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DISSERTATION

Caring for Depression and Comorbid Pain

Evidence from the Health and Retirement Survey and the Healthcare for Communities Survey

Haijun Tian

This document was submitted as a dissertation in March, 2006 in partial fulfillment of the requirements of the doctoral degree in public policy analysis at the Pardee RAND Graduate School. The faculty committee that supervised and approved the dissertation consisted of Richard Buddin (Chair), Emmett Keeler, Roland Sturm, and Cathy Sherbourne.

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ABSTRACT

Depression is a common and serious illness, which often occurs together with painful physical symptoms. Though depression and its social and economical impacts have been well documented in the past decades, the role of pain comorbidity is far less understood. Based on two recent national survey datasets, Health and Retirement Study, and Healthcare for Communities, this dissertation investigates the interaction of depression and pain and its impact on labor market, financial, insurance, disability, medication decision, and medication costs outcomes.

Chapter 2 examined the relationship between depression and pain, and labor market, financial, insurance and disability outcomes among Americans aged 55-65, using wave 3 of Health and Retirement Survey. It found that depression and comorbid pain was associated with worse labor market, financial, insurance and disability outcomes compared to depression alone, and showed the adverse effects were attributed disproportionally to individuals with depression and comorbid pain versus "pure" depression. Chapter 3 examined the relationship between depression and pain, and medication behavior and medication costs outcomes in a nationally representative cross-section of Americans, using first wave of Healthcare for Communities survey. It found that depressed individuals with pain comoridity were substantially less likely to take antidepressant medications compared to those with depression only, and pain comorbidity was associated with a heavier burden on total medication costs and prescription drug costs. Chapter 4 used Health and Retirement Survey to analyze the effect of depression and comorbid pain on the transition from employment to full

retirement for male and female workers. It found that depression and comorbid pain predicted early retirement for female workers, but depression alone did not predict fully retirement for either female workers or male workers.

This dissertation not only makes an important contribution to our understanding of depression and pain comorbidity in terms of its prevalence in the general population, and its effect on treatment and access to care, it will also inform health policy makers who want to reduce the burden of depression and pain, and has implications for health care providers and practitioners to improve the quality of care for depression and pain comorbidity.

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CHAPTER 1. INTRODUCTION

Depression is a common and serious illness, with considerable personal, social and economic implications for depressed individuals, their families, their employers, third-party payers, caregivers, and society in general. Data from Epidemiologic Catchment Area (ECA) indicate that the 1-year prevalence of affective disorders is 9.5% in the population (15.1 million people) in the 1980s. Of those, 1.2% had a bipolar 1 or 2 disorder, 5.0% a unipolar major depressive disorder (MDD), and 3.4% a dysthymic disorder. (Regier DA, Narrow WE, Rae DS, et al, 1993). The National Comorbidity Survey (NCS) provided even higher prevalence of MDD: 14.9% for lifetime and 8.6% for 12-month (Kessler RC, Nelson CB, et al, 1996, Kessler RC, McGonagle KA, Zhao S, et al. 1994) in 1990s. A recent National Comorbidity Survey Replication (NCS-R) estimated that the prevalence of MDD for lifetime was 16.2% (95% confidence interval [CI], 15.1-17.3) (32.6-35.1 million US Adults) and for 12-month was 6.6% (95% confidence interval [CI], 5.9-7.3) (13.1-14.2 million US Adults) (Kessler, RC, Berglund P, et al, 2003)[1].

Economic Burden of depression

The impact of depression extends far beyond the core depressive symptoms, it affects the individuals' quality of life. Based on self-reported measures of physical and

[1] Durations for differenct types of depressive disorders are different. Kessler and collegues reported that the mean episode duration of major depressive disorder was 16 weeks (Kessler, RC, Berglund P, et al, 2003).

social functioning or sick days, depression has larger effects than hypertension, diabetes, or arthritis (Wells KB Stewart A, et al., 1989; Wells KB, Sturm R et al., 1996). Including the disability measure, the global burden of disease study indicated that depression (refers to unipolar depressive disorders) was the fourth leading cause of disease-burden among all causes, accounting for 3.7% of total disability-adjusted-life-years (DALYs), and was one of the leading causes of years lived with disability (YLD), accounting for 10.7% of total YLDs. It is projected that the global burden of depression will rank second only to ischemic heart disease by the year 2020 (Murray CJL, Lopez AD, 1996; Murray CJL, Lopez AD, 1997; Ustun TB, Ayuso-Mateos JL, et al. 2003).

The economic burden of depression not only includes the direct costs associated with recognizing, caring, treating, preventing and rehabilitating depressed patients in primary and secondary health care, but also includes the indirect costs resulting from depressed patients being unable to maintain their usual economic role, such as the effects of illness on lost work productivity, employment and earning losses, the costs of long-term disability and premature mortality, and so on. Although the current available estimates on the economic costs of depression were variable, almost all studies showed that the indirect costs of depression were higher than the direct costs (Marcotte and Wilcox-Gők 2001; Berto P, D'Ilario D, et al. 2000). Stoudemier and colleagues calculated that major depression was associated with a cost of $ 16.3 billion (or $ 52.7 billion, 1998)[2], among which the indirect costs account for $14.2 billion ($ 10 billion for non-productivity cost and $ 4.2 billion for premature deaths) while direct costs were only $ 2.1 billion (13%). Greenberg and colleagues' study estimated the economic burden of

