

Mental Health in the National Health Interview Survey 2007-2013

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May 30, 2017

Introduction

The consequences of neglecting mental health can be just as serious as neglecting one's physical health. For example, the National Institute of Mental Health estimated in 2015 that 6.7% of US adults suffered an episode of major depression, with 2.4% of adults suffering an episode which severely impaired their daily lives. ("Major Depression with Severe Impairment Among Adults," n.d.) However, mental illness is often referred to as an invisible illness because its afflictions are not as obvious as those caused by physical illnesses. While the quality of mental health services has risen throughout the years, people remain reticent on their mental health. Stigma associated with being labelled "mentally ill" is well-documented as a primary reason for this reluctance in both the general American population, (Corrigan 2004) and in combat veterans returning from duty in Iraq and Afghanistan. (Hoge et al. 2004)

Data and Methodology

This study utilized logistic regression models to analyze the *National Health Interview Survey* data from 2007-2013. The National Health Interview Survey is one of the largest and most comprehensive surveys of Americans. Organized by the Centers for Disease Control and carried out with Census Bureau employees, this annual survey interviews a random but representative sample of American households every year. Each year's survey data is divided into several files, each containing a specific set of variables. For example, in every household the interviewer may ask a random adult more detailed questions—answers which are then recoded in the Sample Adult file. The majority of this study's analysis was done by linking the person, family, and sample adult level files.

Aggregating Data

In order to gain higher precision estimates, and to be able to analyze changes over time, data from different survey years were aggregated. However, this was not straightforward. Due to sampling design and non-response, the National Health Interview Survey oversamples certain groups of the American population. As a result, survey weights—the sum of which equals the total population in that point in time—were attached to each year's data.

For the analysis to be statistically valid, these weights also must be modified when rearranging the data. In addition to joining data across files, it is also possible to join data cross years. This is done to increase the sample size available and increase the precision of our estimates. However, two issues arise when doing so. Some variable names and definitions may change, which can be rectified by reading the attached documentation. Secondly, the weights will need to be recalculated. Per the documentation, multi-year analyses are conducted by dividing the weights by the number of years being analyzed.

Missing Data

A small but significant portion of the observations were removed due to missing values in either a predictor or response variable. As a result, only 158,803 out of 175,001 (90.74%) possible observations were used.

Model Building

Because of the large number of potential covariates being studied, a strategy was devised to build the final model. First, covariates were considered on a univariate basis. If they were part of a group of dummy variables, e.g. *Black*, *Asian*, etc., then the dummies were regressed in as a group. Possible interaction effects were then attached to the univariate regressions. Plots of predictors over time were used to assess if there were variations over time. Finally, multiple logistic regression models were constructed by including predictors that were significant at the 80% level.

How Mental Distress Was Measured

This study assessed the prevalence of psychological distress in the American population through responses to three questions contained in the Sample Adult file:

1. How often a person felt worthless in the past 30 days
2. How often he or she felt hopeless in the past 30 days
3. On average, how much sleep a person gets in a 24-hour period

These attributes were chosen since they are useful on their own for evaluating mental distress in an individual. For example, one study found that feelings of hopelessness provided a link between severity of depression and suicide, and that degree of hopelessness predicted suicide more strongly than severity of depression. (Kovacs and Garrison 1985) Furthermore, these are part of the criteria used for diagnosing major depression in the fifth edition of the *Diagnostic and Statistical Manual of Mental Disorders*. (“Depression Symptoms (Major Depressive Disorder)” 2017)

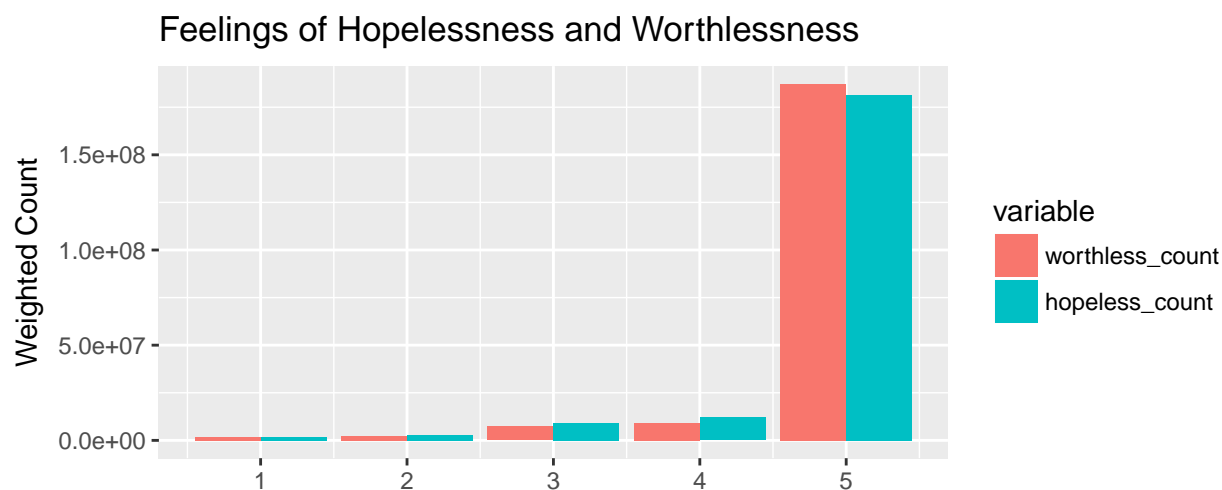
Feelings of Worthlessness and Hopelessness

The responses to the questions regarding worthlessness and hopelessness were coded on a 1-5 scale:

1. All of the time
2. Most of the time
3. Some of the time
4. A little of the time
5. None of the time

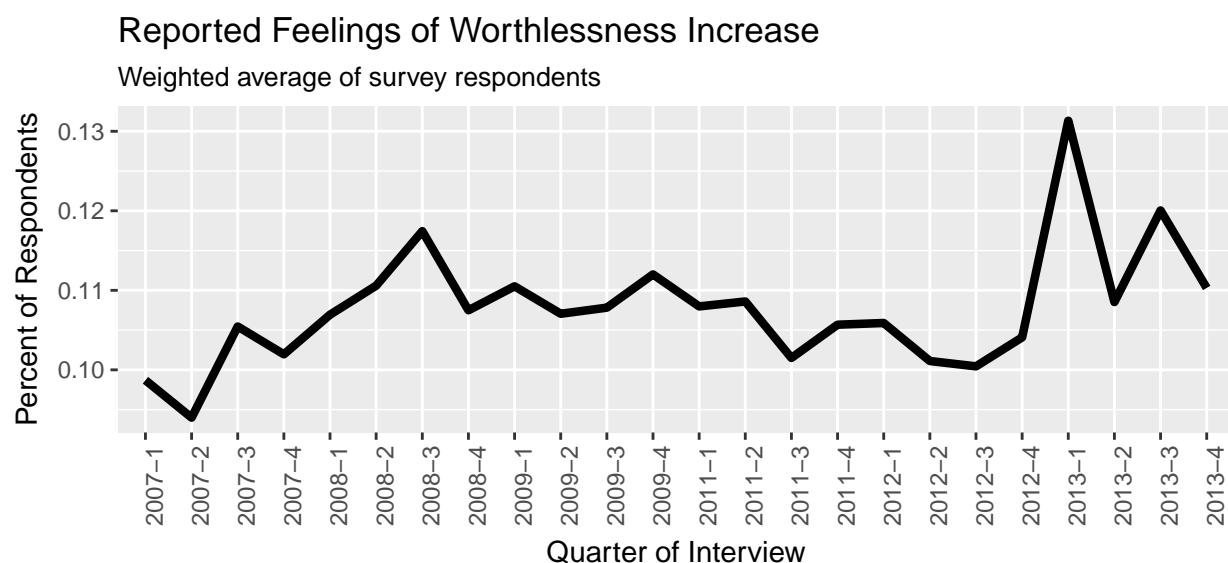
Because only a small proportion of respondents affirmed that they had feelings of worthlessness or hopelessness, a dichotomous variable was created by separating responses into two groups—those that felt worthless or hopeless at least a little of the time (1-4) and those that never felt worthless or hopeless (5).

