

Sensitivity Analyses

Past research suggests reasonable concordance between medical claims and medical records or self-report.[42-44] The use of medical insurance claims data to define various health outcomes – including depression and anxiety – have also been described previously for this study population.[40,45,46] To assess the robustness of outcomes defined using medical claims in the present study, we created six alternative case definitions for treated depression, ranging from very sensitive (i.e., first prescribed antidepressant) to

very specific (i.e., two outpatient visits plus one prescription within 365 days). We additionally assessed the robustness of our findings to the inclusion and exclusion of anxiety-related diagnostic codes (ICD9 293.84, 300.00 – 300.02).

Additional sensitivity analyses included an analysis of time to first episode of treated depression *among* workers hired after the start of follow-up (i.e. after January 1, 2003) and separate assessment of the counts of unique depression-related outpatient visits and prescriptions by occupational class.

Results

Of the 37,201 workers who satisfied the inclusion criteria, we excluded 17 for whom race/ethnicity was missing. Our final study sample included 7,148 women followed for 309,565 person-months and 30,035 men followed for 1,681,394 person-months. Demographic, employment, and health characteristics for the study sample are presented in Table 1. The majority of workers had blue-collar jobs for both women (73.9%) and men (80.3%). Examples of blue-collar job titles included material handler, machine operator, and pot tender. White-collar job titles included human resources manager, senior general accountant, and associate electrical engineer. A small fraction of white collar workers had supervisory roles in the factory environment (i.e. production supervisors). Only a small percentage of workers (3.7%) were promoted from blue- to white-collar status over the course of the study period.

As compared with blue-collar workers, white-collar workers were more likely to be white with higher median annual wages at baseline. Male workers were more likely to have a dependent spouse and dependent children on their health insurance plan at baseline. Using our primary case definition, there were 1,903 blue-collar women (36.0%) and 629 white-collar women (33.7%) who were treated for depression throughout study period. Among men, 4,689 blue-collar workers (19.4%) and 1,171 white-collar workers (19.8%) were treated for depression (Table 1). Among the cases, we find that half of workers received treatment for depression through a combination of outpatient visits and prescriptions (50.1%), although many cases were treated exclusively through prescriptions for antidepressants (37.3%) and a minority of cases were treated exclusively in outpatient visits. Median rates of depression-related service utilization were higher in white-collar workers for both men and women (Table 1 and eFigures 1 and 2 in the Supplemental Materials).

<u>Gender, Occupational Class, and Treated Depression</u>

Among men, blue-collar workers were more likely to be treated for depression over the study period as compared with white-collar workers (Hazard Ratio = 1.26, 95% CI 1.12- 1.41). Similarly, blue-collar women were more likely to be treated for depression as compared with white-collar women **(**HR = 1.36, 1.16 – 1.59) (Table 2, eFigures 1 and 2). In our pooled analysis of all workers, we find that blue-collar women are most likely to be treated for depression as compared with white-collar men (HR = 3.20, 95% CI 2.96 – 3.47), followed by white-collar women (HR = 2.37, 95% CI 2.15 – 2.61) and blue-collar men (HR = 1.26, 95% CI 1.18 – 1.35). For both men and women, workers with dependent children were more likely to be treated for depression whereas non-white workers were less likely to be treated for depression over the study period (Table 2, Table 3).

<u>Rates of Monthly Depression-Related Service Utilization</u>

Among workers treated for depression, blue-collar men and women utilized depression-related healthcare services less frequently than their white-collar counterparts. The rate of monthly depression-related service utilization among blue-collar men was 0.91 times the rate of monthly utilization among white-collar men (95% CI 0.84 – 0.98). Similarly, the rate of monthly depression-related service utilization among blue-collar women was 0.82 times that of white-collar women (95% CI 0.77 – 0.88). For both men and women, rates were decreased among those with dependent children and among non-white workers (Table 4, eFigures 3 and 4).

Sensitivity Analyses

To assess the robustness of outcome, we created six alternative case definitions and further assessed whether results were sensitive to the exclusion of anxiety-related outpatient visits (Figure 2). We found that HRs for time to first depression onset were consistent across all case specifications (top panel). Results were slightly attenuated with the exclusion of anxiety-related outpatient visits (bottom panel). We summarize our six alternative case definitions as well as HRs and 95% CI from Cox proportional hazards regression in the Supplemental Materials (eTable 1).

