Identifying the Mechanisms for Workplace Burden of Psychiatric Illness

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Background: Although previous research indicates that mental disorders detract from labor market outcomes, little is known about which psychiatric symptoms are most important.

Objective: The objective of this study was to identify the mechanisms, or most important symptoms, through which psychiatric disorders affect labor market outcomes. We focus on major depressive episode, panic attack, social phobia, and generalized anxiety disorder. Our approach builds on prior work in that we consider the effects of symptoms both among individuals meeting and among individuals not meeting the diagnostic criteria for mental disorders.

Research Design: Data were obtained from the National Comorbidity Survey Replication and the National Latino and Asian American Study. We used a structural equation model with latent indices for mental disorders, where the indices are generated from the model using multiple indicators (symptoms) and multiple causes of the disorders.

Measures: The outcomes were current employment/labor force participation, weeks worked in last year, and number of work absences in the last month among employed individuals.

Results: We found that for major depressive episode, symptoms of insomnia/hypersomnia, indecisiveness, severe emotional distress, and fatigue are crucial for labor market outcomes. In the case of generalized anxiety disorder, the length of the episode, symptoms relating to difficulty controlling worry, and symptoms of worry/anxiety/nervousness causing significant emotional distress were most detrimental for work outcomes. Social phobia and panic attack were not associated with labor market outcomes.

Conclusion: Our findings suggest that interventions targeting these particular symptoms may be most helpful in improving work functioning.

Key Words: mental disorders, depression, labor market, absenteeism, unemployment

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There is growing awareness among employers of the workplace burden of psychiatric disorders, particularly highly prevalent disorders such as depression and anxiety.[1–5] Depressed and anxious employees are thought to perform worse on the job and have more absences than others.[2] Corporate wellness programs and employee assistance programs increasingly are being viewed as ways employers can reduce the costs of mental illness in the workplace.[1,3,4]

These trends among employers are consistent with academic research on the labor market consequences of mental illness. The societal cost of depression alone was estimated to be $83 billion in 2000, and 62% of these costs were attributed to depression-induced absenteeism and reduced on-the-job productivity.[6] Randomized controlled trials involving employed individuals suggest that better quality psychiatric treatment and care management improves mental health, as well as improves absenteeism, job retention, hours worked, and productivity.[7–10] More broadly, studies based on nationally representative datasets show that psychiatric disorders are associated with unemployment, absenteeism, reduced productivity, and reduced labor supply.[11–16]

One limitation is that in many prior studies, psychiatric illness is measured as a binary variable, which is set equal to 1 if an individual meets the diagnostic criteria for disorder, and is set equal to 0 otherwise (see Chatterji et al[14,15] for examples). This approach considers individuals who do not meet criteria for clinical diagnosis to be healthy, ignoring the fact that individuals not meeting diagnostic criteria could still have significant psychiatric impairment adversely affecting their labor market outcomes. Variation in symptoms of disorders is typically more informative about the underlying health condition and is potentially richer than standard binary measures. A second limitation of prior research is that it is generally not informative about the mechanisms, or symptoms, that link mental disorders to labor market outcomes. Each psychiatric disorder has its own characteristic set of symptoms. However, symptoms often overlap across disorders, and some psychiatric symptoms may be

more important to labor market performance than others. The existing literature does not shed much light on this area.

In this study, we add to the existing literature by providing information on the mechanisms linking mental illness (specifically, depression and anxiety disorders) to 4 labor market outcomes: current employment, labor force participation, the number of weeks worked among those employed, and absenteeism among those employed. Data were obtained from the National Comorbidity Survey Replication (NCS-R) and the National Latino and Asian American Study (NLAAS). The contribution of this study is 2-fold. First, our methodological approach allowed us to identify which psychiatric symptoms were most critical in affecting labor market outcomes. Second, our approach allowed us to gauge the degree to which individuals characterized as not meeting the diagnostic criteria as "healthy" was potentially a problem in studying the labor market consequences of mental illness. By identifying the symptoms most important for work impairment, as well by considering the potential for work-disabling psychiatric symptoms among individuals not meeting diagnostic criteria, this study provides information that may be useful in developing interventions that target specific symptoms in a broader population and reduce workplace consequences of mental illness.