As a result of this coding change, I was reduced from being able to assess the severity of mental distress to merely being able to detect its presence. However, this change also simplified my problem as regressions could be estimated with binomial—rather than more complicated multinomial—logistic regressions. Furthermore, I still encountered difficulty building a reliable model for predicting binary outcomes. These difficulties would only be magnified if my model had to distinguish between levels of mental distress as well. Lastly, but most importantly, this coding change ameliorates the possibility that survey respondents would underreport their levels of mental distress to an unfamiliar Census Bureau employee conducting the survey.



National Health Interview Survey 2007–2013: Sample Adult File

Reported feelings of worthlessness in the NHIS is on a positive trend. Whether this is a result of increased mental distress or greater honesty about internal feelings is undetermined.



Quantity of Sleep

A new feature used in the following regressions was constructed from the amount of sleep a person had—abnormal sleep—which was defined as having less than 6 or more than 10 hours of sleep.

Unweighted Summary Statistics for the NHIS 2007-2013 Sample Adult File

Time of Survey

Survey Year	Survey Quarter	n
2007	1	5196
2007	2	5881
2007	3	3042
2007	4	6138
2008	1	4974
2008	2	5729
2008	3	5734
2008	4	3039
2009	1	2776
2009	2	6588
2009	3	6507
2009	4	9669
2011	1	7466
2011	2	8138
2011	3	7571
2011	4	7382
2012	1	6985
2012	2	8512
2012	3	8080
2012	4	8260
2013	1	7482
2013	2	7519
2013	3	8239
2013	4	7896

Demographic Control Variables

Male	n
0	88210
1	70593

Age

Average	Median	Standard Deviation
47.61	46	17.96

Income

Family Income	n
\$0 - \$34,999	68435
\$35,000 - \$49,999	23282
\$50,000 - \$74,999	26318
\$75,000 - \$99,999	15861
\$100,000 and over	24907

Race and Ethnicity

Table 5: Table continues below

	Hispanic, any race	White (Non-Hispanic)	Black (Non-Hispanic)
n	28357	94890	24647
Percent	0.1786	0.5975	0.1552

Asian (Non-Hispanic)	Other Race (Non-Hispanic)
9386	1523
0.0591	0.00959

Response Variables

Original Survey Variables

Table 7: Table continues below

worthless_mean	hopeless_mean	sleep_mean	worthless_sd	hopeless_sd
4.806	4.754	7.151	0.6434	0.7093

sleep_sd
1.414

Modified Variables

These are the frequencies (in terms of percentages) of the features I created from existing survey attributes.

worthless_once	hopeless_once	abnormal_sleep
0.105	0.1376	0.1038

Age

Age was not significant as a predictor of feelings of worthlessness. It was however, found to be significant at the 99% level to be negatively associated with feelings of hopelessness but positive associated with levels of “abnormal sleep”. While the former finding suggests that older Americans are less likely to be depressed, the latter may simply be a result of old age rather than any underlying mental issues.

Race

Contrary to my expectations, there was no significant interaction effect between race and time throughout the recession. The estimates of feelings of worthlessness for “Other Race” varies erratically throughout time,

Table 10: Age and Symptoms of Depressions

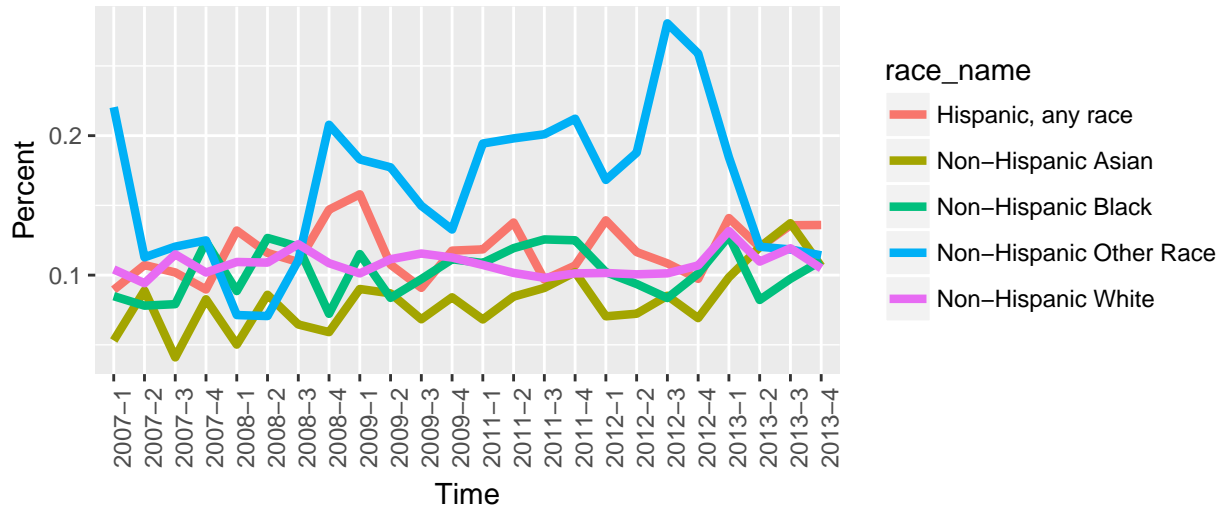
	<i>Dependent variable:</i>		
	Felt Worthless (1)	Felt Hopeless (2)	Abnormal Sleep (3)
age	0.0002 (0.001)	-0.002*** (0.001)	0.005*** (0.001)
Constant	-2.241*** (0.035)	-1.829*** (0.031)	-2.474*** (0.035)
Observations	127,274	127,274	127,274
Log Likelihood	-39,820.120	-47,221.710	-39,652.770
Akaike Inf. Crit.	79,644.230	94,447.430	79,309.540

Note:

*p<0.1; **p<0.05; ***p<0.01

although this may simply be an artifact of their relatively low sample size.