Next, we modeled time to first episode of treated depression *since hire* by restricting our analysis to workers hired after the start of follow-up (eTable 2). Consistent with our primary analysis, blue-collar men hired after the start of follow-up were more likely to be treated for depression (1.26, 1.06 – 1.50). However, in contrast with findings from our primary analysis, we found no evidence that blue-collar women were more likely to be treated for depression than white-collar women among the new hires (0.95, 0.80 – 1.11).from our analyses of the counts of unique depression-related outpatient visits and prescriptions, respectively, were consistent with findings from our analysis of the rate of monthly depression-related service utilization (eTables 3 and 4).

Discussion

In this retrospective cohort study, we characterized trends in depression by gender and occupational class among more than 37,000 men and women employed by a single U.S. aluminum manufacturer between 2003 and 2013. We first modeled time to first episode of treated depression in blue- versus white-collar workers separately for men and women. We next examined the joint implications of gender and occupational class by modeling time to first episode of treated depression among blue-collar women, blue-collar men, and white-collar women as compared to a reference group of white-collar men. Finally, we modeled the rate ratio for monthly depression-related service utilization in blue- versus white-collar workers for men and women separately. All workers in our study population received health insurance from their employer, and psychiatric services were covered through local PPO plans for all workers.

Overall, we observed that women were more likely than to be treated for depression within the study period. This finding is consistent with the greater propensity to seek mental health treatment [47] and higher frequency of affective disorders or mental distress that is consistently documented among women in the general population. [34] Among both men and women, we found that blue-collar workers were more likely to be treated for depression at least once over the study period as compared with white-collar workers. This finding was robust to specification of a wide range of alternative case definitions and to exclusion of anxiety-related ICD-9 codes, although . In our pooled analysis of male and female workers, we found that blue-collar women were more than three times as likely to experience an episode of treated depression within the study period as compared with white-collar men, which underscores that women in blue-collar jobs may uniquely susceptible to depression. Non-white workers were less likely to experience depression throughout the study period, which may reflect decreased propensity to seek care in general or greater stigma surrounding mental illness within racial and ethnic minority groups. [48-50]

The trends in depression we observed by occupational class may reflect a variety of factors, such as the downward social mobility among individuals predisposed to mental illness (i.e. “drift”); the downward selection into lower occupational strata than would otherwise be expected; or an etiologic role of work in onset or exacerbation of underlying depression. [5-7] Aspects of the blue-collar work environment that may lead to depression onset include physical demand; the monotonous, repetitive nature of production; inflexible and demanding work hours; negative coworker interactions; and requirements to work quickly. [12-16] Among female blue-collar workers, physical strain, sexual harassment and discrimination, job insecurity and lack of control over work, and work-life conflict may also contribute to onset of depression or exacerbate underlying disease. [22,24-32] For today’s blue-collar worker, these stressors exist within the

broader context of economic uncertainty, real or perceived job insecurity, and weakened statutory entitlements and protections.

As a sensitivity analysis, we restricted our analysis to workers hired after the start of follow-up and modeled time to first episode of treated depression *since hire*. Consistent with findings for all male workers, we find that blue-collar men hired after the start of follow-up are more likely to be treated for depression within the study period as compared with white-collar men. However, we find no evidence that blue-collar women hired after the start of follow-up were more likely to experience depression. While there is no clear, single explanation for the observed heterogeneity among female workers, our findings could reflect a higher burden of depression among newly hired white-collar women, a decreased burden of depression among newly hired blue-collar women, or greater stigma and less permissive norms surrounding mental healthcare utilization among women newly hired into blue-collar jobs.

Finally, we examined rates of monthly depression-related healthcare utilization over the course of the study period among workers treated for depression. We hypothesized that blue-collar workers would utilize depression-related services more frequently. We found, however, that although blue-collar men and women were more likely to be treated for depression, they utilized depression-related services less frequently than white-collar workers. This finding cannot be explained by systematic differences in insurance status. Less frequent service utilization may reflect systematically less severe depression among blue-collar men and women. Perhaps more plausibly, lower rates among blue-collar workers may reflect barriers to mental healthcare service utilization other than insurance status, including greater stigma or less permissive norms surrounding mental healthcare utilization in working class populations; scheduling demands and temporal inflexibility associated with hourly work; blue-collar workers' sensitivity to the out-of-pocket costs associated with service utilization; or provider behaviors.

