

Poor Mental Health and Smoking: Interactive Impact on Wages

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Abstract

Background: Studies have found important effects of poor mental health on labor market outcomes. The positive association between poor mental health and smoking has also been documented. This is the first study to document the separate and interactive impacts of smoking and mental health on wages.

Aim: The primary aim of this study is to analyze the effect of poor mental health on wages while controlling for smoking status, and the interaction of poor mental health and smoking. We conduct separate regressions by gender.

Methodology: We use data from the Community Tracking Survey for years 1996, 1998 and 2000. This survey interviews 60,000 people per cycle in the United States and collects detailed information on mental health status, smoking history and labor market outcomes. We use a two-step regression procedure to adjust for the fact that smoking and poor mental health may affect the labor market participation decision as well as wages. Separate regressions are estimated for men and women.

Results and Discussion: Our results confirm that poor mental health is negatively associated with wages, as is current smoking, controlling for other factors. The impact of poor mental health is associated with an almost 8% reduction in wages for males and a bit more than a 4% decline for women in our most basic specification. We add to the literature by finding that the impact of poor mental health varies substantially by smoking status for males. Men who are in both poor mental health and who smoke have the largest associated reduction (−16.3%) in wage rates, while the interaction between poor mental health and smoking is insignificant for women.

Limitations: While the data set has rich detail on smoking history and information on mental health, the data set lacks information on why former smokers quit and diagnosis of mental health disorders. The complex relationships among wages, mental health, and smoking also hinder determination of causality.

Conclusions and Implications: Our findings suggest that both smoking and mental health are important factors in the

determinations of wages and that the impact of mental health on wage rates varies by smoking status, at least for males. Our findings suggest that those who both smoke and have mental health problems, especially males, have the greatest productivity losses and are thus in the greatest need of interventions that address both issues jointly.

Future Research: Further economics research should address the difficult issue of the potential endogeneity of mental health, smoking, and their interactions in regressions of wages. Clinical and worksite research could be aimed at determining those work environments and treatments that are effective in helping those with mental health problems who smoke to become more productive.

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Introduction

Poor mental health has been shown to affect negatively a variety of labor market outcomes.¹⁻⁷ Smoking is also associated with relatively poor labor market outcomes.⁸⁻¹⁰ Since mental health and smoking are highly correlated,¹¹ it may be important to control for these two factors simultaneously and to examine their interaction when estimating these effects. Yet, past research has failed to do so.

In this paper, we estimate the individual and interactive impacts of poor mental health and smoking status on wages, a commonly used measure of workplace productivity. We consider men and women separately in recognition that the labor markets differ by gender. We address these questions by estimating wage equations while controlling for mental health status, smoking status, and their interaction. We use data from the Community Tracking Survey (CTS) to estimate these equations. The CTS is appropriate for this research because it contains detailed information on mental health status, smoking status and labor market participation and wages. Moreover, it is a large, nationally representative dataset.

The finding of an interactive effect of mental health status and smoking on productivity would have important policy implications. Treatments addressing these problems simultaneously may result in greater increases in productivity than treatments addressing only one problem. Furthermore, if those in poor mental health are less likely to quit smoking,

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then as smoking prevalence declines, the group of those who smoke will increasingly be composed of those in poor mental health. This is the group with the most detrimental impact on wages, so aiding this group could enhance workplace productivity.

Background

In this section, we describe the existing evidence on the association between poor mental health and labor market outcomes, on the association between poor mental health and smoking, and, finally, on smoking and labor market outcomes.

Poor Mental Health and Labor Market Outcomes

Both theoretically and empirically, the bulk of evidence supports a negative impact of poor mental health on labor market outcomes. As documented in Ettner *et al.*, earlier studies did not always find unambiguous effects, however, all recent studies on the issue show a clear relationship. Ettner *et al.* use the National Co-morbidity Survey and find that mental health significantly reduces both labor market participation and, conditional on working, hours among both men and women.³ Using clinical trial data, Berndt *et al.* find evidence of a negative relationship between chronic depression and work performance.⁵ Lim *et al.* use the Australian Mental Health and Well-Being Survey and find that poor mental health predicts work impairment.¹ Breslin *et al.* use the National Population Health Survey in Canada and find poor mental health increases the likelihood of being unemployed.¹² Frank *et al.* use population based measures of poor mental health and find significant negative effects on earnings.⁷ None of these studies address tobacco use as a potentially important moderator of this effect.

Smoking and Poor Mental Health

There is strong and significant evidence on the association between smoking and poor mental health but there does not seem to be a consensus on the mechanisms governing this relationship. Using the National Comorbidity Survey (1991, 1992), Lasser *et al.* concluded that persons with mental illness are about twice as likely to smoke.¹¹ Using the same data set, Saffer *et al.* found that persons with a history of mental illness are 94 percent more likely to smoke.¹³

Although disentangling the mechanisms behind the association is beyond the scope of this paper, note that causation could be working in a variety of ways. Those in poor mental health might be more likely to take up smoking. Smoking may mitigate anxiety 'reducing the desire to quit' and yet exacerbate anxiety disorders by introducing a psychological dependency that needs to be satisfied. Alternatively, smoking and poor mental health may co-occur due to third factors such as stress. Below, we summarize some empirical studies further documenting the positive correlation between poor mental health and smoking.