METHODS

Conceptual Framework

We applied a structural equation modeling approach with a Multiple Indicator and Multiple Cause (MIMIC) model[17–19] embedded in the structure. This approach involved generating a latent index of mental health from a model using multiple indicators (psychiatric symptoms) and multiple causes (like demographics) of the disorder. At the same time, the different indicators were linked to the labor market outcome variable through the underlying latent indices for mental health conditions. We focused on 4 disorders: major depressive episode (MDE), generalized anxiety disorder (GAD), social phobia, and panic attack. In modeling latent indices for each of these disorders, we used the indicator (symptom) variables, which are used in the World Mental Health (WMH) version of the World Health Organization Composite International Diagnostic Interview (WMH-CIDI)[20] for each disorder for assessment of psychiatric disorders according to the Diagnostic and Statistical Manual of Mental Disorders, fourth edition (DSM-IV).[21]

Our model specification takes the following form:

$$L^* = \theta + \beta X + \mu_1 Dep^* + \mu_2 Panic^* + \mu_3 Social^* + \mu_4 GAD^* + u_1 \tag{1}$$

In case of binary labor market outcomes,

$$L = \begin{cases} 1 \text{ if } L^* \geq 0 \\ 0 \text{ if } L^* \leq 0 \end{cases} \tag{1A}$$

$$Dep^* = \delta_1 + \pi_1 X + u_2 \tag{2}$$

$$Panic^* = \delta_2 + \pi_2 X + u_3 \tag{3}$$

$$Social^* = \delta_3 + \pi_3 X + u_4 \tag{4}$$

$$GAD^* = \delta_4 + \pi_4 X + u_5 \tag{5}$$

$$y_{11} = \gamma_{11} + \alpha_{11} Dep^* + \varepsilon_{11} \tag{6}$$

$$\vdots$$

$$y_{1n_1} = \gamma_{1n_1} + \alpha_{1n_1} Dep^* + \varepsilon_{1n_1} \tag{7}$$

$$y_{21} = \gamma_{21} + \alpha_{21} Panic^* + \varepsilon_{21} \tag{8}$$

$$\vdots$$

$$y_{2n_2} = \gamma_{2n_2} + \alpha_{2n_2} Panic^* + \varepsilon_{2n_2} \tag{9}$$

$$y_{31} = \gamma_{31} + \alpha_{31} Social^* + \varepsilon_{31} \tag{10}$$

$$\vdots$$

$$y_{3n_3} = \gamma_{3n_3} + \alpha_{3n_3} Social^* + \varepsilon_{3n_3} \tag{11}$$

$$y_{41} = \gamma_{41} + \alpha_{41} GAD^* \varepsilon_{41} \tag{12}$$

$$\vdots$$

$$y_{4n_4} = \gamma_{4n_4} + \alpha_{4n_4} GAD^* \varepsilon_{4n_4} \tag{13}$$

where, $L^*(L)$ denotes the labor market outcome; Dep^*, $Panic^*$, $Social^*$, and GAD^* are latent (unobserved) measures of MDE, panic attack, social phobia, and GAD in the past 12 months; X is a vector of demographic and socioeconomic variables, which are assumed to impact the outcome variable and also the mental health of an individual; and y's are indicators (symptoms like depressed mood, diminished pleasure, etc.) of the 4 mental disorders.

Equation (1) was our main equation of interest, measuring the effect of psychiatric disorders in the past year on current labor market outcomes. The coefficients μ_1, μ_2, μ_3, and μ_4 measure the relative contribution of each disorder in their impact on the labor market outcome of the individuals. The vector X in Eqs. (2–5) comprises the multiple causes (determinants) of the psychiatric disorders and the variable y in Eqs. (6–13) consists of the multiple indicators of the mental disorders. Thus, Eqs. (2–13) make up the standard MIMIC model framework.

The set of Eqs. (1–13) form a structural equation model in the sense of establishing relationships among observed variables and hypothetical construct(s), which are not observed by the researcher.[22] These theoretical construct(s) have implications for relationships among observable variables, even though they are not observed directly.[17] The observable variables in our model appeared as different causes (vector X in Eqs. (2–5)) and different effects (y in Eqs. (6–13)) of the underlying latent variables, which measure the severity of a mental disorder. In our context, the main advantage of using this framework and estimating all the equations together under one roof was that the model picks out those indicators of a mental disorder which are most important in explaining the labor market outcome variable. There was substantial correlation within indicators (symptoms) for a particular disorder, specifically MDE, social phobia, and GAD and to a lesser extent in case of panic attack. The MIMIC model allowed us to capture these correlations in a parsimonious way through the latent constructs.[17] Moreover, this approach considered effects of

psychiatric symptoms among all individuals, including those who do not meet the criteria for a psychiatric disorder.