Limitations

There are a number of limitations of the study data and our analysis. Our analyses are based on data from a single firm and may therefore have limited generalizability even to other manufacturers due to differences in organizational culture and institutional practices that may affect worker mental health and mental healthcare utilization. No direct measures of household composition were available in our data, and we ascertained whether workers had a dependent spouse or child on their health insurance policy each year. These measures are likely to systematically underestimate parity and marital status, especially for women, but nevertheless may be an important indicator of each workers economic responsibilities towards household members. We were also unable to adjust for several characteristics – including previous employment and educational attainment – that likely confound our analyses.

Because these data lack accurate job title information, our analysis entailed comparison of two broad and heterogeneous groups – blue- and white-collar workers. Some white-collar jobs may be characterized by work experiences that are similar to blue-collar jobs and vice versa. For example, production managers and supervisors are white-collar workers whose jobs may entail exposure to physical demand, occupational hazards and social environment that is similar or equivalent to those of blue-collar workers. Similarly, clerical workers may be more equivalent to blue-collar workers with respect to their control over work and job security. This heterogeneity inherent in our definition of occupational class is equivalent to exposure misclassification.

Finally, there are at least three notable limitations related to our outcome of interest. First, absent any information on workers' past histories of mental illness, we are unable to differentiate between incident and prevalent depression, even among new hires. Second, we anticipate that outcome misclassification is likely. Because we measured depression outcomes using medical claims, our case definition does not capture untreated depression or treatment for depression received outside of the worker's PPO network. It is commonly noted that the majority of individuals with psychiatric illness do not receive treatment, [51] and moreover it cannot be assumed that treated depression is more severe than untreated depression given

multiple cultural and economic pathways to treatment.[52,53] Finally, we are unable to identify instances of off-label antidepressant prescriptions (for fibromyalgia, neuropathic pain, or other psychiatric morbidities). Unless these sources of outcome misclassification are collectively differential with respect to occupational class, however, we anticipate their effect would be to attenuate study findings.

Conclusion

In the present study, we found that blue-collar workers were more likely to be treated for depression within study period than white-collar workers, and that blue-collar women were most likely to be treated for depression as compared with white-collar men. Among both men and women, non-white workers were less likely to experience depression throughout the study period. In our analysis of depression-related service utilization, we found that blue-collar men and women utilized depression-related services less frequently than their white-collar counterparts. In this insured population, our findings may reflect additional barriers to mental healthcare utilization among blue-collar workers including increased stigma or less permissive norms around mental healthcare utilization; provider behavior; temporal inflexibility; blue-collar workers' greater sensitivity mental healthcare costs. As many of these barriers are potentially modifiable, future public health research may aim to identify the predominant mechanisms that explain systematic differences in mental healthcare utilization by occupational class that we have observed.