How many times in the past 30 days did you feel worthless



Sex

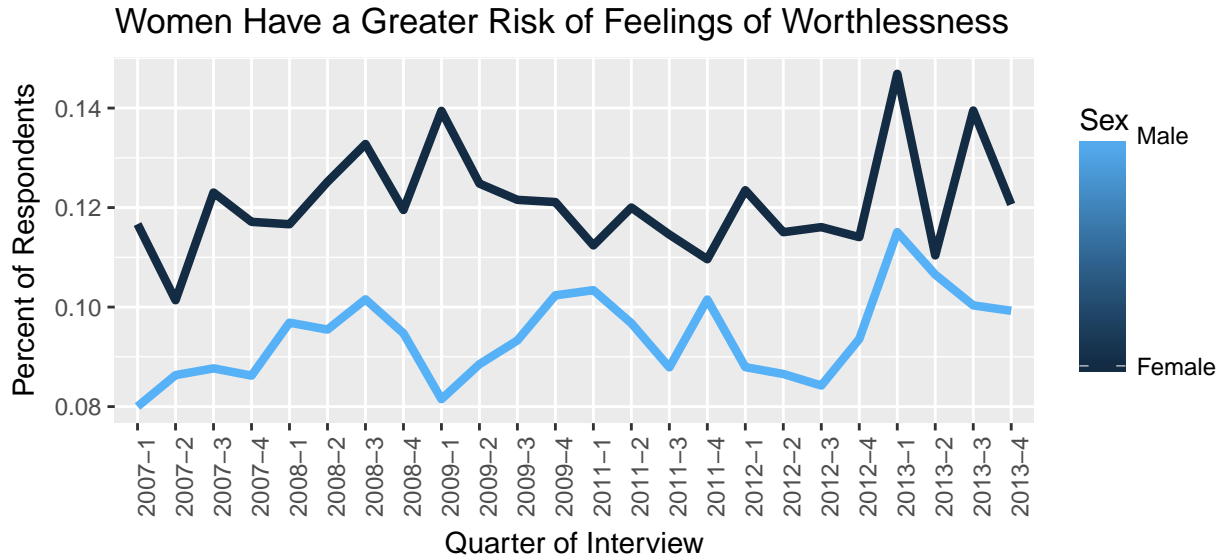
There was no noticeable interaction between sex and time in regards to symptoms of worthlessness. However, a higher proportion of women consistently reported feelings of worthlessness. This parallels the findings of the 2015 National Survey on Drug Use and Health which estimated 8.5% of women having a major depressive episode (5.5% experiencing a depressive episode without severe impairment) but only 3.0% of men having a major depressive episode (3.0% without severe impairment). (“Major Depression with Severe Impairment Among Adults,” n.d.)

Table 11: Relationship Between Race and Symptoms of Depression

	<i>Dependent variable:</i>		
	Felt Worthless (1)	Felt Hopeless (2)	Abnormal Sleep (3)
black	−0.041 (0.035)	0.038 (0.031)	0.542*** (0.030)
asian	−0.258*** (0.057)	−0.205*** (0.051)	−0.299*** (0.059)
hispanic	0.075** (0.032)	0.318*** (0.027)	−0.033 (0.033)
other_race	0.404*** (0.112)	0.396*** (0.102)	0.626*** (0.102)
Constant	−2.232*** (0.015)	−1.991*** (0.014)	−2.301*** (0.016)
Observations	127,274	127,274	127,274
Log Likelihood	−39,794.920	−47,137.280	−39,441.720
Akaike Inf. Crit.	79,599.840	94,284.560	78,893.450

Note:

*p<0.1; **p<0.05; ***p<0.01



Family Income: Does Money Buy Happiness

Family income was once of the strongest predictors of feelings of worthlessness. While the link between happiness and family income may be unclear in the literature, the analyses below that additional income seems to guard against feelings of psychological distress. One explanation, suggested by the paper “Spending

Table 12: Sex and Symptoms of Depression

	<i>Dependent variable:</i>		
	Felt Worthless (1)	Felt Hopeless (2)	Felt Hopeless (3)
male	−0.261*** (0.025)	−0.261*** (0.025)	−0.088*** (0.024)
Constant	−2.113*** (0.016)	−2.113*** (0.016)	−2.192*** (0.016)
Observations	127,274	127,274	127,274
Log Likelihood	−39,728.160	−39,728.160	−39,687.380
Akaike Inf. Crit.	79,460.330	79,460.330	79,378.760

Note:

*p<0.1; **p<0.05; ***p<0.01

Money on Others Promotes Happiness”, is that wealthier families are more able and willing to spend money on others, thus leading to greater happiness. In a representative survey of 632 Americans, the authors analyzed the relationship between income, pro-social spending, and happiness. In one regression, they found the effect of extra income was just as powerful as the effect of spending more money on others. (Dunn, Aknin, and Norton 2008)

The authors then followed up with an experimental design where participants were paid either \$5 or \$20 and told to either spend this money on themselves or on others. Resultantly, those who were instructed to spend the money on others were found to have been significantly happier. However, when they asked the respondents whether they thought personal or prosocial spending was better for their happiness, the majority answered with personal spending. Although this is speculative, it is possible that richer households—having accommodated their basic needs and then some—may be more inclined to spend their wealth on others, thus leading to greater psychological wellbeing.

Feelings of Worthlessness Vary by Income Bracket

Poorest Americans more likely to feel distressed

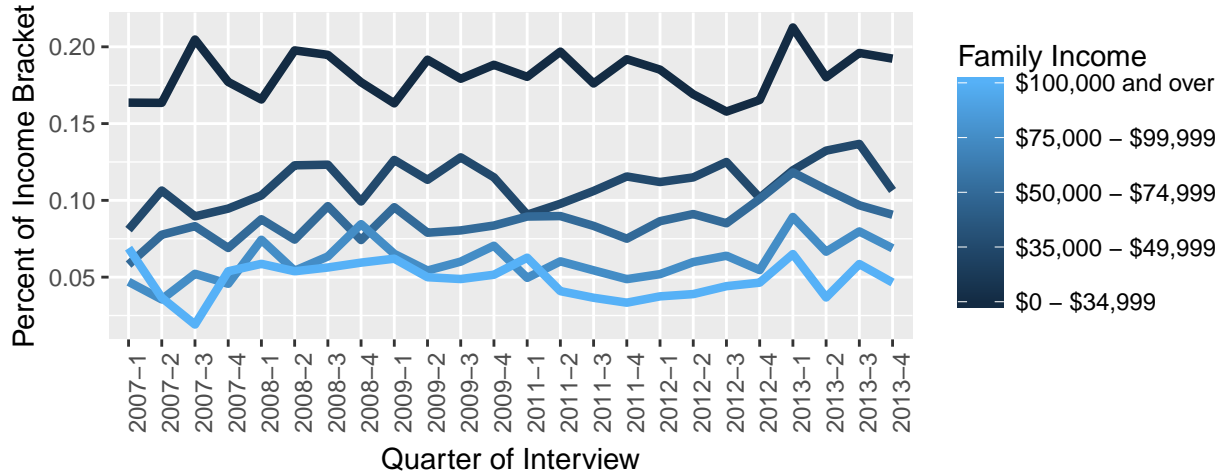


Table 13: Association Between Income and Symptoms of Depression

	<i>Dependent variable:</i>		
	Felt Worthless (1)	Felt Hopeless (2)	Abnormal Sleep (3)
Fam Income \$3550k	−0.482*** (0.035)	−0.475*** (0.032)	−0.276*** (0.035)
Fam Income \$5075k	−0.744*** (0.037)	−0.733*** (0.033)	−0.444*** (0.034)
Fam Income \$75100k	−1.133*** (0.053)	−1.061*** (0.045)	−0.619*** (0.045)
Fam Income \$100k+	−1.316*** (0.046)	−1.302*** (0.040)	−0.856*** (0.041)
Constant	−1.709*** (0.015)	−1.421*** (0.014)	−1.893*** (0.016)
Observations	127,274	127,274	127,274
Log Likelihood	−38,463.870	−45,615.740	−39,163.500
Akaike Inf. Crit.	76,937.740	91,241.480	78,337.000

Note:

*p<0.1; **p<0.05; ***p<0.01

When controlling for income, the lowest income bracket was the left out group

Employment Status

One of the questions I was interested in was the relationship between employment status and depression, especially if the person had a disability. In the most recent *Current Population Reports* published by the US Census Bureau, the occurrence of disability was measured via the 2008 Survey of Income and Program Participation (SIPP), conducted from May 2010 through August 2010. (Kaye 2010) The study found that disabled workers were more likely to lose their jobs during the recession and less likely to be hired as the economy recovered.