McCloughen notes that individuals with schizophrenia are much less likely to quit smoking than individuals with other mental health problems and indicates that there are complex "psychopathological, biochemical and neuro-pharmacological interactions between smoking and schizophrenia."¹⁴ Degenhardt *et al.* examine the comorbidities among tobacco use, substance use disorders and mental health problems. They find that current tobacco use is strongly associated with higher rates of anxiety and affective disorders.¹⁵ Interestingly, Mino *et al.* find that smoking cessation is associated with improved mental health.¹⁶

Breslau *et al.* suggest a causal mechanism between smoking and mental disorders.¹⁷ Using survival analysis with smoking variables as time-dependent covariates to predict the subsequent onset of specific psychiatric disorders, they found that daily smoking predicted future onset of mood disorders for both current and former smokers and that it might be a causal factor in panic disorder and agoraphobia.

As indicated, the above and other studies on mental health and smoking tend to show a strong, positive correlation between poor mental health and smoking, but most do not establish a clear causal pathway. Individuals in poor mental health smoke at higher rates and have more difficulties in quitting, and, individuals who smoke are more likely to be in poor mental health.

Smoking and Labor Market Outcomes

Smoking may detrimentally affect wages through a number of mechanisms. The evidence regarding smoking and labor market outcomes generally shows detrimental labor market outcomes for current smokers in terms of wages,^{8,18,19} absences,^{10,20-22} injuries,²³ and labor market participation.²⁴ Smoking may increase absences, in part because of sickness (see Lye *et al.* for a summary).¹⁹ Furthermore, productivity at work may also be compromised by withdrawal symptoms,²⁵ and cigarette breaks take time and disrupt work flow.^{18,19} However, as noted in Sindelar *et al.*, in the case of absences, many of these early studies have important limitations such as small and/or non representative samples.¹⁰ Studies using national data and more sophisticated methods have found that the impact of current smoking on absences, ranges from rather weak,²⁰ to quite substantial.^{21,22}

Findings with respect to smoking and wages are more robust. Levine *et al.* use data from the National Longitudinal Survey of Youth and find that smoking reduces wages by roughly 4-8 percent.⁸ Exploring the simultaneous effects of smoking and alcohol on wages, both van Ours and Lye *et al.* find significant effects of smoking on wages even when controlling for the effect of drinking.^{18,19}

Methods

Data Analytic Procedures

Given the evidence on the adverse impact of poor mental

health and smoking on wages and the established positive correlation between poor mental health and smoking; our objective is to estimate how being in poor mental health affects wages when controlling not only for smoking but also for the interaction of poor mental health and smoking. Furthermore, we examine the extent to which more parsimonious models are misspecified when analyzing the effect on wages of poor mental health alone and of smoking alone.

Wages are widely used in economic studies as a measure of productivity,^{26,27} and wages or earnings have been used in papers examining the impact of mental health on productivity.^{3,7} In this paper we estimate latent wages. Latent wages are often used in the economics literature since they allow estimation of the implied effect of variables of interest on wages, even though those wages may not be observed.

In specifying our model, we test whether the omission of smoking status affects conclusions about the effect of poor mental health, and vice versa. Our strategy is to incrementally add mental health or smoking status indicators to regressions of each alone. In our final and most important step, we include an interaction term between smoking status and poor mental health. That is, we consider whether the effect of poor mental health varies by smoking status, and conversely, whether the effect of smoking status varies by mental health status.

Effect of Mental Health and Smoking on Wages

In the most inclusive specification, to account for the proposed relationships among wages, smoking, and poor mental health, we specify the following equation for latent wages:

$$w_i^* = \beta_0 + \beta_1 PMH_i + \beta_2 S_i + \beta_3 [S_i \times PMH_i] + X_i \beta_4 + \varepsilon_i, \quad (1)$$

where subscript i stands for the i^{th} respondent; PMH_i indicates poor mental health; S_i is a set of variables reflecting the respondent's smoking status; X_i is a set of variables containing social and demographic characteristics of the respondent; and ε_i is a normally distributed error term.

Mental Health, Smoking and the Decision to Work

Since latent wages w_i^* are only observable for those individuals who have decided to work, to obtain consistent estimates of β_j , for $j = 0, 1, 2, 3, 4$, we need to correct the bias introduced by the selection into the working sample. To correct for this potential bias, we use the Heckman sample selection model.²⁸ We define a dichotomous participation variable (W_i) that is equal to 1 whenever $w_i^* > 0$ (i.e. when wages are observable) and is equal to 0 otherwise. We further assume that the propensity to participate in the labor market (W_i) depends on individual characteristics, Y_i , and smoking history, SH_i , so that:

$$\begin{aligned} \Pr(w_i^* > 0) &= \text{Prob}(\delta_0 + \delta_1 PMH_i + \\ &\quad + \delta_2 SH_i + \delta_3 [SH_i \times PMH_i] + \delta_4 Y_i > 0 = \\ &= \Pr(W_i = 1) = \Phi(P_i' \delta). \end{aligned} \quad (2)$$

Assuming that the error term in equation (1) has a normal

distribution with mean 0 and variance 1, equation (2) above can be estimated using a probit model. Using the estimates of equation (2), we obtain the sample selection bias correcting Mills ratio for whether the individual works, which is introduced into equation (1) as an additional regressor. Equation (1) is then estimated by Maximum Likelihood. We estimate our model using the Heckman procedure available in the Stata (v.8) software package. To correct for the sampling method, we make our results nationally representative by weighting each observation by the inverse of the probability of being in the sample.