NCS-R and the NLAAS

Data used were obtained from the combined sample of the NCS-R and the NLAAS, which are a part of the Collaborative Psychiatric Epidemiology Studies, funded by the National Institute of Mental Health and collected by the University of Michigan Survey Research Center. The studies included diagnostic batteries for mental disorders based on the DSM-IV and health services use, along with data on demographic, socioeconomic, family background, and employment characteristics. All analyses in this study were weighted using a weight that allows one to combine the NCS-R and the NLAAS and use them as though they were a single, nationally representative study. Details about the NCS-R and the NLAAS can be found in the study by Kessler and Merikangas[23] and Alegria et al,[24] respectively.

The initial sample with which we began consisted of 10,341 individuals from Part II of the NCS-R and the NLAAS. We excluded individuals who were either younger than 25 years old or older than 64 years old (n = 2577), individuals with missing values for the work status variable (n = 13), and individuals with missing values for symptoms of disorders (n = 11). Further, individuals who reported their race to be different from African Americans, Latinos, Asians, and non-Latino whites (baseline category) were excluded from the study (n = 223). The final sample with which we worked consisted of 7566 individuals: 4235 women and 3331 men. In case of the work-related variables "number of weeks worked among employed individuals" and "days missed at work for those employed", the number of missing observations was 37 and 91, respectively.

Labor Market Outcomes and Latent Indices for Mental Disorders

The outcomes of interest were: (i) whether an individual is employed, either full-time or part-time versus unemployed/out of labor force (1/0), (ii) whether an individual is part of the labor force, either employed or unemployed but looking and available for work versus out of labor force (1/0), (iii) the number of weeks the individual worked in the past 12 months, conditional on being currently employed; and (iv) number of full days of work the individual missed in the last 30 days, conditional on being employed. The primary covariates of interest were underlying latent (unobserved) variables for psychiatric disorders in the past 12 months—namely, MDE, panic attack, social phobia, and GAD. The latent variable for each mental disorder reflects a set of symptoms, severity, and length of episodes, which were used for diagnosis of a psychiatric disorder according to the rules laid out in the DSM-IV, and several determinants (causes) of the disorders, including demographic, socioeconomic, family background, and chronic physical conditions variables. In our analysis sample, the weighted prevalence rates for these disorders were 9.3% for MDE, 11% for panic attack, 7.4% for social phobia, and 4.6% for GAD.

Other Covariates

In the labor market and mental disorder equations, we also included controls for age, race/ethnicity, marital status (married, widowed/divorced/separated with single as the baseline), educational attainment (12 y, 13–15 y, ≥ 16 years, with <12 y as the baseline category), presence of any chronic physical conditions, and region of residence (Midwest, South, West with Northeast as the reference group). The chronic physical conditions measure was a dichotomous indicator set equal to 1 if an individual reported having arthritis/rheumatism, stroke, heart attack, diabetes, ulcer, or cancer at any point during their lifetime, and set equal to 0 otherwise. We conducted all analyses separately for men and women.

RESULTS

In Table 1, we report the weighted means (see Appendix Table 1, Supplemental Digital Content 1, http://links.lww.com/MLR/A615, for detailed description of the variables). Compared with 84% of men, 69% of women were employed. Employed men worked about 50 weeks in the past year relative to 49 weeks for employed women, and both men and women missed about 1 day of work in the past month, conditional on being employed. Symptoms of psychiatric disorders in the past 12 months were higher for women than for men. Length of the worst depressive episode was little >3.5 months for women, compared to <2.5 months for men in the last 12 months. Among women, 14% experienced symptom of depressed mood, whereas 10% had symptom of diminished pleasure in the past 12 months. The prevalence rates of these symptoms for men were 9% and 6%, respectively. Both men and women had a mean age of 43 years at the time of the survey.

We estimated our model applying the maximum likelihood procedure and used the Structural Equation Model package in Stata 12.[25] The estimated coefficients are presented in Tables 2 and 3. In Table 2, we show the association between the latent indices of MDE, panic attack, social phobia, and GAD and the labor market outcomes. We found that greater severity of MDE and GAD was associated with lower likelihood of employment and labor force participation for both men and women. Further, we found evidence of a more detrimental effect of MDE than GAD on employment and labor force participation in general. Focusing on the continuous work outcomes, we found MDE to reduce the number of weeks worked for both men and woman and GAD to increase missed days at work for men only. Panic attack and social phobia did not have any significant impact on any of the outcomes after accounting for the other disorders.

Next, in Table 3 we move on to identifying the symptoms of the disorders that are most important for labor market outcomes—these correspond to equations (6–13) in our model. We excluded a few work-related symptoms to minimize the possibility of reverse causality, that is, adverse work outcomes can cause psychiatric symptoms and thus prevent us from making claims about a causal relationship between poor mental health and work outcomes. For each of the 4 disorders, the loading on one symptom is normalized to 1.