Unfortunately, to contain the length of this paper, interactions between disability and unemployment were not measured. However, regressions against employment status were ran.

Looking for Work

Those actively looking for a job were found to have a slightly higher risk of symptoms of psychological distress in preliminary estimates. For example, when regressing against feelings of hopelessness, the coefficient on looking for work was $\hat{\beta} = 0.82$. This translates to a $\frac{\exp(-2+0.82)}{1+\exp(-2+0.82)} = 23.5\%$ chance of feeling hopeless if looking for a job, but only 11.9% otherwise. Since, one study on alcohol use during the recession found that middle aged men were more likely to drink as a result of economic loss, (Mulia et al. 2014) I was motivated to see if there was an interaction effects between employment status, age and sex. However, the interaction coefficients were not statistically significant.

Time Fixed Effects

Survey year dummies were included to account for time fixed effects. Quarter dummies were also added to account for any potential seasonality, but none of them were statistically significant.

Table 14: Employment Status and Symptoms of Depression

	<i>Dependent variable:</i>			
	Felt Worthless	Felt Hopeless	Abnormal Sleep	
	(1)	(2)	(3)	(4)
looking_for_work	0.777*** (0.042)	0.714*** (0.127)	0.821*** (0.038)	0.180*** (0.048)
male		-0.270*** (0.026)		
age		0.002** (0.001)		
looking_for_work:male		-0.009 (0.084)		
looking_for_work:age		0.003 (0.003)		
Constant	-2.289*** (0.013)	-2.237*** (0.039)	-2.000*** (0.011)	-2.244*** (0.012)
Observations	127,274	127,274	127,274	127,274
Log Likelihood	-39,575.610	-39,469.580	-46,908.740	-39,689.290
Akaike Inf. Crit.	79,155.220	78,951.150	93,821.480	79,382.590

Note:

*p<0.1; **p<0.05; ***p<0.01

Table 15: Time Fixed Effects and Seasonality

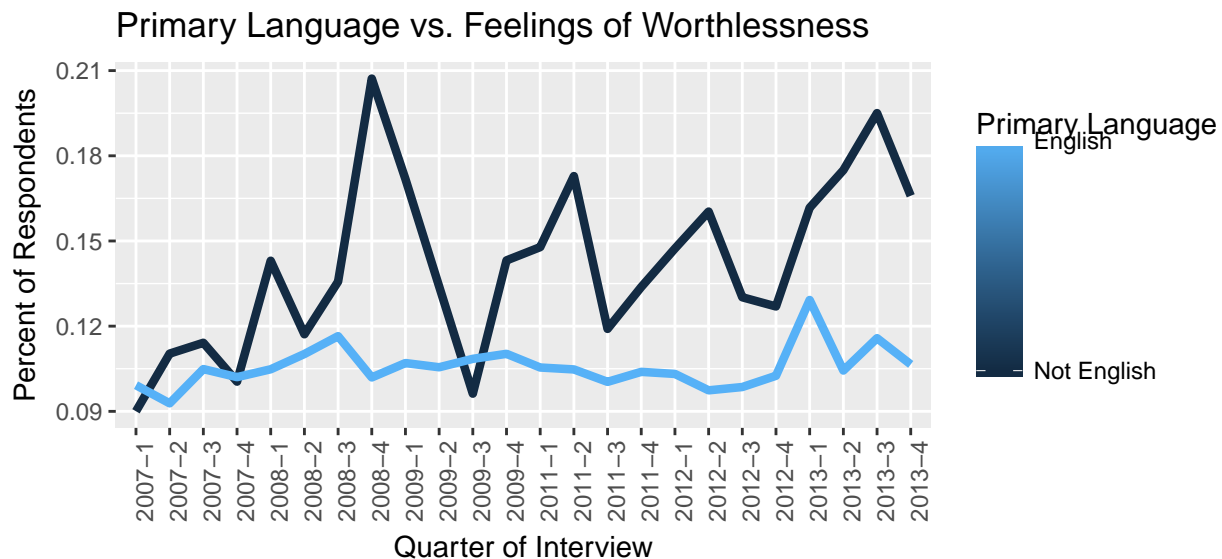
	<i>Dependent variable:</i>		
	Felt Worthless	Felt Hopeless	Abnormal Sleep
	(1)	(2)	(3)
factor(srvy_yr)2008	0.107** (0.048)	0.152*** (0.042)	0.038 (0.047)
factor(srvy_yr)2009	0.105** (0.046)	0.138*** (0.041)	0.057 (0.046)
factor(srvy_yr)2011	0.060 (0.043)	0.109*** (0.039)	0.123*** (0.043)
factor(srvy_yr)2012	0.035 (0.044)	0.062 (0.040)	0.097** (0.043)
factor(srvy_yr)2013	0.165*** (0.043)	0.252*** (0.039)	0.137*** (0.043)
factor(intv_qrt)2	-0.048 (0.034)	-0.063** (0.030)	0.051 (0.034)
factor(intv_qrt)3	-0.018 (0.035)	-0.010 (0.031)	0.038 (0.036)
factor(intv_qrt)4	-0.051 (0.035)	-0.026 (0.031)	0.045 (0.035)
Constant	-2.285*** (0.040)	-2.039*** (0.036)	-2.345*** (0.040)
Observations	127,274	127,274	127,274
Log Likelihood	-39,804.430	-47,194.230	-39,687.630
Akaike Inf. Crit.	79,626.860	94,406.470	79,393.270

Note:

*p<0.1; **p<0.05; ***p<0.01

Language Spoken

I was interested in if there was a relationship between one's primary language and their risk factor for mental distress. Because English is the de facto language of the United States, those who cannot speak English may feel "left out." The language the NHIS interview was conducted in was used as a proxy for the individual's main language. Initially, no such association existed but there appears to be a spike every four years, occurring roughly during and right after the election. This may be a result of the extensive rhetoric and debate around elections, especially concerning immigration.



Marriage

With the talk of high divorce rates, many people may be hesitant to marry. However, a univariate regression reveals a strong negative association between being married and feelings of worthlessness. The coefficient on marriage of $\hat{\beta} = -0.51$ translates to a $\frac{\exp(-1.99095)}{(1+\exp(-1.99095))} = 12\%$ chance of feeling worthless for unmarried individuals but only a $\frac{\exp(-1.99095-0.50677)}{(1+\exp(-1.99095-0.50677))} = 7.6\%$ chance of feeling worthless for married individuals—a difference of 4.4%. Based on feelings of worthlessness, compared to the regressions against family income, being married has roughly the same protective effect as jumping two income brackets. Similar results were found for the other two response variables. In the final model, after controlling for other demographic variables, the protective impact of marriage was diminished but still strong and statistically significant.