The socio-economic and demographic control variables we include when estimating the wage equation (1) are: age, age squared, a set of education achievement dummies, race, marital status, the size of the metropolitan area, industry, survey site, year of the survey, and the interaction between the two latter terms. The latter interaction allows us to control for variations by year for the same site, and conversely by site within the same year. The participation equation (2) contains an expanded smoking history variable that includes a binary indicator of current smoking and a set of dummy variables on the time since quit smoking for former smokers. Also included are age, age squared, education, race, married, number of children, size of the metropolitan area, survey site, survey year, and the interaction between the latter two terms. The justification for including the variable "number of children" in the participation equation stems from the fact that it possibly affects the likelihood to work but not the wages earned and has been used for the identification of wage equations before in the economics literature.²⁹

The assumption of normality of the error term in the selection equation, the inclusion of an additional variable (number of children) and the different measure of smoking status (time since quit additionally to smoking status) implies the identification of our model.

Given that labor market participation and remuneration are different for men and women, we tested and found that the set of coefficients are significantly different by gender. Thus, models are estimated separately for men and women.

Sample and Data

Data

Our sample comes from the Community Tracking Study (CTS) corresponding to rounds 1, 2 and 3 (1996, 1998 and 2000). The CTS is a biennial, stratified random sample of about 60,000 individuals per round in the United States. The survey collects detailed information on mental health status, smoking history, and labor market outcomes as well as basic demographics, insurance coverage, and service utilization. To be nationally representative, fifty-one metropolitan areas and nine non-metropolitan areas were randomly selected for the survey. More detail on the CTS sampling design, survey, and response rates can be found elsewhere.³⁰ For the purpose of this study, we restrict the sample to individuals between the ages of 18 and 64. The remaining analytical sample consists of 119,883 individuals.

Measures

Wage Rate

Our primary outcome measure is an individual's hourly wage rate. Since the distribution of hourly wages is skewed, we use its logarithm. Additionally, to select those that are actively working we use the answer to the question "Last week, did you do any work for pay (or profit)?"

Mental Health Variables

To determine the mental health status of the respondent, we use the answers to the questions corresponding to the MSC12, a component of the SF-12. Larger values denote better health. The MCS12 or "SF-12 Mental Component Summary" score is a constructed variable calculated using the Health Institute's scoring algorithm.* The MCS12 has been shown to have adequate test reliability and sensitivity to recovery from depression.³¹⁻³²

As an indicator of poor mental health, we create a variable called "Poor MH" that takes value 1 if MCS12 is less than 39, and 0 otherwise. According to Sanderson *et al.*, 80 percent of persons from a representative community sample with diagnosed moderate depression and 92 percent of those diagnosed with a severe depression have a MCS12 score below 39; as do 75 percent of those with any affective disorder, 58 percent with any anxiety disorder, and 60 percent of persons with psychosis.³¹ We test the robustness of our results using our measure of poor mental health by performing sensitivity analysis using alternative variables defined by the cutoff points of the lowest 5th, 10th, and 15th percentiles of the MSC12 for our sample (at scores of 31.2, 37.8, and 43.1, respectively).

Smoking Variables

The CTS contains information on past and present smoking behavior. This information allows us to classify individuals into three categories based on smoking status: *current*, *former* or *never smoker*. For more precision in estimating the effects of smoking history on labor market participation, we also use extended categories of smoking behavior derived from information on smoking status and quitting history ("Never smoked" - the omitted category, "Current smoker", "Quit less than a year ago", "Quit between 1 and 5 years ago", "Quit between 5 and 15 years ago" and "Quit more than 15 years ago"). For ease of interpreting effects in the primary analyses, we restrict the smoking categories to current, former, and never in the wage equation specifications.

* In analyzing data from the SF-12, the standard approach is to form two summary scores, based on responses to the SF12 questions. The underlying concept is that overall health is composed of a physical and a mental component. The Physical Component Summary (PCS) weighs more heavily responses to SF-12 items 2-5 and 8 above. The Mental Component Summary (MCS) weighs more heavily responses to SF-12 items 6,7, 9 and 11 above. The other items have roughly equal weights for physical and mental components. The algorithm for computing the PCS and the MCS summary scores is described in the manual for the SF-12.

Table 1 describes the characteristics of our sample. The sample is 48.7 percent men and 51.3 percent women. The average age of all individuals is about 40 years and about 63 percent are married. The average number of children is less than one (.81). With respect to education, 10.4 percent of the sample have less than a high school diploma; 35.6 percent have a high school diploma; 24.8 percent have less than college; 18.3 percent have a college degree; and, 11 percent have education beyond a college degree. Seventy-four percent of the sample is white, 11.5 percent is African-American, 4.2 percent are Asian/Native American or Pacific Islander and 10.1 percent are Hispanic. Twenty-six percent of the sample are current smokers, 22 percent are former smokers and 51 percent are never smokers. About 11 percent of the sample have a MCS12 score < 39, indicating poor mental health. This number is slightly higher for women (13 percent).

Table 2 reports the labor market outcomes, by smoking status and by mental health status. These relationships are as expected. For men, current smokers are less likely to be employed (77.6 percent), compared with never smokers (83.6 percent). For women there is little difference in employment status by smoking status. In terms of hourly wages, both male and female former and never smokers have higher hourly wages than current smokers. Looking at differences in labor market outcomes of those in poor mental health, we find large differences in labor market participation. For men, 61 percent of those in poor mental health are employed, while 83 percent without poor mental health are employed. For women the corresponding numbers are 54 percent and 68 percent. The difference in average wage due to being in poor mental health is about \$2 for both men and women.