[2] Adjustment to 1998 US$ has been done using the Medical consumer price index (Health in the United States, Centers for Disease Control, Atlanta, 1999)

depression to be $ 43.7 billion (or $ 65 billion in 1998) in 1990, and the indirect costs represent the most significant share (72%) (Greenberg PE Stiglin L, et al 1993). A subsequent study by them reported a cost burden of $52.9 billion in 1990 ($ 81.8 billion in 1998) using revised prevalence data, with over 60% of the reported costs resulting from increased absenteeism among depressed workers (Greenberg PE, Kessler RC, Nells TL, et al 1996). Their most updated study indicated that the economic burden of depression remained relatively stable between 1990 and 2000, despite a dramatic increase in the treatment rate for depression (Greenberg PE, Kessler RC, Birnbaum et al, 2003).

The economic and social costs of depression are high, but depression is frequently unrecognized, untreated or undertreated in the United States (Wells KB, Sturm R, 1995; Sturm R, Wells KB, 1995; Ustun, 1999; Greenberg et al., 1993; Murray and Lopez 1996). Using data from The National Comorbidity Survey, Kessler and colleagues found that, in 1990, less than 30% of major depression sufferers received any type of outpatient health care treatment for their depression during a year period (Kessler RC, Zhao S, Katz SJ, et al. 1999). Though the treatment rates have increased in the last 15 years, depression still goes untreated in the majority of cases (Kessler RC, Berglund P, Demler O, et al. 2003). Despite growing numbers of cost-effective depression disease management programs (Katon W, Vonkorff C, Lin E, et al. 1995; Katon W, Bobinson P, Vonkorff M, et al. 1996; Schoenbaum M, Unutzer J, Sherbourne C, et al. 2001), inadequate treatment is still a serious concern (Kessler RC, Berglund P, Demler O, et al. 2003).

Depression and Pain Comorbidity

Depression often occurs together with physical symptoms, notably painful physical symptoms, both unspecific and specific (such as headaches and back pain). Based on data from Medical Outcomes Study, Wells and colleagues found that patients with depressive symptoms experienced significantly more bodily pain than patients with hypertension, diabetes, advanced coronary artery disease, angina or lung cancer - less than patients with arthritis however (Wells KB, Stewart A, Hays RD, et al. 1989). A literature review by Bair and colleagues showed that the reported prevalence of pain ranged from 15% to 100% (mean prevalence 65%) among the depressed patients (Bair MJ, Robinson RL, Katon W, et al. 2003). The relationship between depression and pain in terms of neurobiological, psychological, and behavioral associations has been well established in other literature (Von Korff M, Simon G 1996), though the reasons for this association remain unclear. [3]

The presence of pain symptoms among depressed individuals often complicates the recognition and treatment of depression. (Bair MJ, Robinson RL, Katon W, et al. 2003; Ohayon MM, Schatzberg AF, 2003; Simon GE, Goldberg D, Tiems BG, et al. 1999; Bair MJ, Robinson RL, Eckert GJ, et al. 2004). Patients with depression in primary care settings are more likely to report physical symptoms only, predominantly pain, than depressive symptoms, and physicians (at least initially) often associate these symptoms with an underlying medical illness instead of an underlying depressive disorder (Kirmayer LJ, Robbins JM, Dworkind M, et al. 1993: Bridges KW, Goldberg DP, 1985).

[3] The interaction between depression and pain has been labeled by some authors as the depression-pain syndrome or depression-pain dyad, implying that the conditions often coexist, respond to similar treatment, exacerbated one another, and share biological pathways and neurotransmitters (Bair MJ, Robinson RL, Katon W, et al. 2003).

Though there are few studies that specifically address the role of comorbid pain in the depression treatment, it is speculated that patients' complaint of their physical pain may distract their physicians from treating their depression. A study showed that comorbid pain among persons with depression is associated with more intensive use of general medical services but lower rates of use of mental health services (Bao YH, Sturm R, Croghan TW, 2003).

The presence of pain among depressed patients not only influences their access to care and treatment, but also impacts their depression outcomes, functional status, quality of life, and health care utilization and costs. Though most of the literature on depression and pain comorbity has focused on the impact of depression on poor pain outcomes (Lamb SE, Guralnik JM, Buchner DM, et al 2000; Bertrus PA, Elmore Sk, Hamilton PA 1995; Engel CC, Von Korff M, Katon WJ, 1996; Katz and Yelin, 2001), the impact of pain on depression has been a research focus for some studies. Von Korff and colleagues found that pain is a strong predictor of depression and presence of pain was associated with worse functional limitations, higher unemployment rates, and more frequent use of health services (Von Korff M, Dworkin SF, Le Resche L, Kurger A, 1988; Von Korff M, Ormel J, Katon W, et al. 1992; Von Korff M, Simon G. 1996). Studies by the RAND corporation indicated that comorbid pain was associated with about 20% more visits to medical providers by patients who made at least one visit during a year (Bao YH, Sturm R, Croghan TW, 2003), and depression plus pain were associated with significant functional limitations and economic burdens relative to depression alone (Emptage NP, Sturm R, Robinson RL. 2005). Greenberg PE and colleagues pointed out that when painful physical symptoms accompany the already debilitating emotional symptoms of

depressive disorders, the economic burden on patients and their employers is particularly severe (Greenberg PE, Leong SA, Birnbaum HG, et al. 2003).