References

1. Muntaner C, Eaton W, Diala C, Kessler R, Sorlie P. Social class, assets, organizational control and the prevalence of common groups of psychiatric disorders. *Social science & medicine* 1998;**47**(12):2043-2053.
2. Eaton WW, Muntaner C, Bovasso G, Smith C. Socioeconomic status and depressive syndrome: the role of inter-and intra-generational mobility, government assistance, and work environment. *Journal of Health and Social Behavior* 2001;**42**(3):277.
3. Eaton WW, Muntaner C. Socioeconomic Stratification and Mental Disorder. In: Horwitz AV, Scheid TL, eds. *Sociology of Mental Health and Illness*. New York, NY: Cambridge University Press, 1999;259 - 283.
4. Joensuu M, Väänänen A, Koskinen A, Kivimäki M, Virtanen M, Vahtera J. Psychosocial work environment and hospital admissions due to mental disorders: a 15-year prospective study of industrial employees. *Journal of affective disorders* 2010;**124**(1):118-125.
5. Eaton WW. *The sociology of mental disorders* Praeger Publishers, 2001.
6. Dohrenwend BP, Levav I, Shrout PE, Schwartz S, Naveh G, Link BG, Skodol AE, Stueve A. Socioeconomic status and psychiatric disorders: the causation-selection issue. *Science* 1992;**255**(5047):946-952.
7. Muntaner C, Eaton WW, Miech R, O'campo P. Socioeconomic position and major mental disorders. *Epidemiologic reviews* 2004;**26**(1):53-62.
8. Wheaton B. The sociogenesis of psychological disorder: Reexamining the causal issues with longitudinal data. *American Sociological Review* 1978:383-403.
9. Johnson JG, Cohen P, Dohrenwend BP, Link BG, Brook JS. A longitudinal investigation of social causation and social selection processes involved in the association between socioeconomic status and psychiatric disorders. *Journal of abnormal psychology* 1999;**108**(3):490.
10. Miech RA, Caspi A, Moffitt TE, Wright BRE, Silva PA. Low socioeconomic status and mental disorders: a longitudinal study of selection and causation during young adulthood. *American journal of Sociology* 1999;**104**(4):1096-1131.
11. Power C, Stansfeld SA, Matthews S, Manor O, Hope S. Childhood and adulthood risk factors for socio-economic differentials in psychological distress: evidence from the 1958 British birth cohort. *Social science & medicine* 2002;**55**(11):1989-2004.
12. DeSanto IJ, Cullen MR, Cantley L, Slade MD, Fiellin M, Kasl SV. Effects of externally rated job demand and control on depression diagnosis claims in an industrial cohort. *American Journal of Epidemiology* 2010;**171**(3):303 - 311.
13. Kawamaki N, Haratani T, Araki S. Effects of perceived job stress on depressive symptoms in blue-collar workers of an electrical factory in Japan. *Scandinavian Journal of Work, Environment, and Health* 1992;**18**:195-200.
14. Kawamaki N, Araki S, Kawashima M, Masumoto T, Hayashi T. Effects of work-related stress reduction on depressive symptoms among Japanese blue-collar workers. *Scandinavian Journal of Work, Environment, and Health* 1997;**23**:54-59.
15. d'Errico A, Cardano M, Landriscina T, Marinacci C, Pasian S, Petrelli A, Costa G. Workplace stress and prescription of antidepressant medications: A prospective study on a sample of Italian workers. *International Archives of Occupational and Environmental Health* 2011;**4**:413 - 424.
16. Cohidon C, Santin G, Imbernon E, Goldberg M. Working conditions and depressive symptoms in the 2003 decennial health survey: The role of the occupational category. *Social Psychiatry and Psychiatric Epidemiology* 2010;**45**(12):1135 - 1147.
17. Arnold D, Bongiovi JR. Precarious, Informalizing, and Flexible Work: Transforming Concepts and Understandings. *American Behavioral Scientist* 2012;**57**(3):289 - 308.
18. Berman E, Bound J, Griliches Z. Changes in the demand for skilled labor within US manufacturing: Evidence from the annual survey of manufacturers. *The Quarterly Journal of Economics* 1994;**109**(2):367 - 397.