Results

Table 3 and **Table 4** show the estimated coefficients for the effect of mental health, smoking status, and their interaction on wages, separately for men and women. To make interpretation easier, **Table 5** summarizes our findings reporting the overall coefficient associated with each combination of mental health and smoking status.

For each gender, the individual columns in **Table 3** and **Table 4** correspond to distinct specifications. All regressions contain the full set of socio-economic, demographic and geographic variables; however, they differ in the specification of the mental health and smoking variables. The first specification contains only the poor mental health indicator on the right hand side; the second only the smoking status indicators; the third both smoking and poor mental health but no interactions; and the final the smoking status indicators, the poor mental health indicator, and their interactions. To make interpretation easier, the z-statistics associated with significant variables are in bold (at the 90% or higher level). Given that the dependent variable is the logarithm of the wage, the coefficients can be interpreted as the *percentage change in the wage rate*, i.e., a coefficient of .05 indicates that there is a reduction in the hourly rate of 5 percent. The second panel of each table indicates the coefficients from the relevant participation equation.

Table 1. Descriptive Statistics of the Study Sample

| | All | Men (48.7%) | Women (51.3%) |
|----------------------------------|-------------|----------------|------------------|
| Mean age (years) | 40.10 | 40.03 | 40.16 |
| Percent Married | 62.8% | 65.3% | 60.7% |
| Number of Children (s.d.) | 0.81 (1.11) | 0.76 (1.10) | 0.85 (1.12) |
| Education | | | |
| Less than HS | 10.4% | 10.6% | 10.2% |
| HS diploma | 35.6 | 35.5 | 35.7 |
| Less than college | 24.8 | 23.1 | 26.2 |
| College degree | 18.3 | 18.7 | 17.9 |
| More than college | 11.0 | 12.1 | 10.1 |
| Race: | | | |
| White | 74.2% | 75.9% | 72.7% |
| Black | 11.5 | 10.0 | 12.8 |
| Asian/Native Amer/Pacif Islander | 4.2 | 4.2 | 4.3 |
| Hispanic | 10.1 | 9.9 | 10.2 |
| Size of the Metropolitan Area | | | |
| Large | 85.0% | 84.9% | 85.3% |
| Small | 3.4 | 3.4 | 3.4 |
| Rural | 11.5 | 11.6 | 11.3 |
| Smoking Status | | | |
| Current | 26% | 28% | 24% |
| Former | 22 | 25 | 19 |
| Never | 52 | 47 | 56 |
| Mental health | | | |
| Poor MH | 11% | 9% | 13% |
| Non-poor MH | 89 | 91 | 87 |
| N | 119,883 | 58,335 | 61,548 |

Data source: Community Tracking Survey, years 1996, 1998 and 2000.

Table 2. Poor Mental Health (MH), Smoking Status and Labor Market Outcomes

| | Males | | Females | |
|----------------------|------------|---|------------|---|
| | % employed | Mean wage, conditional on employment (sd) | % employed | Mean wage, conditional on employment (sd) |
| Smoking Status | | | | |
| Current | 77.7% | \$14.10 (8.40) | 65.6% | \$11.30 (6.37) |
| Former | 80.5 | \$18.36 (10.04) | 66.0 | \$14.37 (8.40) |
| Never | 83.6 | \$17.18 (10.03) | 66.7 | \$13.20 (8.05) |
| Mental health | | | | |
| Poor MH ¹ | 61.3% | \$14.29 (8.85) | 53.9% | \$11.62 (7.30) |
| Non-poor MH | 83.0 | \$16.80 (9.78) | 68.1 | \$13.14 (7.95) |

¹ Poor mental health indicates MCS12 score < 39.

Table 3. Heckman Model Estimates of Wages on Poor Mental Health and Smoking (Males)