However the economic and social costs of depression and pain comorbidity are far less understood than the economic costs of depression alone. As suggested by the above review, the past decade has seen many studies of the economic costs of depression either by health services researchers and economists, but the role of pain symptoms are less understood. Could it be that the large economic burden of depression stems primarily from this subgroup? Most of the studies addressing this issue are based on clinical samples. Since clinical data usually do not include measures of labor market and financial outcomes, little is known about the indirect costs of depression and pain comorbidity and its relative role among depression.

Objective of this dissertation and chapter plan

The dissertation aims to fill the gap on the understanding of economic costs of depression and pain comorbidities and raises the policy discussion on reducing the economic burden of depression and pain. The dissertation will address the following research questions: (1) What is the relationship between depression and comorbid pain, and labor market, financial, insurance, and disability outcomes among near elderly Americans? Does the pain comorbidity account for a large share of the adverse social and economic outcomes attributed to depression? (2) Does the pain comorbidity affect medication behaviors on the use of antidepressants or supplements that are good for depression? Are depression and pain associated with heavier burden in terms of

medication costs? (3) Does depression and pain comorbidity affect the retirement decisions? Are there gender differences?

Using two national survey data sets, health and retirement survey (HRS), and Healthcare for Communities (HCC), the dissertation estimates the interaction of depression and pain, and their impact on labor market related outcomes, and medication related outcomes. The outline of the dissertation follows.

Chapter 2 uses cross-sectional data from wave 3 of the HRS to analyze the relationship between depression and comorbid pain, and labor market, financial, insurance and disability outcomes among Americans aged 55-65. It estimates the share of pain comordity on the adverse social and economic outcomes attributed to depression, and discusses the policy implications of these results to health care provisions and health policies. Using first wave data from HCC, chapter 3 considers the interaction of depression and pain, and analyzes their associations with medication behaviors and medication costs among Americans. Outcomes analyzed include any use of antidepressants, use of effective antidepressants, use of St. John's Wort, total medication costs, and prescription drug costs. Chapter 4 explores the wave 2 to wave 6 data from HRS, and investigates the impact of depression and pain on the retirement behavior of older adult Americans from a longitudinal perspective. It separately analyzes retirement behavior for older men and older women and compares the gender differences. The final chapter concludes and discusses the policy implications of the dissertation results.

CHAPTER 2. LABOR MARKET, FINANCIAL, INSURANCE AND DISABILITY OUTCOMES AMONG NEAR ELDERLY AMERICANS WITH DEPRESSION AND PAIN: A NATIONAL STUDY

(As published in the Journal of Mental Health Policy and Economics, 8, 219-228 (2005))

ABSTRACT

Background: The economic burden of depression has been documented, but the role of comorbid conditions is unclear. Depression and comorbid pain are particularly common, are associated with worse clinical outcomes and require different care than "pure" depression. Does this comorbidity account for a large share of the adverse social outcomes attributed to depression?

Aims of Study: We analyzed the relationship between depression and comorbid pain, and labor market, financial, insurance and disability outcomes among Americans aged 55-65.

Methods: Cross-sectional data were used from Wave 3 of the Health and Retirement Survey, a nationally representative sample of individuals aged 55-65 surveyed in 1996. Multivariate regression analyses, controlling for socio-demographics and chronic health conditions, estimated the associations between depression and pain, and economic outcomes. Outcomes included: employment and retirement status, household income, total medical expenditures, government health insurance, social security, limitations in activities of daily living (ADLs), and health limitations affecting work. Primary

explanatory variables included the presence of severe pain, mild/moderate pain, or absence of pain, with or without depression.

Results: Compared to depression alone, depression and comorbid pain was associated with worse labor market (non-employment, retirement), financial (total medical expenditures), insurance (government insurance, social security) and disability outcomes (limitations in ADLs, health limitations affecting work), after covariate adjustment ($p \leq 0.01$, except retirement with $p < 0.1$). Findings were even more disparate as level of pain severity increased. The simulated results showed that the magnitudes of the adverse effects were attributed disproportionally to individuals with comorbid pain and depression versus "pure" depression. Of those with depression, 51% had comorbid pain. Yet, this subgroup of depressed individuals accounted for 59% of those not employed, 61% of those with government health insurance, 79% of those with limitations in ADLs, and 72% of those with health limitations affecting work.

Discussion and Limitation: Depression with comorbid pain, not depression alone was responsible for a large part of the higher economic burden associated with depression. The study is limited by self-reported measures of pain, depression, and outcomes. It is cross-sectional and cannot identify causal effects of depression with pain. These findings may not be generalizable to other age groups.

Implications for Health Care Provision and Use: The depressed with comorbid pain appear to experience greater burden through increased costs and worse functioning and may require different management than those with depression alone. The depressed with comorbid pain may benefit from treatment practices and guidelines that address the duality of these conditions throughout the process of care.

Implication for Health Policies: The depressed with comorbid pain were more likely to receive government support than depression alone. Given the central role of employer-sponsored health insurance in the U.S., they may have worse access to health care because they leave employment or retire earlier. With the evolving state of Medicare, broad formulary access to mental health treatments might be considered.