I was also curious to see if any sex benefitted more from marriage than the other, at least in terms of mental health. However, in the regression against feelings of worthlessness, the interaction term was trivial and not statistically significant.

Neck and Back Pain

One study of chronic back pain in the Canadian Community Health Survey—with a sample size of over 100,000—found that those with chronic bank pain were at high risk for developing major depression. (Currie and Wang 2004) Furthermore, they also tested for the significance of the interaction between back pain, age, and gender—with only the gender interaction being statistically significant.

Table 16: Language Spoken and Symptoms of Depression

	<i>Dependent variable:</i>			
	frml			
	(1)	(2)	(3)	(4)
english	−0.289*** (0.041)	−0.019 (0.116)	−0.551*** (0.034)	0.277*** (0.048)
factor(srvy_yr)2008		0.448*** (0.160)		
factor(srvy_yr)2009		0.273* (0.149)		
factor(srvy_yr)2011		0.297** (0.136)		
factor(srvy_yr)2012		0.366*** (0.142)		
factor(srvy_yr)2013		0.517*** (0.138)		
english:factor(srvy_yr)2008		−0.365** (0.167)		
english:factor(srvy_yr)2009		−0.179 (0.157)		
english:factor(srvy_yr)2011		−0.254* (0.144)		
english:factor(srvy_yr)2012		−0.357** (0.149)		
english:factor(srvy_yr)2013		−0.379*** (0.146)		
Constant	−1.963*** (0.039)	−2.296*** (0.110)	−1.430*** (0.032)	−2.495*** (0.046)
Observations	127,274	127,274	127,274	127,274
Log Likelihood	−39,797.650	−39,776.950	−47,101.400	−39,674.040
Akaike Inf. Crit.	79,599.310	79,577.900	94,206.800	79,352.070

Note:

*p<0.1; **p<0.05; ***p<0.01

Table 17: Relationship Between Marriage and Symptoms of Depression

	<i>Dependent variable:</i>			
	Felt Worthless		Felt Hopeless	Abnormal Sleep
	(1)	(2)	(3)	(4)
married	−0.507*** (0.025)	−0.493*** (0.033)	−0.530*** (0.022)	−0.371*** (0.024)
male		−0.236*** (0.032)		
married:male		−0.008 (0.051)		
Constant	−1.991*** (0.015)	−1.887*** (0.019)	−1.687*** (0.014)	−2.051*** (0.015)
Observations	127,274	127,274	127,274	127,274
Log Likelihood	−39,467.220	−39,389.290	−46,777.120	−39,521.120
Akaike Inf. Crit.	78,938.430	78,786.590	93,558.240	79,046.240

Note:

*p<0.1; **p<0.05; ***p<0.01

Unlike the aforementioned study, severity of neck or back pain could not be considered as—in the National Health Interview Survey—they were simply coded as “Yes” or “No” if the person being interviewed suffered either in the last three months. However, the regressions below obtained similar results, with the coefficients obtained being the greatest in magnitude in this study (aside from those on income). For example, in the single regression of back pain against feelings of worthlessness, the fitted coefficient was $\hat{\beta} = 1.09$ with an intercept of −2.64. This translates to a probability of 17.3% of feeling worthless for those who had back pain compared to a just 6.6% for those without.

Furthermore, I also found statistically significant mixed results between the interaction effects and the three response variables. For example, back pain was more likely to hinder sleep for older males. Likewise, males with back pain were also more likely to experience feelings of worthlessness than others afflicted.

Table 18: Association Between Neck and Back Pain and Symptoms of Depression

	<i>Dependent variable:</i>					
	Felt Worthless		Felt Hopeless	Abnormal Sleep		abnormal_sleep
	(1)	(2)	(3)	(4)	(5)	(6)
neck_pain	1.124*** (0.027)	1.124*** (0.027)	0.832*** (0.028)		1.124*** (0.027)	0.832*** (0.028)
back_pain				1.087*** (0.025)		
Constant	−2.471*** (0.015)	−2.471*** (0.015)	−2.395*** (0.014)	−2.643*** (0.017)	−2.471*** (0.015)	−2.395*** (0.014)
Observations	127,274	127,274	127,274	127,274	127,274	127,274
Log Likelihood	−38,584.490	−38,584.490	−39,059.990	−38,282.010	−38,584.490	−39,059.990
Akaike Inf. Crit.	77,172.980	77,172.980	78,123.990	76,568.010	77,172.980	78,123.990

Note:

*p<0.1; **p<0.05; ***p<0.01

Table 19: Neck and Back Pain Interaction Effects

	<i>Dependent variable:</i>		
	Felt Worthless	Felt Hopeless	Abnormal Sleep
	(1)	(2)	(3)
neck_pain	0.726*** (0.102)	0.670*** (0.093)	0.621*** (0.109)
back_pain	0.883*** (0.085)	0.876*** (0.076)	0.958*** (0.083)
male	−0.160*** (0.036)	−0.229*** (0.031)	0.026 (0.033)
age	−0.004*** (0.001)	−0.007*** (0.001)	0.005*** (0.001)
neck_pain:back_pain	−0.093 (0.063)	−0.094* (0.057)	0.058 (0.066)
neck_pain:male	0.091 (0.060)	0.044 (0.055)	0.084 (0.062)
back_pain:male	−0.127** (0.055)	−0.042 (0.049)	−0.178*** (0.054)
neck_pain:age	0.0003 (0.002)	0.002 (0.002)	−0.004** (0.002)
back_pain:age	0.001 (0.002)	−0.0003 (0.001)	−0.005*** (0.001)
Constant	−2.440*** (0.054)	−1.975*** (0.044)	−2.827*** (0.049)
Observations	127,274	127,274	127,274
Log Likelihood	−37,761.520	−44,797.990	−38,557.190
Akaike Inf. Crit.	75,543.040	89,615.990	77,134.380

Note:

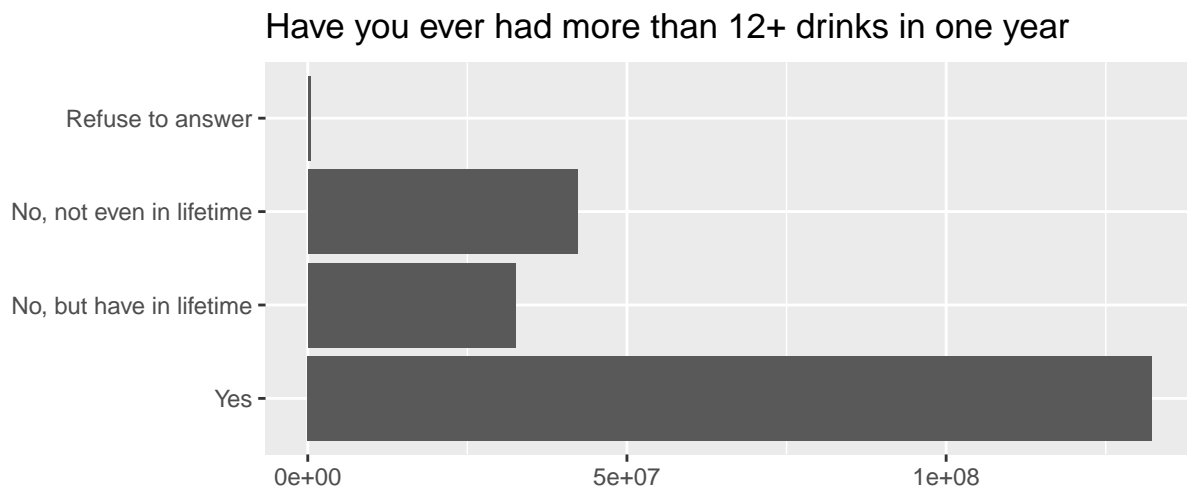
*p<0.1; **p<0.05; ***p<0.01

Alcohol Use

Alcohol use is commonly linked with depression (why). It is also doubly important to this paper since the time frame of our data includes the recession. Intuitively, we can imagine (or have seen) some turn to the bottle as a result of losing a job or even worse, a home. Economic loss and alcohol consumption and problems during the 2008 to 2009 US recession. In one paper, found evidence that severe economic losses were associated with increased alcohol consumption and its associated consequences. (Mulia et al. 2014)

Frequency and Prevalence of Drinking

The vast majority of survey respondents reported that they have had at least 12 drinks in a single year.



National Health Interview Survey 2007–2013: Sample Adult File

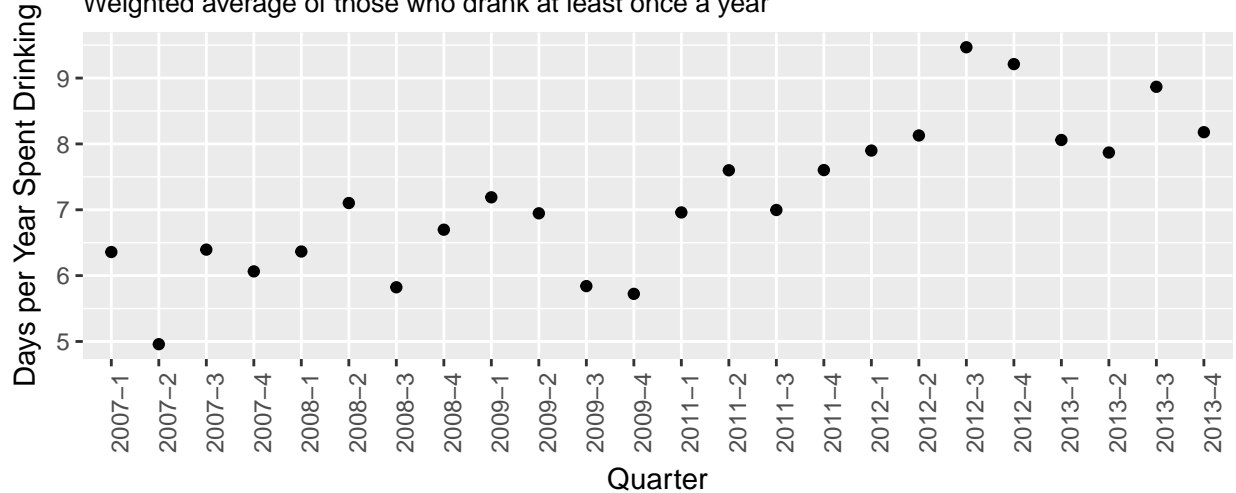
However, the distribution of drinking is skewed. with most respondents report drinking less than once a week or not at all.

Drinking and the Recession

On average, Americans drank more during the recession, but the plot below also suggests that this may be driven by just a small fraction of people.

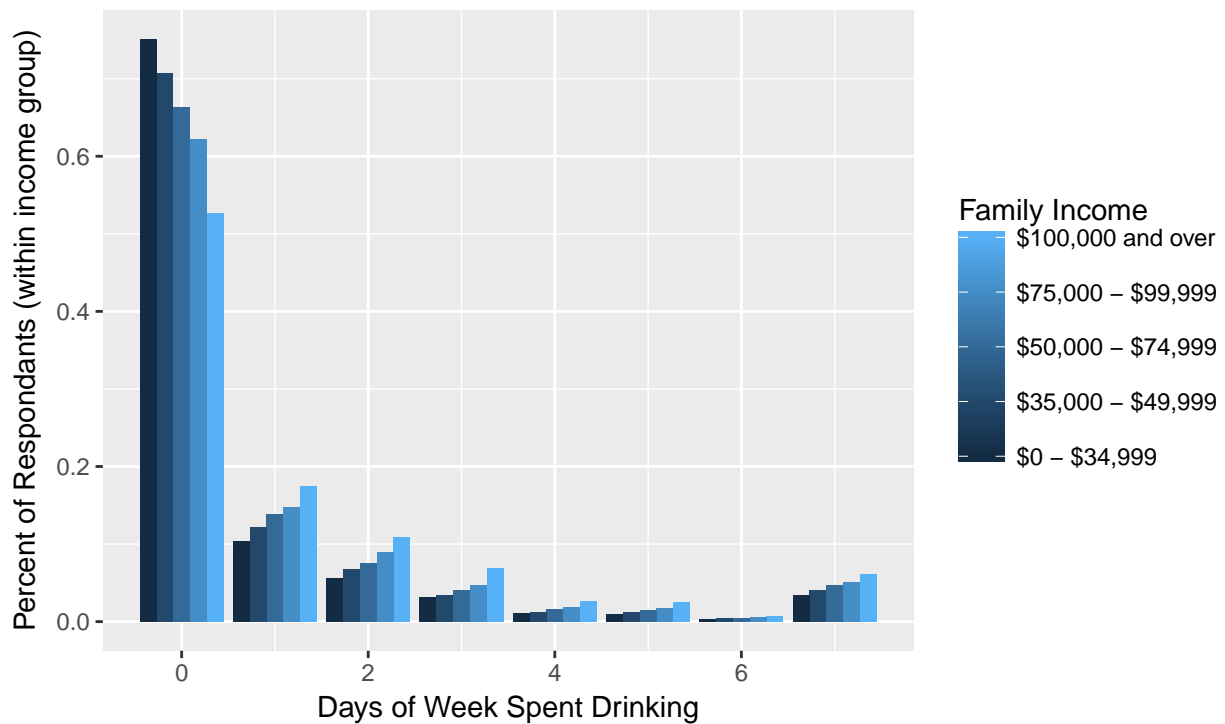
Alcohol Consumption Increases During the Recession

Weighted average of those who drank at least once a year



Alcohol Use Varies by Income

Wealthier are heavier drinkers



National Health Interview Survey 2007–2013: Sample Adult File

A Surprising Finding

Surprisingly, the group at highest risk for mental distress were those who either did not drink at all or drank—on average—less than once a week. The heaviest drinkers (those who drank all days of the week) were the second highest risk group. It was found that a polynomial relationship between alcohol consumption (days per week spent drinking) and mental distress was more accurate than a linear one. While the figure