TABLE 1. Weighted Means

Variables	Male (N = 3331) (%)†	Female (N = 4235) (%)†
Labor market outcomes		
Employed	84.21	69.20
In labor force	86.24	75.13
Weeks worked in past year conditional on employment*	50.46 (0.20)	49.41 (0.19)
Days missed in the past month conditional on employment*	1.08 (0.13)	1.22 (0.10)
Major depressive episode indicators		
Depressed mood	8.61	13.70
Diminished pleasure	6.23	10.27
Significant weight change	6.13	11.64
Insomnia or hypersomnia	8.07	12.64
Restlessness or retardation	4.76	7.09
Fatigue	7.28	12.75
Worthlessness	3.99	6.98
Indecisiveness	7.76	12.57
Suicidal thoughts	6.03	10.41
Frequently severe emotional distress	7.30	11.66
Severe emotional distress	8.19	13.13
Length of depressive episode*	71.02 (11.05)	107.77 (14.81)
Panic attack indicators		
Sweating	4.38	6.37
Trembling	2.54	4.65
Choking	5.47	9.75
Chest pain or nausea	4.64	9.30
Dizziness or unreality	5.23	8.91
Social phobia indicators		
Afraid meeting new people	7.42	9.38
Afraid talking to authority	6.37	8.66
Shy at social gathering	6.25	7.77
Shy performing	8.22	11.06
Shy of unknown people	5.95	7.57
Shy at disagreement	4.91	7.68
Shy with others watching	3.36	5.75
Shy using public restroom	2.66	3.74
Shy in dating situation	5.28	6.27
Uncomfortable getting attention	6.84	9.15
Fear of embarrassment	9.21	11.84
Fear of social situation	8.89	11.52
Avoid social situations	8.67	10.97
Social situations cause intense anxiety	8.22	10.72
Recent occurrence after age 18	9.58	12.21
Generalized anxiety disorder (GAD) indicators		
Excess anxiety	6.19	10.52
Length of GAD episode*	76.13 (14.29)	122.47 (21.25)
Difficult to control worry	5.84	9.82
Restlessness	5.57	9.66
Tired	4.43	8.51
Irritable	4.98	8.64
Difficulty concentrating	4.83	9.13
Tense muscles	3.60	7.36
Sleeping problems	5.38	8.93
Excessive nervousness	4.68	9.14
Significant emotional distress	5.77	9.79
Worry not always due to physical causes	2.09	2.50
Sociodemographic variables		
Age*	42.78 (0.37)	43.40 (0.34)
Asian	4.88	4.85
Latino	13.19	11.63
African American	10.46	11.81
Married	70.44	63.98

(Continued)

TABLE 1. Weighted Means (*continued*)

Variables	Male (N = 3331) (%)†	Female (N = 4235) (%)†
Divorced	14.80	21.45
12 y of education	30.40	28.54
13–15 y of education	26.83	29.89
≥ 16 years of education	27.65	28.61
Midwest	23.92	22.28
South	33.23	35.14
West	24.28	23.91
Physical chronic conditions		
Chronic conditions	34.16	38.25

†Means of binary variables expressed in percentage terms; all variables are binary, except for those marked with an asterisk (*); SEs in parentheses for continuous variables; statistics are adjusted for complex survey design.

Thus, the importance of all the other symptoms were estimated with respect to that normalized symptom. The normalized symptoms were listed first for each disorder; these symptoms were: depressed mood for MDE and excess anxiety for GAD.

Our results suggest that insomnia/hypersomnia, indecisiveness, and severe emotional distress for both men and women, and fatigue for women were the most crucial indicators of MDE, which are debilitating for work outcomes. The length of a GAD episode is most detrimental aspect of GAD for labor market outcomes, followed by symptoms relating to difficulty controlling worry and symptoms of worry/anxiety/nervousness causing significant emotional distress for both men and women. As we did not find significant adverse impact of either panic attack or social phobia on any work outcome, we shall not discuss the results for indicators of these disorders.

Next, we performed a concordance analysis to determine whether there was a significant advantage to our latent variable approach over the standard approach of using a binary indicator of mental illness in estimating effects of psychiatric disorder on labor market outcomes. To this effect, we dichotomized the estimated latent scale over the relevant range for different alternative values for the cutoff points (τ). Thus, individuals with a predicted score for the latent mental disorder variable to the left of τ were characterized as not having a disorder and those with a score $\geq \tau$ were classified as having the disorder. The predicted values were obtained from Eqs. (6 and 7) for MDE; Eqs. (8 and 9) for panic attack; Eqs. (10 and 11) for social phobia; and Eqs. (12 and 13) for GAD.