Implications for Further Research: Further research should focus on causality of depression and comorbid pain on economic outcomes. Depression research should consider the heterogeneity of this disorder in outcomes assessment.

INTRODUCTION

Depression has received much attention in recent decades, partly as a consequence of research that has shown the substantially strong adverse effects on functioning and quality of life (Wells KB, Sturm R, Sherbourne CD, et al. 1996; Wells KB, Stewart A, Hays RD, et al. 1989; Blazer DG, Kessler RC, McGonagle KA, et al. 1994; Frerichs RR, Aneshensel CS, Yokopenic PA, et al. 1982; Craig TJ, Van Natta PA. 1983), and partly because a wider range of effective treatments became available. Many economic studies have analyzed the adverse economic outcomes of depression (Greenberg PE, Kessler RC, Birnbaum HG, et al. 2003; Greenberg PE, Stiglin LE, Finkelstein SN, et al. 1993; Berto P, D'Ilario D, Ruffo P, et al. 2000; Stoudemire A, Frank R, Hedemark N, et al. 1986), however there is substantial heterogeneity among individuals with depression, raising the question whether the adverse economic outcomes of depression are concentrated among clinical subgroups, for example, those with comorbid conditions. Clinical studies have shown that depression with pain, a particularly common comorbidity, is associated with far worse clinical outcomes than either condition alone (Von Korff M, Dworkin SF, Resche L, et al. 1988; Bair MJ, Robinson RL, Eckert GJ, et al. 2004; Bertrus PA, Elmore Sk, Hamilton PA. 1995; Gureje O, Simon GE, Von Korff M. 2001; Salerno SM, Browning R, Jackson JL. 2002). In specific clinical samples, patients with depression and pain also had more functional limitations and higher health-care utilization and costs than patients with either pain or depression alone (Bertrus PA, Elmore Sk, Hamilton PA. 1995; Lamb SE, Guralnik JM, Buchner DM, et al. 2000; Engel CC, Von Korff M, Katon WJ. 1996; Katz PP, Yelin EH. 1994). Could it be that the large economic burden of depression stems primarily from this

subgroup? Clinical studies rarely measure labor market related outcomes. Clinical trials also poorly represent the broad range of individuals with depression in the general population. For example, individuals with chronic comorbid conditions or those not seeking treatment are often excluded from clinical trials. Despite a 50% increase in treatment rates in the last 15 years, depression still goes untreated in the majority of cases (Kessler RC, Berglund P, Demler O, et al. 2005). There exist many health economics studies on labor market and financial outcomes of depression or other mental illness (Bartel A, Taubman P. 1979; Mitchell JM, Anderson KH. 1989; Frank R, Gertler P. 1991; Ettner SL, Frank RG, Kessler RC. 1997; Kessler RC, Frank RG. 1997; French MT, Zarkin GA. 1998; Hamilton VH, Merrigan P, Dufresne E. 1997; Alexandre PK, French MT. 2001; Gresenz CR, Sturm R. 2000; Marcotte DE, Wilcox-Gök V; 2003), but with few exceptions they do not specifically consider the issue of comorbidities (Greenberg PE, Leong SA, Birnbaum HG, et al. 2003; Emptage NE, Sturm R, Robinson RL. 2005).

In this study, we consider the interaction between depression and pain, and analyze their associations with labor market, financial, insurance and disability outcomes among near elderly Americans. The presence of pain is common among the depressed and complicates the recognition and treatment of depression (Bair MJ, Robinson RL, Katon W, et al. 2003). Manifestations of pain among depressed patients have been characterized as frequently nonspecific complaints (Kirmayer LJ, Robbins JM. 1991; Pearson SD, Katzelnick DJ, Simon GE, 1999) and were often unrelated to a known organic disease process (Kroenke K. 2001). The significant public health concern depression with pain poses extends to individuals experiencing these conditions later in life. Although the prevalence of major depressive disorder tends to decrease in those

over age 60 (Kessler RC, Berglund P, Demler O, et al. 2005), the presence of depressive symptoms and chronic pain are still high among elderly patients (Blazer D, Hughes DC, George LK, 1987; Montano CB. 1999; Clark JD 2002).

DATA AND METHODS

Data and variables

This study used wave 3 (1996 round) of the Health and Retirement Survey (HRS) with individuals aged 55-65. HRS is a longitudinal national survey initiated in 1992 to track national trends biennially in health and economic well-being among retired and near-retired Americans. Individuals and proxy respondents with missing depression and pain data were excluded[4], leaving a study sample of 7350 individuals with an average age of about 60 years.