| | Model 1 | | Model 2 | | Model 3 | | Model 4 | |
|--|------------------------------|---------------|--------------------------|---------------|--|---------------|--|---------------|
| | Effect of poor mental health | | Effect of smoking status | | Effect of both poor mental health and smoking status | | Effect of PMH and smoking status plus interactions | |
| <i>Dep Var: Wage per hour^a</i> | coeff | z | coeff | z | coeff | z | coeff | z |
| Poor mental health (PMH) | -0.078 | -6.20 | | | -0.069 | -5.34 | -0.034 | -1.64 |
| Current smoker | | | -0.067 | -9.48 | -0.064 | -9.16 | -0.059 | -8.19 |
| Former smoker | | | 0.004 | 0.61 | 0.005 | 0.67 | 0.007 | 1.00 |
| PMH and current smoker | | | | | | | -0.070 | -2.62 |
| PMH and former smoker | | | | | | | -0.049 | -1.54 |
| Age | 0.062 | 32.00 | 0.062 | 28.84 | 0.062 | 29.69 | 0.063 | 31.14 |
| Age squared | -0.6E-3 | -25.54 | -0.6E-3 | -22.82 | -0.6E-3 | -23.59 | -0.6E-3 | -24.85 |
| Education: | | | | | | | | |
| High School Diploma | 0.182 | 17.69 | 0.175 | 16.66 | 0.174 | 16.69 | 0.175 | 16.83 |
| Less than College | 0.292 | 26.53 | 0.278 | 24.48 | 0.277 | 24.68 | 0.278 | 24.94 |
| College Degree | 0.505 | 42.53 | 0.486 | 38.93 | 0.484 | 39.35 | 0.486 | 39.83 |
| More than College | 0.660 | 49.07 | 0.639 | 45.41 | 0.637 | 45.94 | 0.638 | 46.39 |
| Race: | | | | | | | | |
| Black | -0.171 | -16.48 | -0.172 | -16.48 | -0.172 | -16.51 | -0.173 | -16.69 |
| Asian/Native Amer/Pacif | -0.093 | -6.20 | -0.091 | -5.99 | -0.090 | -5.97 | -0.091 | -6.01 |
| Hispanic | -0.166 | -15.42 | -0.172 | -15.94 | -0.171 | -15.84 | -0.171 | -15.86 |
| Being married | 0.106 | 15.92 | 0.101 | 14.80 | 0.098 | 14.57 | 0.098 | 14.63 |
| Small metropolitan area | -0.309 | -3.90 | -0.308 | -3.95 | -0.309 | -3.95 | -0.308 | -3.94 |
| Rural area | -0.129 | -5.06 | -0.130 | -5.06 | -0.129 | -5.04 | -0.129 | -5.04 |
| <i>Selection Equation: Worked for pay^b</i> | | | | | | | | |
| PMH | -0.650 | -41.44 | | | -0.639 | -40.59 | -0.493 | -19.44 |
| Current smoker | | | -0.119 | -12.50 | -0.079 | -8.15 | -0.056 | -5.70 |
| Quit less than 1yr ago | | | -0.154 | -6.68 | -0.132 | -5.59 | -0.132 | -5.54 |
| Quit 1-5 yrs ago | | | -0.005 | -0.26 | 0.005 | 0.30 | 0.034 | 1.85 |
| Quit 5-15 yrs ago | | | 0.045 | 3.03 | 0.059 | 3.95 | 0.085 | 5.65 |
| Quit more than 15 yrs ago | | | 0.041 | 2.94 | 0.040 | 2.88 | 0.064 | 4.41 |
| PMH and current smoker | | | | | | | -0.213 | -6.04 |
| PMH and quit less than 1yr ago | | | | | | | -0.051 | -0.56 |
| PMH and quit 1-5 yrs ago | | | | | | | -0.288 | -3.88 |
| PMH and quit 5-15 yrs ago | | | | | | | -0.272 | -4.42 |
| PMH and quit more than 15 yrs ago | | | | | | | -0.285 | -4.63 |
| Age | 0.160 | 72.86 | 0.154 | 71.44 | 0.161 | 72.47 | 0.161 | 72.72 |
| Age squared | -0.002 | -76.50 | -0.002 | -75.11 | -0.002 | -76.14 | -0.002 | -76.38 |
| Education: | | | | | | | | |
| High School Diploma | 0.298 | 19.54 | 0.322 | 21.24 | 0.288 | 18.87 | 0.288 | 18.86 |
| Less than College | 0.377 | 23.58 | 0.393 | 24.68 | 0.360 | 22.41 | 0.361 | 22.43 |
| College Degree | 0.612 | 37.38 | 0.627 | 37.98 | 0.587 | 35.17 | 0.587 | 35.20 |
| More than College | 0.668 | 38.06 | 0.685 | 38.62 | 0.640 | 35.77 | 0.639 | 35.78 |
| Race: | | | | | | | | |
| Black | -0.272 | -19.13 | -0.282 | -20.28 | -0.277 | -19.44 | -0.277 | -19.54 |
| Asian/Native Amer/Pacif | -0.266 | -13.46 | -0.270 | -13.86 | -0.265 | -13.37 | -0.265 | -13.34 |
| Hispanic | -0.035 | -2.45 | -0.051 | -3.65 | -0.041 | -2.86 | -0.041 | -2.87 |
| Being married | 0.153 | 16.69 | 0.178 | 19.42 | 0.141 | 15.08 | 0.142 | 15.29 |
| Number of children | 0.043 | 11.43 | 0.040 | 10.74 | 0.042 | 11.15 | 0.042 | 11.17 |
| Size of town: | | | | | | | | |
| Small metropolitan area | -0.056 | -0.75 | -0.032 | -0.42 | -0.048 | -0.64 | -0.045 | -0.60 |
| Rural area | -0.022 | -0.65 | -0.025 | -0.75 | -0.021 | -0.61 | -0.020 | -0.58 |
| Mill's Ratio coefficient | 0.015 | 0.64 | -0.005 | -0.14 | -0.006 | -0.17 | 0.005 | 0.20 |
| <i>Wald Test: Prob > Chi²(k)^c</i> | 0.0000 | | 0.0000 | | 0.0000 | | 0.0000 | |
| <i>Number of observations</i> | 54890 | | 54890 | | 54890 | | 54890 | |

(a) The wage equation additionally controls for the industry where the person works, the site of the survey, the year of the survey, and the interaction between the two latter terms.

(b) The participation equation additionally controls for the site of the survey, the year of the survey, and the interaction between the two latter terms.

(c) k is the number of regressors.

(d) Significance at the 10% level denoted in bold.

Data source: Community Tracking Survey, years 1996, 1998 and 2000. Weights are used to make results nationally representative.