19. Navarro V. The labor process and health: a historical materialist interpretation. *International Journal of Health Services* 1982;**12**(1):5-29.
20. Kalleberg AL. Job Quality and Precarious Work: Clarifications, Controversies, and Challenges. *Work and Occupations* 2012;**39**(4):427 - 448.
21. Kalleberg AL. Precarious Work, Insecure Workers: Employment Relations in Transition. *American Sociological Review* 2009;**74**:1 - 22.
22. Messing K, Dumais L, Courville J, Seifert AM, Boucher M. Evaluation of exposure data from men and women with the same job title. *Journal of occupational medicine.: official publication of the Industrial Medical Association* 1994;**36**(8):913-917.
23. Reskin BF, Padavic I. Men and women at work. *Thousand Oaks, CA: Pine ForgePress. ReskinMen and women at work1994* 1994.
24. Courville J, Vézina N, Messing K. Comparison of the work activity of two mechanics: a woman and a man. *International Journal of Industrial Ergonomics* 1991;**7**(2):163 - 174.
25. Messing K, Lippel K, Demers D, Mergler D. Equality and difference in the workplace: Physical job demands, occupational illnesses, and sex differences. *NWSA Journal* 2000:21-49.
26. Mansfield PK, Koch PB, Henderson J, Vicary JR, Cohn M, Young EW. The job climate for women in traditionally male blue-collar occupations. *Sex Roles* 1991;**25**(1-2):63-79.
27. Gruber JE. The impact of male work environments and organizational policies on women's experiences of sexual harassment. *Gender & Society* 1998;**12**(3):301-320.
28. Gruber JE, Bjorn L. Blue-collar blues: The sexual harassment of women autoworkers. *Work and Occupations* 1982;**9**(3):271-298.
29. Maypole DE, Skaine R. Sexual harassment of blue collar workers. *J. Soc. & Soc. Welfare* 1982;**9**:682.
30. Harrell WA. Perceived risk of occupational injury: Control over pace of work and blue-collar versus white-collar work. *Perceptual and motor skills* 1990;**70**(3_suppl):1351-1359.
31. Hocschild A, Machung A. *The Second Shift: Working Families and the Revolution at Home* Penguin Books, 2012.
32. Messing K, Punnett L, Bond M, Alexanderson K, Pyle J, Zahm SH, Wegman D, Sctock SR, de Grosbois S. Be the fairest of them all: challenges and recommendations for the treatment of gender in occupational health research. *American Journal of Industrial Medicine* 2003;**43**(6):618 - 629.
33. U.S. Bureau of Labor Statistics. Women in the labor force: a databook. https://www.bls.gov/opub/reports/womens-databook/2016/home.htm Accessed July 13, 2018.
34. Kessler RC, Berglund P, Demler O, Jin R, Koretz D, Merikangas KR, Rush AJ, Walters EE, Wang PS. The epidemiology of major depressive disorder: results from the National Comorbidity Survey Replication (NCS-R). *Jama* 2003;**289**(23):3095-3105.
35. Kessler RC. Epidemiology of women and depression. *Journal of affective disorders* 2003;**74**(1):5-13.
36. Rutter M, Caspi A, Moffitt TE. Using sex differences in psychopathology to study causal mechanisms: unifying issues and research strategies. *Journal of Child Psychology and Psychiatry* 2003;**44**(8):1092-1115.
37. Einav L, Finkelstein A, Pascu I, Cullen MR. How general are risk preferences? Choices under uncertainty in different domains. *American Economic Review* 2012;**102**(6):2606-38.
38. Clougherty JE, Eisen EA, Slade MD, Kawachi I, Cullen MR. Gender and sex differences in job status and hypertension. *Occupational and Environmental Medicine* 2011;**68**(1):16-23.
39. Clougherty JE, Eisen EA, Slade MD, Kawachi I, Cullen MR. Workplace status and risk of hypertension among hourly and salaried aluminum manufacturing employees. *Social science & medicine* 2009;**68**(2):304-313.
40. Modrek S, Hamad R, Cullen MR. Psychological well-being during the great recession: changes in mental health care utilization in an occupational cohort. *American Journal of Public Health* 2015;**105**(2):304-310.

41. Faraway JJ. *Extending the linear model with R: generalized linear, mixed effects and nonparametric regression models*. Vol. 124 CRC press, 2016.
42. Quam L, Ellis LB, Venus P, Clouse J, Taylor CG, Leatherman S. Using claims data for epidemiologic research: the concordance of claims-based criteria with the medical record and patient survey for identifying a hypertensive population. *Medical care* 1993:498-507.
43. Fowles JB, Fowler EJ, Craft C. Validation of claims diagnoses and self-reported conditions compared with medical records for selected chronic diseases. *The Journal of ambulatory care management* 1998;**21**(1):24-34.
44. Jiang L, Zhang B, Smith ML, Lorden AL, Radcliff TA, Lorig K, Howell BL, Whitelaw N, Ory MG. Concordance between self-reports and Medicare claims among participants in a national study of chronic disease self-management program. *Frontiers in public health* 2015;**3**:222.
45. Cullen MR, Vegso S, Cantley L, Galusha D, Rabinowitz P, Taiwo O, Fiellin M, Wennberg D, Iennaco J, Slade MD, Sircar K. Use of medical insurance claims data for occupational health research. *Journal of Occupational and Environmental Medicine* 2006;**48**(10):1054 - 1061.
46. Modrek S, Cullen MR. Health consequences of the 'Great Recession'on the employed: evidence from an industrial cohort in aluminum manufacturing. *Social Science & Medicine* 2013;**92**:105-113.
47. Mojtabai R. Use of specialty substance abuse and mental health services in adults with substance use disorders in the community. *Drug & Alcohol Dependence* 2005;**78**(3):345-354.
48. Gary FA. Stigma: Barrier to mental health care among ethnic minorities. *Issues in mental health nursing* 2005;**26**(10):979-999.
49. Yeh M, McCabe K, Hurlburt M, Hough R, Hazen A, Culver S, Garland A, Landsverk J. Referral sources, diagnoses, and service types of youth in public outpatient mental health care: A focus on ethnic minorities. *The journal of behavioral health services & research* 2002;**29**(1):45-60.
50. Wells K, Klap R, Koike A, Sherbourne C. Ethnic disparities in unmet need for alcoholism, drug abuse, and mental health care. *American Journal of Psychiatry* 2001;**158**(12):2027-2032.
51. Wang PS, Lane M, Olfson M, Pincus HA, Wells KB, Kessler RC. Twelve-month use of mental health services in the United States: results from the National Comorbidity Survey Replication. *Archives of general psychiatry* 2005;**62**(6):629-640.
52. Pescosolido BA, Gardner CB, Lubell KM. How people get into mental health services: Stories of choice, coercion and "muddling through" from "first-timers". *Social science & medicine* 1998;**46**(2):275-286.
53. Pescosolido BA, Martin JK, Long JS, Medina TR, Phelan JC, Link BG. "A disease like any other"? A decade of change in public reactions to schizophrenia, depression, and alcohol dependence. *American Journal of Psychiatry* 2010;**167**(11):1321-1330.