Given a cutoff point (τ), we defined the hit rate (H) (also called sensitivity[26]) as the proportion of correct diagnosis (based on our measure) when an individual meets diagnostic criteria for a disorder and the false alarm rate (F) [$(1-F)$ is called specificity[26]] as the proportion of incorrect diagnosis when an individual does not meet diagnostic criteria.[27] In Table 4, we show the contingency table for diagnosis based on clinical measures and that based on the model, given τ. In terms of Table 4, $H = a/(a+c)$ and $F = b/(b+d)$.

TABLE 2. Effect of Potentially Comorbid Psychiatric Disorders: Labor Market Equation

	Employed		In Labor Force		Weeks Worked in Past Year Conditional on Employment		Days Missed in Past Month Conditional on Employment	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Male	Female	Male	Female	Male	Female	Male	Female
Labor market equation								
Depression*	−0.169***	−0.098***	−0.139***	−0.094***	−1.479**	−1.365*	0.962*	0.137
	(0.03)	(0.03)	(0.03)	(0.03)	(0.63)	(0.72)	(0.49)	(0.25)
Panic attack*	−0.095	−0.080	−0.108	−0.081	−3.502	1.344	−0.817	0.699
	(0.12)	(0.09)	(0.12)	(0.07)	(2.64)	(1.26)	(0.77)	(0.58)
Social phobia*	−0.058	0.017	−0.072*	0.019	−0.644	0.131	0.444	0.198
	(0.04)	(0.04)	(0.04)	(0.03)	(0.81)	(0.62)	(0.43)	(0.35)
GAD*	−0.108**	−0.079***	−0.112**	−0.099***	−1.143	−0.600	1.120*	0.274
	(0.05)	(0.02)	(0.05)	(0.02)	(0.92)	(0.77)	(0.59)	(0.23)

Coefficients only on latent psychiatric disorder variables in the labor market equation (Eq. (1)) reported; SEs in parentheses.
*$P<0.10$.
**$P<0.05$.
***$P<0.01$.
Results are adjusted for complex survey design.
GAD indicates generalized anxiety disorder.

We used 2 measures to evaluate the performance of our latent indices vis-à-vis the standard binary variables used: (a) the Peirce skill score (PS)[27] and (b) the odds ratio (OR), which are better discriminatory measures when the outcome of interest is relatively uncommon. PS is the difference between the hit rate and the false alarm rate (PS = $H-F$) and the OR is defined as the ratio of the odds of making a correct prediction and the odds of an incorrect prediction (OR = $[H/(1-H)]/[F/(1-F)]$). A value of 0 for the PS or, alternatively, a value of 1 for the odds ratio indicates a perfect mismatch between our prediction based on the MIMIC model and a clinical diagnosis of the disorder. In Table 5, we report these statistics for given values of τ for each psychiatric disorder used in our study. Our preferred choice of cutoff value τ was one which maximized PS and/or OR. Thus, we choose $\tau = 0.1$ for MDE, $\tau = 0.1$ for panic attack, $\tau = 0.7$ for social phobia, and $\tau = 0.4$ for GAD. Following the study by Van Doorslaer and Jones,[28] we normalized the predicted values of the latent mental disorder variables such that they lie in the [0, 1] interval.

In Table 6, we present contingency tables for clinical diagnosis and diagnosis of a mental disorder based on the optimal cutoff values chosen above for each psychiatric disorder. In the case of MDE, social phobia, and GAD, we identified a large number of individuals who did not meet diagnostic criteria but would be classified as having the disorder based on our chosen cutoff value (176, 262, and 367 individuals, respectively). Further, the distribution of the latent indices for mental disorders for this set of individuals closely resembles those who meet diagnostic criteria for the disorder, thus indicating similarly poor mental health. In an analysis of the labor market effects of mental illness using a binary indicator for meeting diagnostic criteria for a disorder, one would misclassify these groups of individuals as being healthy, thus potentially generating a misleading estimate of the impact of mental illness on work outcomes. Note that the number of false negatives, denoted by c in Table 4, is very small for each disorder (Table 6).

DISCUSSION

In this study, we have proposed an alternative methodological approach using latent indices for disorders to examine the effect of mental disorders on labor market outcomes of individuals. Our findings identified specific symptoms of disorders that were particularly harmful for labor market outcomes. In this way, we go beyond the main thrust of previous research, which merely indicates particular categories of mental disorders, such as depression, that were associated with worse labor market outcomes, but it is not clear which symptoms were relatively more detrimental.[11,14,15] Our focus on symptoms, rather than on binary indicators for diagnostic categories, is also consistent with the decreasing emphasis on such categories by clinicians, researchers, and policymakers.[29,30] For example, using a multinomial probit model, Slade & Salkever[31] estimated the effects of specific symptoms of schizophrenia that are most important in the choice of not working for pay, employment in a nonsupported job, and employment in supported/sheltered jobs.