Table 4. Heckman Model Estimates of Wages on Poor Mental Health and Smoking (Females)

| | Model 1 | | Model 2 | | Model 3 | | Model 4 | |
|--|------------------------------|---------------|--------------------------|---------------|--|---------------|--|---------------|
| | Effect of poor mental health | | Effect of smoking status | | Effect of both poor mental health and smoking status | | Effect of PMH and smoking status plus interactions | |
| <i>Dep Var: Wage per hour^a</i> | coeff | z | coeff | z | coeff | z | coeff | z |
| Poor mental health (PMH) | -0.042 | -4.23 | | | -0.036 | -3.30 | -0.042 | -2.90 |
| Current smoker | | | -0.019 | -2.77 | -0.017 | -2.51 | -0.018 | -2.47 |
| Former smoker | | | 0.039 | 5.11 | 0.040 | 5.17 | 0.038 | 4.78 |
| PMH and current smoker | | | | | | | 0.007 | 0.38 |
| PMH and former smoker | | | | | | | 0.016 | 0.62 |
| Age | 0.047 | 22.09 | 0.045 | 14.48 | 0.046 | 19.16 | 0.046 | 19.03 |
| Age squared | -0.5E-3 | -17.89 | -0.5E-3 | -11.40 | -0.5E-3 | -15.40 | -0.5E-3 | -15.29 |
| Education: | | | | | | | | |
| High School Diploma | 0.153 | 11.50 | 0.140 | 7.34 | 0.144 | 9.80 | 0.144 | 9.76 |
| Less than College | 0.296 | 20.47 | 0.278 | 12.41 | 0.284 | 17.30 | 0.284 | 17.20 |
| College Degree | 0.536 | 33.89 | 0.516 | 20.86 | 0.522 | 28.90 | 0.521 | 28.73 |
| More than College | 0.736 | 40.58 | 0.712 | 24.52 | 0.720 | 34.38 | 0.720 | 34.16 |
| Race: | | | | | | | | |
| Black | -0.030 | -3.19 | -0.025 | -2.53 | -0.026 | -2.79 | -0.026 | -2.78 |
| Asian/Native Amer/Pacif | -0.056 | -3.86 | -0.050 | -3.27 | -0.051 | -3.49 | -0.051 | -3.48 |
| Hispanic | -0.079 | -5.77 | -0.076 | -5.17 | -0.077 | -5.51 | -0.077 | -5.50 |
| Being married | 0.049 | 7.06 | 0.054 | 5.44 | 0.050 | 6.27 | 0.050 | 6.24 |
| Small metropolitan area | -0.027 | -0.25 | -0.032 | -0.31 | -0.033 | -0.31 | -0.033 | -0.32 |
| Rural area | -0.163 | -6.42 | -0.164 | -6.43 | -0.163 | -6.42 | -0.163 | -6.42 |
| <i>Selection Equation: Worked for pay^b</i> | | | | | | | | |
| PMH | -0.383 | -31.45 | | | -0.382 | -31.28 | -0.329 | -19.34 |
| Current smoker | | | -0.036 | -3.81 | -0.006 | -0.57 | 0.016 | 1.52 |
| Quit less than 1yr ago | | | -0.126 | -4.78 | -0.110 | -4.17 | -0.095 | -3.34 |
| Quit 1-5 yrs ago | | | -0.096 | -4.47 | -0.091 | -4.35 | -0.086 | -3.94 |
| Quit 5-15 yrs ago | | | -0.009 | -0.57 | -0.007 | -0.43 | 0.6E3 | 0.04 |
| Quit more than 15 yrs ago | | | 0.088 | 5.43 | 0.092 | 5.74 | 0.094 | 5.68 |
| PMH and current smoker | | | | | | | -0.124 | -4.57 |
| PMH and quit less than 1yr ago | | | | | | | -0.108 | -1.45 |
| PMH and quit 1-5 yrs ago | | | | | | | -0.048 | -0.70 |
| PMH and quit 5-15 yrs ago | | | | | | | -0.066 | -1.23 |
| PMH and quit more than 15 yrs ago | | | | | | | -0.018 | -0.32 |
| Age | 0.128 | 54.71 | 0.126 | 53.13 | 0.129 | 54.44 | 0.129 | 54.38 |
| Age squared | -0.002 | -59.69 | -0.002 | -57.87 | -0.002 | -59.50 | -0.002 | -59.46 |
| Education: | | | | | | | | |
| High School Diploma | 0.445 | 27.15 | 0.463 | 28.25 | 0.444 | 27.03 | 0.444 | 26.98 |
| Less than College | 0.616 | 36.49 | 0.634 | 37.58 | 0.613 | 36.19 | 0.613 | 36.14 |
| College Degree | 0.655 | 37.25 | 0.681 | 38.39 | 0.648 | 36.43 | 0.649 | 36.42 |
| More than College | 0.836 | 44.34 | 0.862 | 45.25 | 0.826 | 43.27 | 0.827 | 43.29 |
| Race: | | | | | | | | |
| Black | -0.109 | -8.75 | -0.113 | -8.97 | -0.110 | -8.67 | -0.110 | -8.73 |
| Asian/Native Amer/Pacif | -0.209 | -11.12 | -0.210 | -11.24 | -0.208 | -11.05 | -0.208 | -11.03 |
| Hispanic | -0.143 | -9.52 | -0.157 | -10.38 | -0.145 | -9.57 | -0.146 | -9.67 |
| Being married | -0.275 | -33.25 | -0.253 | -30.48 | -0.278 | -33.20 | -0.278 | -33.21 |
| Number of children | -0.158 | -39.72 | -0.158 | -39.87 | -0.159 | -39.88 | -0.159 | -39.84 |
| Size of town: | | | | | | | | |
| Small metropolitan area | 0.050 | 0.64 | 0.066 | 0.83 | 0.045 | 0.59 | 0.048 | 0.61 |
| Rural area | 0.024 | 0.74 | 0.029 | 0.87 | 0.024 | 0.72 | 0.024 | 0.72 |
| Mill's Ratio coefficient | -0.092 | -1.90 | -0.175 | -1.60 | -0.136 | -2.02 | -0.137 | -2.00 |
| <i>Wald Test: Prob > Chi²(k)^c</i> | 0.0000 | | 0.0000 | | 0.0000 | | 0.0000 | |
| <i>Number of observations</i> | 64875 | | 64875 | | 64875 | | 64875 | |

(a) The wage equation additionally controls for the industry where the person works, the site of the survey, the year of the survey, and the interaction between the two latter terms.