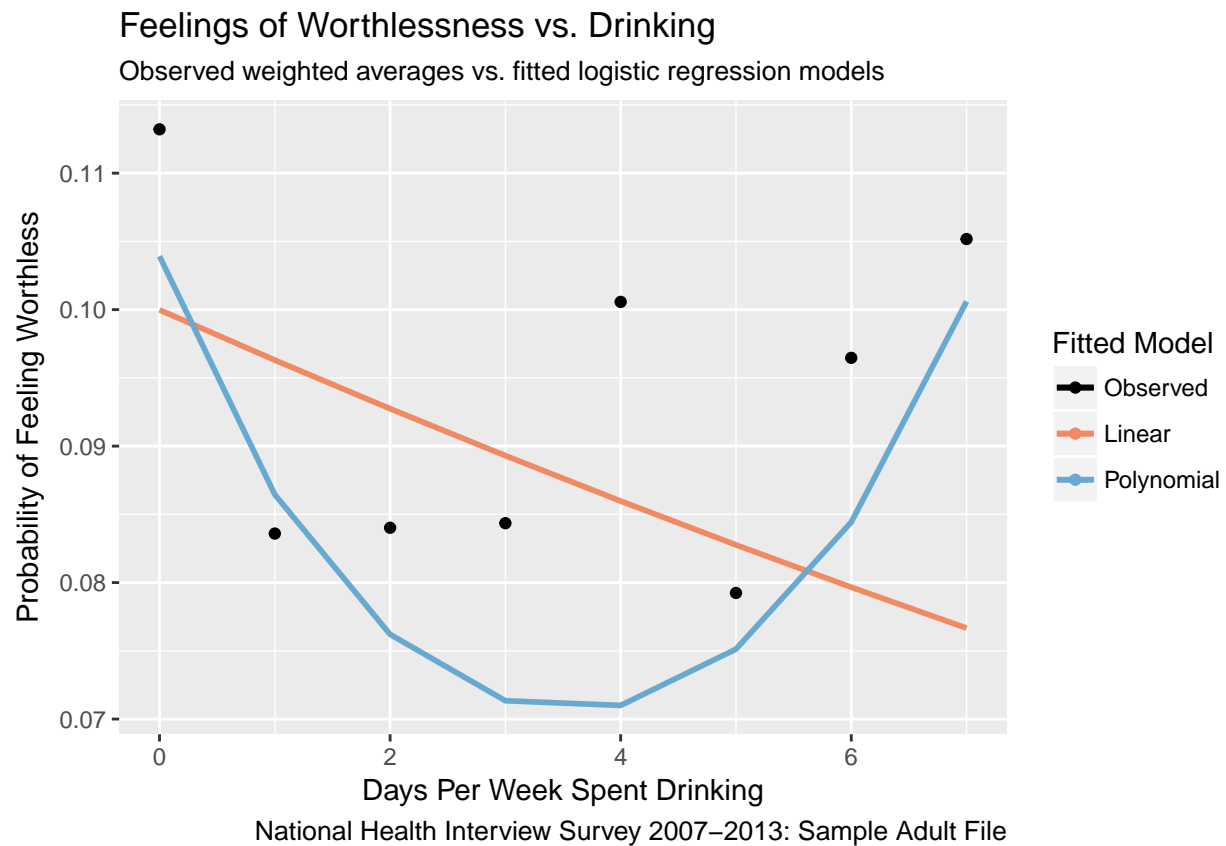
above suggests that this may simply due to poorer Americans not being able to afford alcohol, the regression in the final model still found a significant curvilinear relationship after controlling for demographic variables (although the magnitude of the coefficients was reduced).

Table 20: Effect of Alcohol on Symptoms of Depression

	<i>Dependent variable:</i>					
	Felt Worthless		Felt Hopeless		Abnormal Amount of Sleep	
	(1)	(2)	(3)	(4)	(5)	(6)
Days/Week Drinking	−0.046*** (0.008)	−0.260*** (0.023)	−0.056*** (0.007)	−0.225*** (0.020)	−0.071*** (0.008)	−0.275*** (0.024)
(Days/Week Drinking) ²		0.036*** (0.004)		0.029*** (0.003)		0.035*** (0.004)
Constant	−2.185*** (0.014)	−2.139*** (0.014)	−1.885*** (0.012)	−1.848*** (0.012)	−2.183*** (0.013)	−2.140*** (0.014)
Observations	127,509	127,509	127,509	127,509	127,509	127,509
Log Likelihood	−40,058.720	−39,967.950	−47,479.880	−47,410.740	−39,408.460	−39,335.030
Akaike Inf. Crit.	80,121.440	79,941.900	94,963.760	94,827.470	78,820.920	78,676.050

Note:

*p<0.1; **p<0.05; ***p<0.01



Full Model

ROC curves are shown below for the models predicting feelings of worthlessness and abnormal sleep. The closeness of the curves for the testing and training sets suggest that our model will generalize well to outside data.