Our results suggest that insomnia/hypersomnia, indecisiveness, and severe emotional distress for both men and women, and symptom of fatigue for women were relatively more important indicators of depression in explaining work-related outcomes. This result suggests that medications or interventions that target these symptoms (eg, medications to improve sleep) may be especially helpful for improving work functioning. In an earlier study, Bombardier and Buchwald[32] had found chronic fatigue, along with chronic fatigue syndrome and fibromyalgia, to be associated with work disability and low rates of employment. Our findings were consistent with these results. In the case of GAD, the length

TABLE 3. Effect of Potentially Comorbid Psychiatric Disorders: Measurement Model Equations

	Employed		In Labor Force		Weeks Worked in Past Year Conditional on Employment		Days Missed in Past Month Conditional on Employment	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Male	Female	Male	Female	Male	Female	Male	Female
Measurement model equations								
Depressed mood								
Depression*	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)
Diminished pleasure								
Depression*	0.760***	0.767***	0.760***	0.767***	0.729***	0.747***	0.734***	0.749***
	(0.04)	(0.02)	(0.04)	(0.02)	(0.04)	(0.03)	(0.04)	(0.03)
Significant weight change								
Depression*	0.724***	0.866***	0.724***	0.866***	0.658***	0.877***	0.652***	0.875***
	(0.03)	(0.02)	(0.03)	(0.02)	(0.05)	(0.02)	(0.05)	(0.02)
Insomnia or hypersomnia								
Depression*	**0.948*****	**0.936*****	**0.948*****	**0.936*****	**0.926*****	**0.942*****	**0.927*****	**0.940*****
	(0.02)	(0.01)	(0.02)	(0.01)	(0.03)	(0.01)	(0.03)	(0.01)
Restlessness or retardation								
Depression*	0.568***	0.537***	0.568***	0.537***	0.561***	0.520***	0.562***	0.522***
	(0.04)	(0.03)	(0.04)	(0.03)	(0.05)	(0.03)	(0.05)	(0.03)
Fatigue								
Depression*	0.859***	**0.940*****	0.859***	**0.940*****	0.811***	**0.955*****	0.807***	**0.953*****
	(0.03)	(0.01)	(0.03)	(0.01)	(0.03)	(0.01)	(0.03)	(0.01)
Worthlessness								
Depression*	0.496***	0.526***	0.496***	0.526***	0.451***	0.517***	0.454***	0.518***
	(0.04)	(0.02)	(0.04)	(0.02)	(0.05)	(0.03)	(0.05)	(0.03)
Indecisiveness								
Depression*	**0.922*****	**0.931*****	**0.922*****	**0.931*****	**0.905*****	**0.956*****	**0.908*****	**0.954*****
	(0.02)	(0.01)	(0.02)	(0.01)	(0.03)	(0.01)	(0.03)	(0.01)
Suicidal thoughts								
Depression*	0.730***	0.774***	0.730***	0.774***	0.694***	0.748***	0.698***	0.746***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.04)	(0.03)	(0.04)	(0.03)
Frequently severe emotional distress								
Depression*	0.868***	0.856***	0.868***	0.856***	0.880***	0.835***	0.877***	0.832***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)	(0.02)	(0.03)
Severe emotional distress								
Depression*	**0.968*****	**0.964*****	**0.968*****	**0.964*****	**0.963*****	**0.963*****	**0.974*****	**0.962*****
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Length of depressive episode								
Depression*	0.988***	0.952***	0.988***	0.952***	0.748***	0.642***	0.736***	0.642***
	(0.16)	(0.12)	(0.16)	(0.12)	(0.23)	(0.10)	(0.23)	(0.10)
Excess anxiety								
GAD*	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)
Length of GAD episode								
GAD*	**1.407*****	**1.319*****	**1.407*****	**1.319*****	**1.160*****	**1.052*****	**1.161*****	**1.049*****
	(0.23)	(0.20)	(0.23)	(0.20)	(0.26)	(0.18)	(0.27)	(0.18)
Difficult to control worry								
GAD*	**0.946*****	**0.938*****	**0.946*****	**0.938*****	**0.946*****	**0.932*****	**0.946*****	**0.933*****
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)

(Continued)