Table 1. Baseline Demographic, Employment, and Health Characteristics for Active Workers at 32 U.S. Aluminum Plants, 2003 – 2013

	Women (N = 7,148)		**Men** (N = 30,035)	
	Blue-Collar (N = 5,279)	**White-Collar** (N = 1,869)	**Blue-Collar** (N = 24,124)	**White-Collar** (N = 5,911)
Demographic Characteristics				
Age – Median (IQR)	43.9 (35.5 – 51.0)	41.3 (31.6 – 48.8)	42.2 (31.9 – 50.8)	43.8 (35.7 – 50.2)
Race – N (%)				
White	3,427 (64.9)	1,513 (81.0)	17,561 (72.8)	5,004 (84.7)
Black	871 (16.5)	164 (8.8)	2,585 (10.7)	355 (6.0)
Hispanic	748 (14.2)	101 (5.4)	2,839 (11.8)	278 (4.7)
Other	233 (4.4)	91 (4.9)	1,139 (4.7)	274 (4.6)
Dependent Spouse – N (%)	2,033 (38.5)	820 (43.9)	15,213 (63.1)	4,487 (75.9)
Number of Dependent Children – N (%)				
None	3,247 (61.5)	1,239 (66.3)	12,875 (53.4)	2,844 (48.1)
One	1,007 (19.1)	310 (16.6)	4,457 (18.5)	1,151 (19.5)
Two	655 (12.4)	231 (12.4)	4,093 (17.0)	1,237 (20.9)
Three or more	370 (7.0)	89 (4.8)	2,699 (11.2)	679 (11.5)
Employment Characteristics				
New Hires – N (%)	2,446 (46.3)	831 (44.5)	10,053 (41.7)	1,974 (33.4)
Tenure at Baseline (Years)[a] – Median (IQR)	2.9 (1.0 – 5.2)	5.0 (1.8 – 15.3)	5.5 (2.0 – 19.3)	4.0 (1.4 – 16.9)
Annual Wages[b] **–** Median	$28.9K (16.9 – 39.6)	$46.4K (31.3 – 60.8)	$39.5 (22.8 – 49.9)	$59.0 (42.0 – 76.4)
Health Characteristics				
Person-Months of Follow-Up – N	221,210	88,355	1,301,649	379,745
Number of Cases – N (%)[c]	1,903 (36.0)	629 (33.7)	4,689 (19.4)	1,171 (19.8)
Avg. Utilization Rate for Cases[d] **–** Median (IQR)	2.82 (1.00 – 7.02)	4.00 (1.43 – 8.58)	2.08 (0.73 – 5.82)	2.61 (0.8 – 7.2)