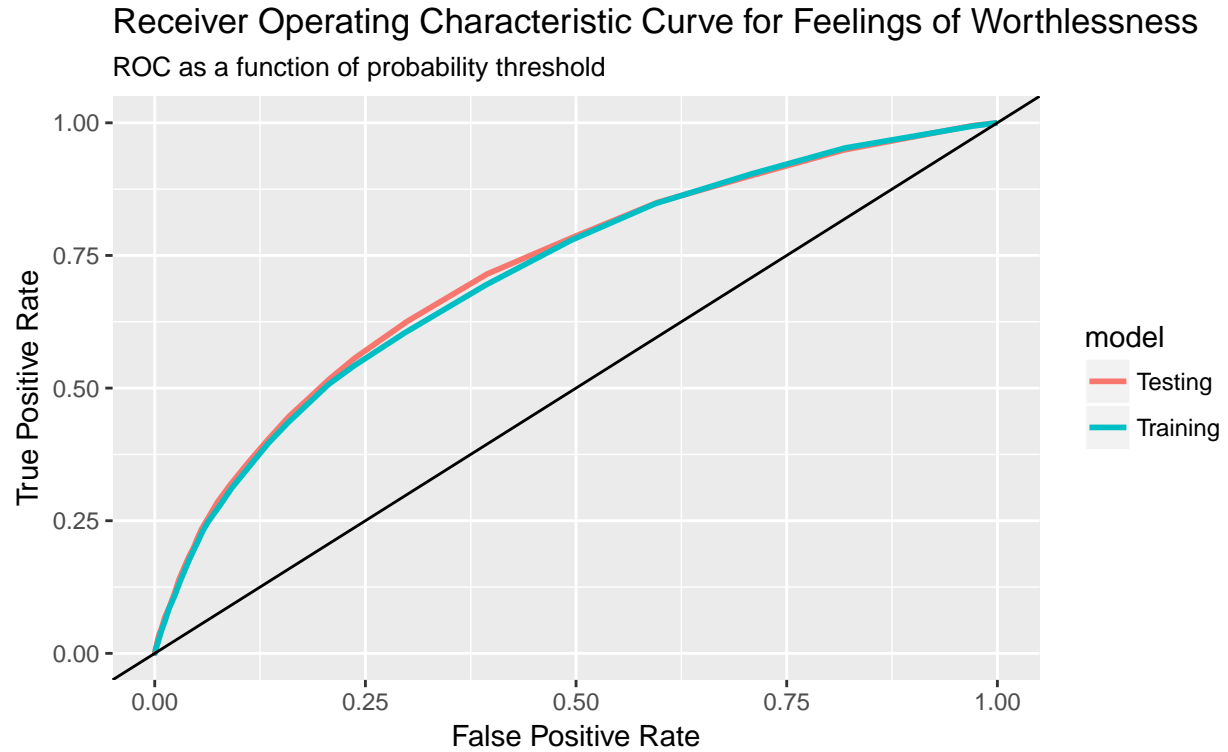
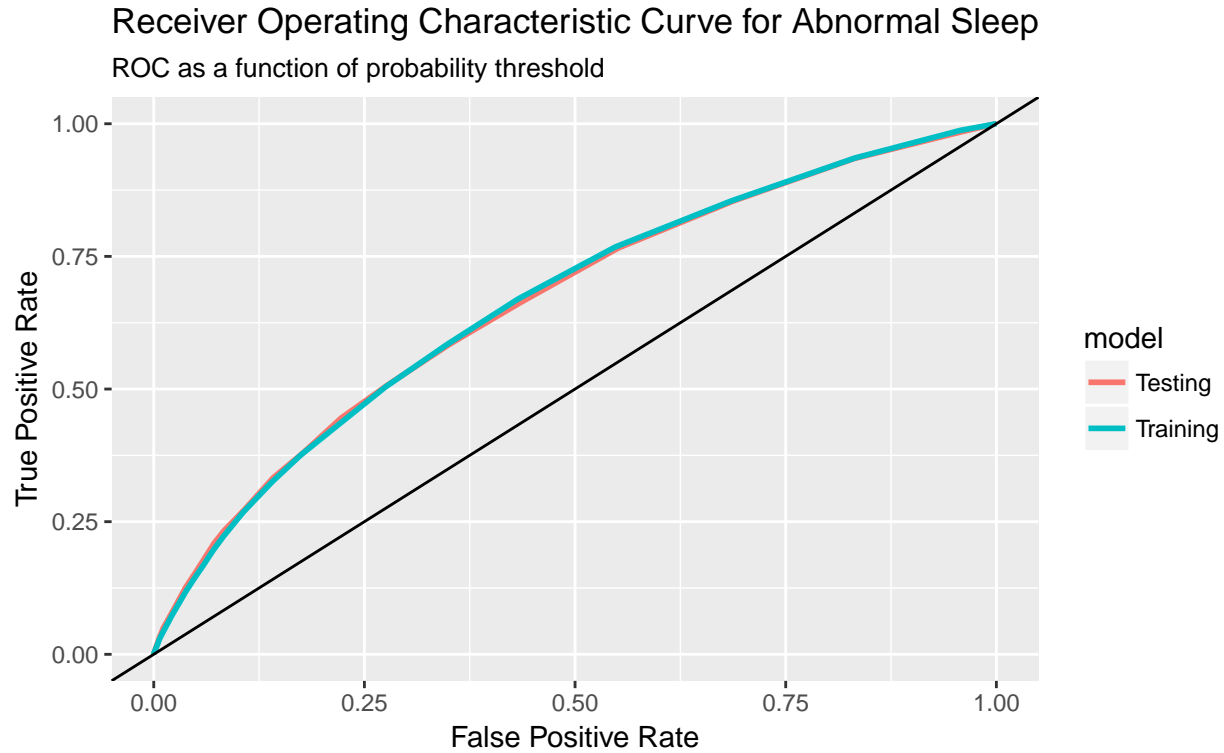


Table 21:

	<i>Dependent variable:</i>		
	Felt Worthless	Felt Hopeless	Abnormal Sleep
	(1)	(2)	(3)
Age	−0.003*** (0.001)	−0.004*** (0.001)	0.006*** (0.001)
Black	−0.272*** (0.037)	−0.198*** (0.033)	0.460*** (0.032)
Asian	−0.097 (0.060)	−0.069 (0.054)	−0.145** (0.060)
Hispanic	−0.145*** (0.041)	0.051 (0.036)	0.035 (0.040)
Other Race	0.149 (0.120)	0.136 (0.106)	0.504*** (0.107)
Fam Income \$3550k	−0.381*** (0.037)	−0.362*** (0.033)	−0.172*** (0.036)
Fam Income \$5075k	−0.594*** (0.040)	−0.556*** (0.035)	−0.289*** (0.037)
Fam Income \$75100k	−0.931*** (0.056)	−0.822*** (0.048)	−0.402*** (0.049)
Fam Income \$100k+	−1.069*** (0.051)	−1.010*** (0.044)	−0.583*** (0.045)
Looking for Work	0.615*** (0.046)	0.640*** (0.042)	0.022 (0.050)
Married	−0.222*** (0.029)	−0.254*** (0.026)	−0.203*** (0.028)
Male	−0.113*** (0.036)	−0.196*** (0.031)	0.115*** (0.033)
English	0.058 (0.124)	−0.106 (0.103)	0.600*** (0.136)
Neck Pain	0.688*** (0.030)	0.684*** (0.028)	0.494*** (0.031)
Back Pain	0.809*** (0.035)	0.763*** (0.031)	1.037*** (0.074)
Days Week Drinking	−0.125*** (0.024)	−0.100*** (0.022)	−0.194*** (0.025)
(Days/Week Drinking) ²	0.020*** (0.004)	0.015*** (0.003)	0.024*** (0.004)
Male * Back Pain	−0.051 (0.051)	0.025 (0.046)	−0.115** (0.050)
Age * Back Pain			−0.008*** (0.001)
Constant	−2.023*** (0.127)	−1.542*** (0.105)	−3.205*** (0.141)
Observations	127,274	127,274	127,274
Log Likelihood	−36,410.250	−43,091.520	−37,795.260
Akaike Inf. Crit.	72,878.500	86,241.040	75,650.510

Note:

The interaction effects between language and time, as well as time dummies were omitted to preserve space.
 When controlling for race, the lowest income group was omitted.
 When controlling for income, the lowest income group was omitted.



Summary

While mental health is a difficult public health problem, this paper has shown that it is possible to build a decent predictive model with just a handful of easily attainable socioeconomic and lifestyle characteristics. For feelings of worthlessness, the probability threshold closest to a perfect classifier ($TPR = 1$, $FPR = 0$) gives a 58.4% true positive and a 35.1% false positive rate. Although this is far from perfect, this model is significantly better than guessing at random. Others may wish to build upon this model to achieve better rates, working with the predictors identified to build a model more suitable for medical use. However, this model may also be put to immediate use. For example, those trying to raise awareness about mental health issues, or trying to offer services, should target areas with high unemployment rates, high poverty rates, and a larger proportion of unmarried individuals.

Limitations

This problem this paper deals with is classification. As such, the purpose was to include as many covariates as possible in order to increase the accuracy of predictive models. This method allows us to analyze the relative importance of various socioeconomic, medical, and lifestyle factors as risk factors for mental distress. However, the main drawback is that the relationships between specific covariates and the response were not examined very thoroughly. While some nonlinear and interaction effects were considered, many more were not due to the scope of this paper. Many of the covariates in this model were included in linear form and interested researchers may wish to examine these relationships more thoroughly.

Furthermore, due to time constraints, some interesting attributed contained in the NHIS were not examined. For example, while this paper examined the relationship between being married and mental distress, it did not examine the relationship between divorce and mental distress. While the relationship between disability and depression was briefly examined through the inclusion of not being able to work due to disability as a predictor, others may wish to study the relationship between the nature and severity disability and

depression. Lastly, sexual orientation was not studied in this paper because it was only recently introduced as an item in the 2013 National Health Interview Survey.

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