TABLE 3. Effect of Potentially Comorbid Psychiatric Disorders: Measurement Model Equations (*continued*)

	Employed		In Labor Force		Weeks Worked in Past Year Conditional on Employment		Days Missed in Past Month Conditional on Employment	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Male	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**
Restlessness								
GAD*	0.905***	0.925***	0.905***	0.925***	0.908***	0.905***	0.908***	0.905***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Tired								
GAD*	0.722***	0.816***	0.722***	0.816***	0.730***	0.787***	0.730***	0.787***
	(0.04)	(0.02)	(0.04)	(0.02)	(0.04)	(0.03)	(0.04)	(0.03)
Irritable								
GAD*	0.810***	0.831***	0.810***	0.831***	0.811***	0.837***	0.811***	0.835***
	(0.04)	(0.02)	(0.04)	(0.02)	(0.04)	(0.02)	(0.04)	(0.02)
Difficulty concentrating								
GAD*	0.786***	0.876***	0.786***	0.876***	0.800***	0.877***	0.800***	0.877***
	(0.03)	(0.02)	(0.03)	(0.02)	(0.04)	(0.02)	(0.04)	(0.02)
Tense muscles								
GAD*	0.587***	0.707***	0.587***	0.707***	0.492***	0.655***	0.491***	0.654***
	(0.05)	(0.02)	(0.05)	(0.02)	(0.04)	(0.03)	(0.04)	(0.03)
Sleeping problems								
GAD*	0.876***	0.856***	0.876***	0.856***	0.839***	0.839***	0.839***	0.840***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.04)	(0.03)	(0.04)	(0.03)
Excessive nervousness								
GAD*	0.758***	0.874***	0.758***	0.874***	0.769***	0.864***	0.769***	0.864***
	(0.04)	(0.02)	(0.04)	(0.02)	(0.03)	(0.03)	(0.03)	(0.03)
Significant emotional distress								
GAD*	**0.937*****	**0.938*****	**0.937*****	**0.938*****	**0.939*****	**0.912*****	**0.939*****	**0.912*****
	(0.02)	(0.01)	(0.02)	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)
Worry not always due to physical cause*s*								
GAD*	0.341***	0.242***	0.341***	0.242***	0.284***	0.183***	0.284***	0.183***
	(0.06)	(0.02)	(0.06)	(0.02)	(0.05)	(0.02)	(0.05)	(0.02)
CD	0.208	0.252	0.208	0.217	0.151	0.149	0.129	0.148
N	3331	4235	3331	4235	2710	2815	2698	2779

Measurement model equations reported only for major depressive episode (MDE) [Eqs. (6 and 7)] and GAD [Eqs. (12 and 13)] as panic attack and social phobia have no significant impact on any labor market outcome; SEs in parentheses.

$*P < 0.10$; $**P < 0.05$; $***P < 0.01$.

Results are adjusted for complex survey design; length of depressive episode and length of GAD episode indicator variables standardized to mean 0 and SD 1; the coefficient on each latent index for each disorder with respect to their first indicator variable in the measurement model is constrained to 1 as a normalization constraint.

CD indicates coefficient of determination; GAD, generalized anxiety disorder.

The bold numbers indicate that corresponding symptoms are most detrimental.

TABLE 4. Contingency Table

	Clinical Diagnosis		
	Yes	**No**	**Total**
MIMIC diagnosis			
Yes	a (hit)	b (false alarm)	a+b
No	c (miss)	d (correct rejection)	c+d
Total	a+c	b+d	a+b+c+d

MIMIC indicates Multiple Indicator and Multiple Cause Model.

of a GAD episode, followed by symptoms relating to difficulty controlling worry and symptoms of worry/anxiety/nervousness causing significant emotional distress are crucial indicators of the disorder with respect to the labor market.

Our analysis also identified individual psychiatric disorders, which were detrimental for work. MDE had the greatest impact and detracts from employment and labor force participation of individuals, which was consistent with prior research. For example, Chang and Yen[33] found that a higher score based on depressive symptoms significantly detracts from employment of the elderly. Using binary indicators for mental disorders, Ettner et al[11] found major depression to significantly lower the likelihood of employment by about 7 percentage points for both men and women.

One limitation of our study was that we have not accounted for the endogeneity of mental disorders in our analysis. Omitted variables bias, measurement error, and/or simultaneity between work outcomes and mental health might lead to biased and inconsistent estimates, preventing us from making any claims about the causal impact of psychiatric disorders on labor market outcomes. In other work, we examined the causal effect of mental illness on labor market outcomes, addressing the endogeneity of mental illness using instrumental variables.[34] The estimated effect of mental ill health on the outcomes was typically larger by a small margin after accounting for endogeneity. In the context of this study, therefore, we believe that our estimates, if anything, understate the true causal impact of psychiatric disorders on work outcomes.