Wave 3 was chosen because it was the only time when two depression measures were assessed. These measures included the short form (8 items) of the Center for Epidemiologic Studies Depression Scale (CES-D) and the Short Form Composite International Diagnostic Interview (CIDI-SF) (Radloff LS. 1977; Kessler RC , Andrews G, Mroczek D. 1998). The shortened CES-D ranges from 0 to 8 and asks respondents to evaluate the following symptoms experienced over the past seven days either all or most of the time: depression, everything is an effort, sleep is restless, felt alone, felt sad, could not get going, felt happy (reverse-coded), and enjoyed life (reverse-coded). Sensitivity

[4] About 20% of individuals were missing depression and/or pain items. Males, nonwhites, married, and less educated individuals were more likely to be missing data. Our results may be biased due to the nonrandomness of missing values. Our analysis used complete data, rather than trying to impute depression and pain status, which raises its own set of limitations. There were still substantial observations left and we believe the reduction in power due to missing values was not consequential.

and specificity analysis comparing short form, eight-item CES-D of HRS to the full twenty-item CES-D used by another study (i.e. National Longitudinal Survey of Mature Women) showed that a cutoff point of 4 or higher has a sensitivity of 90.2 percent and specificity of 97.4 percent when compared to the full, twenty-item CES-D with a cutoff of 16 or higher (Steffick DE. 2000). On the CIDI-SF, a cutoff point of 3 or more symptoms on the zero to seven scale indicates a diagnosis of clinical depression most comparable to the full CIDI (Steffick DE. 2000; Walters EE, Kessler RC, Nelson CB, et al. 2001). We used the short form CES-D classification as our primary measure and the CIDI-SF classification for sensitivity analyses.

To measure pain status, respondents were asked whether or not they often experienced pain without reference to physical pathology (yes/no), and their degree of pain (mild, moderate, or severe). Since our sensitivity analyses indicated that the association of depression, pain and outcome variables was different for severe pain compared to mild or moderate pain, we categorized measure of pain into three levels: no pain, mild/moderate pain, and severe pain.

The independent variable was constructed by combining the dichotomous measure of depression with the 3-level measure of pain deriving 6 mutually exclusive groups: neither depression nor pain, depression only (no pain), mild/moderate pain only (no depression), mild/moderate pain with depression, severe pain only (no depression), severe pain with depression.

To assess labor market, financial, insurance and disability outcomes by the six groups, we examined the following self-reported dependent variables:

1) Labor market

a. Employment: not employed versus employed[5].

b. Retirement: retired versus not retired.

2) Financial

a. Annual household income: Sum (in nominal dollars) of all income categories including earnings, employer pension or annuity, government support and transfers, and any other source.

b. Total medical expenditures: All costs (in nominal dollars) for health care utilization over the previous two years including hospitalizations, nursing home stays, special facilities or services, and outpatient care including physician and dentist visits.

3) Insurance

a. Governmental health insurance plan coverage: Recipients of Medicare, Medicaid and VA/CHAMPUS versus non-recipients.

b. Social Security: Recipients of social security earnings (Old Age Survivor and Disability Insurance (OASDI)) versus non-recipients.

4) Disability

a. Limitations in Activities of Daily Living (ADLs): presence or absence of difficulties performing any of the five tasks including walking across a room, bathing, eating, dressing, and getting in and out of bed.

b. Health limitations affecting work: presence or absence of impairments or health problems that limit the kind or amount of paid work respondents could do.

[5] Respondents who was not working for pay as they were interviewed were defined as "not employed".

Data Analytic Procedures

We descriptively compared the six groups across sociodemographics, health conditions, and outcome variables. Chi-square tests were conducted for categorical variables and bivariate regressions were conducted for continuous variables. All analyses were weighted by sampling weights, if possible[6].

Multivariate regression analyses were then conducted to adjust for observed confounding factors. Logistic regression models were used for dichotomous outcome variables (employment and retirement status, government health insurance, social security, limitations in ADLs, health limitations affecting work) and median regression models for continuous outcome variables (annual household income and total medical expenditures). Median regression is more robust to outliers than ordinary least squares regression, although it measures the median effects, not the mean. Standard errors in logistic regression models were corrected by the Huber/White/Sandwich' robust variance estimators. We treated neither depression nor pain as the reference group and used 5 dummy variables to indicate each of the other five groups as explanatory variables. Control variables included socio-demographics including age (years), gender, ethnicity (white vs. nonwhite), marital status (married or not), education (years), smoking (currently smoking or not), and number of persons in the household. We also included a count of number of chronic health conditions (diabetes, hypertension, cancer, stroke, heart disease, lung disease, and arthritis) diagnosed by a doctor.

Our analyses specifically addressed differences between "pure" depression and depression with comorbid pain (mild/moderate pain, or severe pain). Post hoc Wald tests were used to test these contrasts. To illustrate the effects of comorbid pain on depression,

[6] Median household income and median medical expenditures were not weighted.

we provided predicted values of outcomes by running simulations on the study sample for four groups: neither depression nor pain, depression alone, depression with mild/moderate pain, and depression with severe pain. These predicted values were based on the multivariate regressions models above, adjusting for socio-demographics and physical health conditions; and were weighted to be nationally representative.

To further illustrate the adverse effects of comorbid pain on depression, we provided the prevalence of comorbid pain (mild/moderate pain or severe pain) among the depressed; and calculated the share of comorbid pain on some adverse economic outcomes attributed to depression, adjusting for socio demographics and chronic health conditions. These outcomes included non-employment, government health insurance, limitations in ADLs, and health limitations affecting work. All these values were weighted to be nationally representative.

RESULTS

Descriptive statistics

The results of the descriptive analyses are reported in **Table 1**. There were 7,350 individuals in the study sample, among which 5,239 (72.3%) had neither depression nor pain, 459 (5.7%) had depression only, 1042 (14.5%) had mild/moderate pain only, 382 (4.8%) had depression and mild/moderate pain, 124 (1.5%) had severe pain only, and 104 (1.2%) had depression and severe pain.