(b) The participation equation additionally controls for the site of the survey, the year of the survey, and the interaction between the two latter terms.

(c) k is the number of regressors.

(d) Significance at the 10% level denoted in bold.

Data source: Community Tracking Survey, years 1996, 1998 and 2000. Weights are used to make results nationally representative.

Mental Health

The coefficients associated with being in poor mental health (PMH) in Column 1 in **Table 3** and **Table 4** confirm that being in poor mental health negatively affects wages. It decreases men's hourly wages by 7.8 percent ($p < .001$) and women's by 4.2 percent ($p < .001$).

Column 3 in **Table 3** and **Table 4** reports the specification in which both being in poor mental health and smoking status are included as explanatory variables but not their interaction. When controlling for smoking status, being in poor mental health remains significant and negative at -6.9 percent for men and -3.6 percent for women. For the ease of the exposition, the results of the last specification, which include poor mental health and smoking status main effects and interactions, are reported below.

Smoking

From column 2 in **Table 3**, we observe that being a current smoker decreases hourly wages by 6.7 percent for males compared to a never-smoker ($p < .0001$) and 1.9 percent for females ($p < .01$). Surprisingly, the effect of having been a smoker in the past, but not smoking now, has a significant positive effect on wages for women compared to a never-smoker as it increases wages by 3.9 percent ($p < .001$). For men, this effect is approximately zero.

Looking at the third column of **Table 3** and **Table 4**, we observe that when controlling for mental health, the effect on wages of being a current smoker is still negative and significant: -6.4 percent for men ($p < .0001$) and -1.7 percent for women ($p < .01$). Being a former smoker is still positive and nearly 4 percent ($p < .001$) for women, but again insignificant for men. Comparing the coefficients in columns 2 and 3, we observe that the introduction of poor mental health in the model has little effect on the smoking coefficient.

Poor Mental Health and Smoking

Columns 4 of **Table 3** and **Table 4** report the coefficients for the specification in which being in poor mental health, smoking status, and their interactions are included. These estimated coefficients are used to calculate summaries of the effects of specific combinations of mental health and smoking status. We provide these summaries in **Table 5**. The following discussion refers to the numbers reported in **Table 5** which are derived from the coefficients Model 4, the interacted model, in **Table 4**. The omitted category in this last specification is "being a never-smoker in good mental health" as indicated also in **Table 5**. Therefore, all effects are relative to the wage of such an individual. We report on the calculated net effects of poor mental health and smoking status found respectively in the last column and last two rows.

For males, the effect on wages of being in poor mental health is a 3.4 percent decline in the wage rate for never smokers, a 10.4 percent decline for current smokers, and a 8.3 percent decline for former smokers. The effect of current smoking on males in good mental health is a 5.9 percent decline in wages, compared to a 12.9 percent decline for those in poor mental health. This differential impact of current smoking and poor mental health of 7 percent is significant at the $p < .01$ level. In total, current male smokers in poor mental health see their wages reduced by 16.3 percent compared to never smokers not in poor mental health.

For females, the effect of poor mental health on wages is to reduce wages by 4.2, 3.5 and 2.6 percent for never, current smokers, and former smokers respectively. On the other hand, the impact of smoking is a 1.8 percent decline for those in good mental health and a 1.1 percent decline for those in poor mental health.

Table 5. The Effect of Poor Mental Health and Smoking on Wages*

| | Males | | | Females | | |
|---|-------------|---------|----------------------------------|-------------|---------|----------------------------------|
| | Non-poor MH | Poor MH | Net effect of Poor Mental Health | Non-poor MH | Poor MH | Net effect of Poor Mental Health |
| Never Smoker | - | -3.4% | -3.4% | - | -4.2% | -4.2% |
| Current Smoker | -5.9% | -16.3% | -10.4% | -1.8% | -5.3% | -3.5% |
| Former Smoker | +0.7% | -7.5% | -8.3% | +3.8% | +1.2% | -2.6% |
| Net effect of Current smoker (compared with never smoker) | -5.9% | -12.9% | | -1.8% | -1.1% | |
| Net effect of Former smoker (compared with never smoker) | +0.7% | -4.1% | | +3.8% | -5.4% | |

Data source: Community Tracking Survey, years 1996, 1998 and 2000.

* Calculated from coefficients in Tables 3 and 4.

Other Considerations

Effect of Other Variables

All of the control variables have the expected signs and magnitudes; greater education, being white, being married and living in a large metropolitan area are all associated with higher earnings. As expected, age has a concave effect on wages for both men and women. With respect to the selection into work, the variables all have the expected sign including the finding that being married and having a greater number of children increased the likelihood of being employed for men, while for women, these two variables have a negative effect.