a. Tenure at baseline is calculated for workers who were hired prior to the start of follow-up on January 1, 2003
b. Wage data are missing for 200 women and 809 men
c. We define the date of the first depression episode within the study period as the second depression-related outpatient visit *or* the second prescribed antidepressant within 365 days (whichever was first). Depression-related outpatient visits were identified using ICD-9 codes 293.84, 296.2 – 296.3, 300, 309, and 311; antidepressants included selective serotonin reuptake inhibitors (SSRI); selective norepinephrine reuptake inhibitors (SNRI); tricyclic antidepressants (TCAs) and monoamine oxidase inhibitors (MAOIs).
d. Average utilization rates for cases correspond to the sum of all months in which there was either a depression-relate outpatient visit or filled prescription for a prescribed antidepressant by the total duration of PPO eligibility in years, taking into account prescription duration.

Table 2. Adjusted hazards ratios time to first depression episode among blue- and white-collar workers

Covariates [a]	**Women** (N = 7,148)			**Men** (N = 30,035)		
	Workers	**Cases – N** (%)[b]	**Hazard Ratios** [c] (95% CI)	**Workers**	**Cases – N** (%)[b]	**Hazard Ratios** [c] (95% CI)
Occupational Class						
White-Collar	1,869	629 (33.7)	1.00	5,911	1,171 (19.8)	1.00
Blue-Collar	5,279	1,866 (35.3)	1.36 (1.16 – 1.59)	24,124	4,689 (19.4)	1.26 (1.12 – 1.41)
Dependent Children						
None	4,486	1,570 (35.0)	1.00	15,719	2,906 (18.5)	1.00
One	1,317	482 (35.6)	1.11 (1.00 – 1.24)	5,608	1,111 (19.8)	1.07 (0.98 – 1.17)
Two	886	303 (34.2)	1.08 (0.91 – 1.28)	5,330	1,185 (22.0)	1.18 (1.07 – 1.34)
Three or more	459	140 (30.5)	1.27 (1.05 – 1.54)	3,378	658 (19.5)	1.19 (1.07 – 1.32)
Dependent Spouse						
No	4,295	1,400 (32.6)	1.00	10,335	1,414 (13.7)	1.00
Yes	2,853	1,095 (38.4)	0.90 (0.83 – 0.97)	19,700	4,446 (22.6)	1.02 (0.95 – 1.10)
Race/Ethnicity						
White	4,940	1,990 (40.3)	1.00	22,565	5,092 (22.6)	1.00
Black	1,035	245 (23.7)	0.50 (0.42 – 0.60)	2,940	278 (9.5)	0.46 (0.34 – 0.62
Hispanic	839	195 (23.2)	0.75 (0.63 – 0.91)	3,117	387 (12.4)	0.73 (0.62 – 0.87)
Other	334	65 (19.5)	0.52 (0.32 – 0.82)	1,413	103 (7.3)	0.43 (0.29 – 0.63)

a. Attained age is used as the timescale, and models additionally include fixed effects for plant location and calendar year.

b. We define the date of the first depression episode within the study period as the second depression-related outpatient visit *or* the second prescribed antidepressant within 365 days (whichever was first). Depression-related outpatient visits were identified using ICD-9 codes 293.84, 296.2 – 296.3, 300, 309, and 311; antidepressants included selective serotonin reuptake inhibitors (SSRI); selective norepinephrine reuptake inhibitors (SNRI); tricyclic antidepressants (TCAs) and monoamine oxidase inhibitors (MAOIs).

c. We estimated 95% confidence intervals by resampling from plant location using a cluster bootstrap with 1,000 repetitions.

Table 3. Adjusted hazards ratios time to first depression episode by gender and occupational class

Covariates [a]	**All Workers** (N = 37,183)		
	Workers	**Cases – N** (%)[b]	**Hazard Ratios** [c] (95% CI)
Gender and Occupational Class			
White-Collar Men	5,911	1,171 (19.8)	1.00
Blue-Collar Men	24,124	4,689 (19.4)	1.26 (1.18 – 1.35)
White-Collar Women	1,869	629 (33.7)	2.37 (2.15 – 2.61)
Blue-Collar Women	5,279	1,866 (35.3)	3.20 (2.96 – 3.47)
Dependent Children			
None	20,205	4,476 (22.2)	1.00
One	6,925	1,593 (23.0)	1.08 (1.02 – 1.15)
Two	6,216	1,488 (23.9)	1.17 (1.09 – 1.25)
Three or more	3,837	798 (20.8)	1.20 (1.10 – 1.30)
Dependent Spouse			
No	14,630	2,814 (19.2)	1.00
Yes	22,553	5,541 (24.6)	0.97 (0.92 – 1.02)
Race/Ethnicity			
White	20,205	7,082 (35.1)	1.00
Black	3,975	523 (13.2)	0.48 (0.44 – 0.53)
Hispanic	3,966	582 (14.7)	0.73 (0.66 – 0.81)
Other	1,737	168 (9.6)	0.46 (0.39 – 0.54)