Relative to those with neither condition or those with depression alone, individuals with depression and comorbid pain univariately reported worse outcomes (all $p \leq 0.01$). However, there also were large differences in the social-demographics and chronic health conditions across the six groups. Individuals with depression and

comorbid pain were most likely to be female, nonwhite, smokers, unmarried, have less education, and have more chronic health conditions.

Main Results

As shown in **Table 2** and **Table 3**, depression with comorbid pain (either mild/moderate pain or severe pain) was strongly associated with the worse labor market, financial, insurance and disability outcomes compared to neither condition, after adjusting for socio demographics and chronic health conditions ($p<0.01$ in each model except $p=0.03$ for depression and severe pain on retirement, $p=0.22$ for depression and severe pain on household income). Depression with comorbid pain fared worse than depression alone in all adjusted models (at $p<0.01$) except for nonsignificant differences in outcomes of retirement and annual household income. Compared to depression with mild/moderate pain, depression with severe pain was associated with higher rates of non-employment ($p<0.05$), limitations in ADLs ($p<0.01$), and total medical expenditures ($p<0.01$).

Table 4 showed predicted values of outcomes of depression with comorbid pain (either mild/moderate pain or severe pain) in comparison with depression alone and neither condition. The predicted probability of non-employment was highest in the depression with severe pain group relative to depression alone (72.1% vs. 44.1%; $\chi^2=19.77$, df=1, $p<0.01$) and depression with mild/moderate pain (72.1% vs 58.6%; $\chi^2=4.28$, df=1, $p<0.05$). Depression with mild/moderate pain also significantly increased the risk of non-employment compared to depression alone (58.6% vs. 44.1%; $\chi^2=18.07$, df=1, $p<0.01$). Depression with severe pain (34.9%; $\chi^2=3.69$, df=1, $p=0.05$) and depression with mild/moderate pain (32.2%; $\chi^2=3.29$, df=1, $p=0.07$) marginally increased

the likelihood to be retired compared to depression alone (26.6%), but the magnitudes of differences were not substantially large.

Depression and severe pain was associated with the highest medical expenditures (median=$6142), relative to depression alone (median=$2054; χ^2=223.43, df=1, p<0.01) and depression with mild/moderate pain (median=$3817; χ^2=70.82, df=1, p<0.01). Depression with mild/moderate pain also had higher medical expenditures compared to depression alone (χ^2=101.19, df=1, p<0.01). However, the association of depression with comorbid pain (mild/moderate or severe) and annual household income was not statistically different from depression alone.

The depression with severe pain group had a higher probability of being covered by government health insurance (34.7% vs. 19.3%; χ^2=11.83, df=1, p<0.01) and receiving social security (44.7% vs 29.5%; χ^2=7.02, df=1, p<0.01) than depression alone. Likewise, depression with mild/moderate pain was worse than depression alone on these outcomes (28.2% vs. 19.3% for governmental health insurance; χ^2=12.96, df=1, p<0.01; and 37.2% vs 29.5% for social security; χ^2=10.40, df=1, p<0.01).

The depression with severe pain group was significantly associated with greater limitations in ADLs relative to depression alone (43.6% vs. 9.4%; χ^2=62.58, df=1, p<0.01), and relative to depression with mild/moderate pain (43.6% vs. 30.7%; χ^2=5.38, df=1, p=0.02). Depression with mild/moderate pain also was associated with higher probabilities of limitations in ADLs compared depression alone (30.7% vs. 9.4%; χ^2=73.44, df=1, p<0.01). Depression with severe pain (56.9% vs. 23.0%; χ^2=29.28, df=1, p<0.01) and depression with mild/moderate pain (56.6% vs. 23.0%; χ^2=95.16, df=1,

$p<0.01$) had higher probabilities of reporting health limitations affecting work compared to depression alone.

Finally, **Figure 1** illustrated the prevalence of mild/moderate pain and severe pain among the depressed; **Figures 2-5** illustrated the share of comorbid pain (mild/moderated pain, or severe pain) among the depressed on outcomes including non-employment, government health insurance, limitations in ADLs, and health limitations affecting work, respectively. Half of the near elderly Americans of individuals who had depression also had comorbid pain (51%). Among those with depression, the depression with pain group accounted for 3/5 of those who were not employed (59%), 3/5 of those with government health insurance (61%), 4/5 of those with limitations in ADLs (79%), and 3/4 of those with health limitations affecting work (72%). The effect of "pure" depression is relatively smaller. In addition, although severe pain only accounted for a small portion among the depressed (10%), their relative adverse effects were large. They accounted for 14% of the depressed who were not employed, 14% of those with government health insurance, 20% of those with limitations in ADLs, and 14% of those with health limitations affecting work.

Sensitivity Analysis

Using CIDI-SF to measure depression gave very similar results (data not shown), except that the association of depression with pain was slightly stronger for some outcomes (i.e. government health insurance, social security). This indicated that our results were robust to the measure of depression.

DISCUSSION

This study compared the associations of depression and comorbid pain versus depression alone or neither condition on labor market, financial, insurance, and disability outcomes in a nationally representative cross-section of near elderly Americans. Depression with comorbid pain was associated with worse outcomes compared to depression alone or neither condition, after controlling for socio-demographics and other chronic health conditions. The simulated results showed that magnitudes of the adverse effects of comorbid pain on depression were substantial. The study suggests that individuals with depression were not homogenous. The effect of depression might be overestimated without considering the effect of comorbid pain and programs focused on depression in general may not achieve policy goal for the depressed with comorbid pain. Furthermore, our study found that although severe pain only account for a small portion in the depressed, it is associated with worst social outcomes[7] and its relative adverse effect should not be ignored.