Participation Equation

The lower panels in **Table 3** and **Table 4** report the estimates for the impact of being in poor mental health and smoking on the *decision to work*. The estimated equation contains labor participation as a dependent variable, being in poor mental health as defined above, and the expanded set of smoking variables. It controls for socio-economic and demographic factors, metropolitan area size, year of the survey, site of the survey, and the interaction between the latter two terms. For both men and women, being in poor mental health significantly decreases the likelihood of being in the labor force regardless of smoking status. However, just as in the case of wages, the interaction effects among poor mental health and smoking status are significant mainly for males.

Selection Bias Correction

The estimated parameter associated with the Mill's ratio is statistically significant for women, indicating that inferences about the effect of poor mental health and smoking status on wages using equation (1) alone would have been incorrect. However, for men, this coefficient is not significant. Based on this result, correcting for the selection bias into working is not necessary for males. Nevertheless, for benefit of comparison to females we chose to express effects for males in terms of latent wages.

Goodness of Fit

For all specifications, the results of the associated Wald test indicates that the variables has a strong explanatory power. The results of these tests are reported in the bottom panel of **Table 3** and **Table 4**. The null hypothesis that setting all parameters to 0 would produce a better fit is rejected at the .00001 level of confidence for all models for both genders.

Conclusions, Implications, and Future Research

Recent research has found a strong correlation between smoking and poor mental health. Our results confirm prior research that finds that both poor mental health and smoking are negatively associated with wages, controlling for other

factors. We find the negative impacts of both are more significant and of greater magnitude for men than for women. We extend this line of research and show that the impact of mental health on wage rates varies significantly by smoking status for men. Men who are in both poor mental health and who smoke have the largest associated reduction in wage rates (-16.3%) relative to those who have never smoked and are not in poor mental health, while the interaction between poor mental health and smoking is insignificant for women (-5.3%).

That the effects of smoking and poor mental health on wages are greater for men than for women is somewhat puzzling. One possible explanation is that women get paid a lower wage per hour in general and the detrimental effects in term of percentages are smaller, i.e. a ceiling effect. Women who smoke may be more likely to self-select into not working and thus the primary negative impact is through the decision to work. This is confirmed in results from the labor market participation regression; the negative impact of current smoking is larger for women than for men. Also, jobs typically held by men may be more affected by the disruptions caused by smoking compounded with poor mental health (in terms of more frequent smoking breaks and associated anxiety) than jobs typically held by women.

The positive impact of being a former smoker may be in part be due to unobserved differences relating to the self-selection of who initiated smoking. Women were historically less likely to start smoking and thus those who chose to smoke but later quit might have been more different from never-smokers for women than for men. For men, only current smoking has a significant impact.

Limitations

This is the first study to examine the interplay between smoking and poor mental health as they jointly impact wages. The data are rich and allow us to use detailed information on smoking, quitting and mental health, by gender. Specifically, we are able to delineate current and former smokers and time since quit smoking for former smokers. However, this work has some limitations, many of which spring from lack of data on other covariates of interest. For example, the data do not contain information on specific mental health diagnosis nor on drug and alcohol abuse or dependence. The results could vary by specific mental health disorder, e.g. major depression versus schizophrenia and/or by alcohol abuse or dependence. Because alcohol, smoking, and mental health are positively correlated, the smoking and mental health coefficients may pick up some of the impact of alcohol abuse or dependence. However, earlier evidence on the impact of smoking on wages supports a negative effect of smoking in wage regressions even when alcohol is controlled.^{18,19} Because alcohol has a well-documented non-linear relationship with respect to wages, interpreting the impact of the exclusion of alcohol abuse/dependence on the mental health and smoking coefficients is quite difficult. However, because men are more likely to abuse and be dependent on alcohol, this gender difference could help to explain some of the gender

differences that are found in this paper. Unfortunately, accounting for a 3x3 interaction between alcohol/drug use, smoking, and mental health is not feasible with this dataset.

Another limitation is that we do not have data to control for detailed information within the smoking categories, such as number of cigarettes smoked or why smokers quit. Also, we do not have detailed work histories. Finally, there might be unobserved factors that explain mental health, smoking status and wages simultaneously, creating an endogeneity problem that we have not addressed. A full accounting for these relationships is beyond the scope of this paper, yet we believe that the associations that were found are compelling.

Implications

An implication of our findings is that public policies aimed at increasing labor force participation and earnings of individuals with mental health problems will have to take into account the simultaneous effect of individuals' smoking status, especially for males. Our findings suggest that those who both smoke and have mental health problems, especially males, have the greatest productivity losses and are thus in the greatest need for treatments that address both issues jointly. Thus, employers wanting to address productivity losses by offering workplace programs should consider these interaction effects. For instance, smoking cessation programs should consider treatment for mental disorders in order to increase worker productivity, especially for males. Mental health treatments should aid cessation for those who smoke.

Further economics research should address the complex issue of the potential endogeneity of mental health, smoking, and their interactions in regressions of wages. This is a relatively difficult endeavour due to the multifaceted relationships among working, smoking, and mental health. This would become even more complex if substance abuse and dependence were also to be considered. Further research is also needed on the interaction of specific mental disorders and smoking; there may be differences across disorders in their interactions with smoking and the impacts on wages. Research could be aimed at determining those work environments and treatments that are effective in helping those with mental health problems who smoke to become more productive. Clinical research should find treatments that are particularly effective for this group with the twin disorders of smoking addiction and poor mental health.

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