TABLE 6. Contingency Tables for Psychiatric Disorders

	Clinical Diagnosis		
	Yes	**No**	**Total**
Depression ($\tau = 0.1$)			
MIMIC diagnosis			
Yes	852	**176**	1028
No	4	6534	6538
Total	856	6710	7566
Panic attack ($\tau = 0.1$)			
MIMIC diagnosis			
Yes	901	19	920
No	4	6642	6646
Total	905	6661	7566
Social phobia ($\tau = 0.7$)			
MIMIC diagnosis			
Yes	625	**262**	887
No	11	6668	6679
Total	636	6930	7566
Generalized anxiety disorder ($\tau = 0.4$)			
MIMIC diagnosis			
Yes	382	**367**	749
No	4	6813	6817
Total	386	7180	7566

MIMIC indicates Multiple Indicator and Multiple Cause Model.
The characteristics of the group of individuals indicated in bold are discussed in the paper.

We also emphasize that there exists substantial correlation among pairs of symptoms, which may make it difficult to tease out their independent effects on labor market outcomes. Therefore, targeting particular symptoms in isolation may not be restorative and a more holistic approach that directs treatment towards multiple symptoms would most likely be effective. The estimated factor loadings associated with different psychiatric disorders of our MIMIC model were consistent with this approach.

On the basis of the concordance analysis, the results of this paper show that significant numbers of individuals do not meet diagnostic criteria for psychiatric disorder but actually have similarly poor mental health as diagnosed individuals. This finding has 2 important implications. First, in studies estimating the labor market consequences of mental illness, coding sub-threshold individuals as "healthy"

TABLE 5. Concordance Measures for Psychiatric Disorders

	Depression				Panic Attack				Social Phobia				GAD			
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**	**(11)**	**(12)**	**(13)**	**(14)**	**(15)**	**(16)**
τ	*H*	*F*	PS	OR	*H*	*F*	PS	OR	*H*	*F*	PS	OR	*H*	*F*	PS	OR
0.1	0.9953	0.0262	**0.9691**	**7907.63**	0.9956	0.0029	**0.9927**	**78742.66**	0.9843	0.0457	0.9385	1305.91	0.9896	0.0517	0.9380	1752.72
0.2	0.9953	0.0262	0.9691	7907.63	0.9956	0.0029	0.9927	78742.66	0.9843	0.0457	0.9385	1305.91	0.9896	0.0517	0.9380	1752.72
0.3	0.9953	0.0262	0.9691	7907.63	0.9768	0.0029	0.9739	14715.61	0.9843	0.0457	0.9385	1305.91	0.9896	0.0513	0.9384	1767.79
0.4	0.9930	0.0258	0.9672	5353.03	0.9127	0.0027	0.9100	3858.73	0.9843	0.0457	0.9385	1305.91	0.9896	0.0511	**0.9385**	**1772.87**
0.5	0.9918	0.0252	0.9666	4694.26	0.7867	0.0024	0.7843	1532.14	0.9843	0.0447	0.9395	1336.81	0.9896	0.0511	0.9385	1772.87
0.6	0.9860	0.0243	0.9617	2824.98	0.6917	0.0021	0.6896	1065.29	0.9843	0.0418	0.9424	1433.32	0.9896	0.0511	0.9385	1772.87
0.7	0.9661	0.0204	0.9457	1368.20	0.6044	0.0018	0.6026	846.60	0.9827	0.0378	**0.9449**	**1446.04**	0.9896	0.0511	0.9385	1772.87
0.8	0.9019	0.0145	0.8874	626.56	0.3050	0.0011	0.3039	417.10	0.9135	0.0248	0.8887	415.05	0.9870	0.0496	0.9375	1460.64
0.9	0.6624	0.0101	0.6522	191.64	0.0066	0.0002	0.0065	44.45	0.6132	0.0113	0.6020	139.27	0.8808	0.0358	0.8450	199.11

F indicates false alarm rate; H, Hit rate; OR, odds ratio; PS, peirce score; τ, cutoff point.
The value of τ associated with the bold numbers is chosen for further analysis.

may lead to misleading estimates. Second, from a policy perspective, interventions targeting workplace consequences of mental illness may benefit not only those who meet diagnostic criteria for mental illness but also many of those with subclinical levels of symptoms. Besides the afflicted individuals, employers also would potentially stand to gain from improved work functioning of those individuals.

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