Although the economic burden of depression has been well documented, data and studies on the social costs of depression and comorbid pain are rare. Existing studies are limited to claims data or patient data from selected employers or practices (Greenberg PE, Leong SA, Birnbaum HG, et al. 2003). Our study enriched the literature by simultaneously studying the association between depression and comorbid pain, and labor market, financial, insurance and disability outcomes in nationally representative survey data. Numerous studies have examined the economical and disability outcomes of

[7] In this chapter, "social outcomes" refer to labor market, financial, insurance, and disability outcomes.

depression, however our study demonstrated that depression with comorbid pain, not just "pure" depression, might especially drive these adverse outcomes.

The study also demonstrated that near elderly Americans with depression and comorbid pain were particularly vulnerable. They were at a higher risk of disability and the negative influences disability may have on household income. Since depression with pain was negatively associated with employment and therefore employment-based insurance, these individuals may have reduced access to care. With limited household income, near elderly Americans with depression and comorbid pain may be more likely to find health care unaffordable before they make the transition into Medicare. This, in turn, leads to even greater progression of worsening health status for them (Baker DW, Sudano JJ, Albert JM, et al. 2001; Heisler M, Langa KM, Eby EL, et al. 2004).

Worse social outcomes and large economic costs conversely imply a high economic return for policies that aid in the identification and treatment of depression and comorbid pain. Our data were collected through interviews and self-report of pain, which may reflect symptoms, but not necessarily physical pathology. In fact, symptoms like pain, stiffness, lack of energy, cramps account for more than half of outpatient encounters in the United States and more than a third of such symptoms lack an adequate physical explanation, but these symptoms increase health care costs and remain an obvious source of ill health (Kroenke K, Mangelsdorff AD. 1989; Kroenke K, Price RK. 1993). Although pain is often measured broadly in research, treatment data usually focuses on a specific condition. This makes application of evidence based medicine challenging. Despite the high percentage of depressed patients that present soley with unexplained pain, there is little data about the best practices for treating this population (Bair MJ, Robinson RL,

Katon W, et al. 2003; Rost K. 2003). Most current studies focus on treating one condition in the presence of another, and some also suggest treating both conditions will improve overall outcomes (Bair MJ, Robinson RL, Katon W, et al. 2003 Campbell LC, Clauw DJ, Keefe FJ. 2003; Fava M. 2003). Although our study provided no information on the adequacy of care for depression and pain, it suggested that public health and policy should target clinical practice guidelines for depression and pain and identify more adequate and efficient care (either pain management, depression management, or both). Our study on the other hand suggested that reduced access to care due to loss of insurance and poor economic situation is a probable reason for some patients with depression and pain to have lack of care or inadequate care. With the evolving state of Medicare (particularly its Medicare Modernization Act provisions) and in Medicaid with states that have mental health exemptions for psychotropic drugs, broad formulary access to mental health treatments might be considered. Attempts to improve the quality of health coverage on these government health insurance plans and social security programs may be very beneficial for some of those who are eligible.

LIMITATIONS

Though this study expands knowledge on the association of depression and pain, our indicators of depression and pain were based on self-reported subjective measures. Previous literature suggested that subjective measures of health may biases estimates in both directions (Bound J. 1991). The lack of comparability of subjective depression or pain across respondents is likely to underestimate their effects on labor market outcomes due to measurement error. The problem is heightened when continuous variables, such as

depression and pain, are categorized into dichotomous variables. The endogeneity of self-reported depression and pain (for example, individual may mention depression or pain to rationalize their not working or retirement behavior) will overestimate estimates. Though there is a tendency to cancel out the opposite directions of biases, this study does not quantify the real direction and magnitude of biases. Biases in our estimations of depression or pain on outcomes may also lead to biases on coefficients of other variables that were correlated with depression or pain.

Another limitation of the study relates to endogeneity inherent in cross-sectional studies. We studied effects of depression and pain on outcomes, however these outcomes might also have effect on depression and pain. Our study did not address the potential reverse causality issue. Additionally, there may exist other unmeasured variables that were correlated with depression, pain and outcomes that were not included in the analyses. For example, we were unable to control for personality traits. If individuals predisposed to depressive episodes have negative preference for labor participation, then our estimates for depression on labor market outcomes would be overestimated. Similar arguments may apply to other variables as unmeasured education, life circumstances, economic environment and so on. Finally, the study was limited in the age range as the HRS Wave 3 only includes primary respondents between the ages of 55 to 65. The results may not be generalizable to other age groups.

Despite these limitations, depression with pain, not depression alone may be responsible for a large part of the higher economic burden associated with depression. Depressed patients with pain may benefit from educational and treatment practices that acknowledge both depressive and painful symptoms.