a. Attained age is used as the timescale, and models additionally include fixed effects for plant location and calendar year.

b. We define the date of the first depression episode within the study period as the second depression-related outpatient visit *or* the second prescribed antidepressant within 365 days (whichever was first). Depression-related outpatient visits were identified using ICD-9 codes 293.84, 296.2 – 296.3, 300, 309, and 311; antidepressants included selective serotonin reuptake inhibitors (SSRI); selective norepinephrine reuptake inhibitors (SNRI); tricyclic antidepressants (TCAs) and monoamine oxidase inhibitors (MAOIs).

c. We estimated 95% confidence intervals by resampling from plant location using a cluster bootstrap with 1,000 repetitions.

Table 4. Adjusted rate ratios for monthly depression-related service utilization within the study period among the cases [a]

Covariates [b]	**Women** (N = 2,495)		**Men** (N = 5,860)	
	Workers (%)	**Rate Ratios (95% CI)** [d,e]	**Workers** (%)	**Rate Ratios (95% CI)** [d,e]
Age [c]		1.16 (1.12 – 1.22)		1.21 (1.19 – 1.24)
Age Squared		0.99 (0.95 – 1.02)		0.99 (0.79 – 1.01)
Occupational Class				
White-Collar	592 (23.7)	1.00	1,065 (18.2)	1.00
Blue-Collar	1,903 (76.3)	0.82 (0.77 – 0.88)	4,795 (81.8)	0.91 (0.84 – 0.98)
Dependent Children				
None	1,433 (57.4)	1.00	2,566 (43.8)	1.00
One	514 (20.6)	0.87 (0.77 – 1.00)	1,183 (20.2)	0.86 (0.79 – 0.94)
Two	348 (13.9)	0.81 (0.72 – 0.91)	1,274 (21.7)	0.91 (0.85 – 0.97)
Three or more	200 (8.0)	0.71 (0.61 – 0.82)	837 (14.3)	0.86 (0.80 – 0.94)
Dependent Spouse				
No	1,412 (56.6)	1.00	1,506 (25.7)	1.00
Yes	1,083 (43.4)	0.97 (0.92 – 1.03)q	4,354 (74.3)	0.99 (0.92 – 1.06)
Race/Ethnicity				
White	1,990 (79.8)	1.00	5,092 (86.9)	1.00
Black	245 (9.8)	0.68 (0.61 – 0.76)	278 (4.7)	0.57 (0.45 – 0.71)
Hispanic	195 (7.8)	0.72 (0.59 – 0.89)	387 (6.6)	0.63 (0.55 – 0.73)
Other	65 (2.6)	0.85 (0.68 – 1.06)	103 (1.8)	0.76 (0.63 – 0.93)

a. Analysis is restricted to workers who satisfied our primary case definition for depression (N = 8,355).
b. We used a generalized linear model with the gamma distribution and log link to estimate average rate ratios. Both models include fixed effects for plant location.
c. Age was mean-centered and rescaled such that average rate ratios correspond to a 10-year increase in age.
d. Average utilization rates for cases correspond to the sum of all months in which there was either a depression-relate outpatient visit or filled prescription for a prescribed antidepressant by the total duration of PPO eligibility in years, taking into account prescription duration. Depression-related outpatient visits were identified using ICD-9 codes 293.84, 296.2 – 296.3, 300, 309, and 311; antidepressants included selective serotonin reuptake inhibitors (SSRI); selective norepinephrine reuptake inhibitors (SNRI); tricyclic antidepressants (TCAs) and monoamine oxidase inhibitors (MAOIs).
e. We estimated 95% confidence intervals by resampling from plant location using a cluster bootstrap with 1,000 repetitions.