Table 2. 1. Characteristics of Near Elderly Americans in Health and Retirement Survey Wave 3 (1996), By Depression and Pain Status

Variables	Whole Sample	Neither Depression nor pain	Depression only	Mild/moderate pain only	Depression and mild/moderate pain	Severe pain only	Depression and severe pain
	(N=7,350) ‡	(N= 5,239)	(N= 459)	(N= 1,042)	(N= 382)	(N= 124)	(N=104)
	(100%)‡	(72.3%)	(5.7%)	(14.5%)	(4.8%)	(1.5%)	(1.2%)
Outcome Variables							
Not employed (%)***	42.2	36.7	48.8	51.7	69.5	68.4	82.5
Retired (%)***	27.3	24.8	27.6	34.0	37.5	39.8	43.0
Median household income ($) [1]***	34879	39066	21917	31089	15939	21124	12279
Median Medical Expenditures ($)[2]***	1788	1520	1574	3711	4471	4471	7154
Governmental health insurance (%)***	18.8	14.3	23.1	27.8	39.6	36.6	54.8
Receive Social Security (%) ***	27.8	24.2	31.4	35.1	43.6	47.1	56.8
Limitations in ADLs (%)***	10.1	3.1	10.7	24.3	46.5	44.9	64.6
Health Limitations affecting work (%)***	25.2	13.9	29.0	53.7	77.4	66.2	82.5
Other Socio-demographic Variables							
Mean Age (years)***	59.8	59.9	59.7	59.8	59.5	59.8	59.4
(SD)	(0.04)	(0.05)	(0.15)	(0.10)	(0.17)	(0.28)	(0.31)
Female (%)***	56.0	52.7	65.1	60.8	71.7	70.3	69.2
Non-White (%)***	13.4	12.9	18.3	10.1	16.4	21.8	36.9
Married (%)***	75.7	78.3	60.8	75.8	57.5	71.8	63.5
Education (years)***	12.5	12.8	11.3	12.3	10.8	11.4	9.7
(SD)	(0.03)	(0.04)	(0.16)	(0.09)	(0.16)	(0.30)	(0.35)
Smoking (%) [a] ***	21.3	19.8	27.5	21.7	32.5	23.5	33.2
Mean Number of persons in Household	2.4	2.4	2.3	2.3	2.3	2.4	2.6
(SD)	(0.01)	(0.02)	(0.06)	(0.03)	(0.07)	(0.09)	(0.13)
Health Variables							
Mean Number of chronic health conditions	1.1	1.1	1.7	2.0	2.8	2.1	3.1
(SD)***	(0.02)	(0.02)	(0.07)	(0.04)	(0.08)	(0.12)	(0.18)

Note: we report mean and standard deviation (in parenthesis) for continuous variables, and percentage for categorical variables. *** p<0.01, **p<0.05 *p<0.1

‡ Number of observations and corresponding percentage (weighted)

[1] Range of annual household income is from $0 to $2,830,203. [2] Range of total medical expenditures is from $0 to $ 894,200.

[a] Based on 7078 observations (272 are missing smoking status)

Table 2.2. Multivariate Estimates of Dichotomous Outcomes (Logistic Regression Models)*

	Not Employed	Retired	Government Health Insurance	Receive Social Security	Limitations in ADLs	Health limitations affecting work
Depression only	1.28[12]	1.07[aº]	1.26[12]	1.39[12]	2.71[12]	1.56[12]
	(0.02)	(0.56)	(0.07)	(0.02)	(0.00)	(0.00)
Mild/moderate pain only	1.54	1.41	1.85	1.76	7.21	5.22
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Depression and Mild/moderate Pain	2.55[3]	1.47	2.23	2.38	13.3[3]	9.18
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Severe Pain only	2.94	1.77	2.87	3.43	18.8	8.38
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Depression and Severe Pain	5.12	1.69	3.17	3.91	24.7	9.29
	(0.00)	(0.03)	(0.00)	(0.00)	(0.00)	(0.00)
Age	1.19	1.28	1.19	1.64	1.04	1.01
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.29)
Female	2.05	1.00	.72	1.12	0.76	0.76
	(0.00)	(0.96)	(0.00)	(0.09)	(0.00)	(0.00)
Nonwhite	1.04	1.15	1.58	1.15	1.54	1.18
	(0.49)	(0.06)	(0.00)	(0.12)	(0.00)	(0.05)
Married	1.32	1.16	.59	.76	.74	.80
	(0.00)	(0.05)	(0.00)	(0.00)	(0.00)	(0.00)
Education	0.91	1.00	.93	.92	.90	.91
	(0.00)	(0.98)	(0.00)	(0.00)	(0.00)	(0.00)
Smoking	1.15	1.15	1.27	1.14	1.10	1.31
	(0.03)	(0.05)	(0.00)	(0.11)	(0.35)	(0.00)
Smoking_missing	1.58	2.11	1.13	1.63	0.96	1.63
	(0.03)	(0.00)	(0.42)	(0.00)	(0.84)	(0.00)
Number of persons in the Household	0.96	.89	1.03	1.00	1.00	.93
	(0.06)	(0.00)	(0.34)	(0.99)	(0.92)	(0.02)
Number of chronic health conditions	1.33	1.26	1.43	1.36	1.49	1.95
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)

* "No depression or pain" is the reference group for all analyses. Estimates of odds ratio and correspondent p-values (in the bracket) are reported.

[1] Difference between depression with mild/moderate pain and depression only is statistically significant at p<0.01.

[2] Difference between depression with severe pain and depression only is statistically significant at p<0.01.

[3] Difference between depression with severe pain and depression with mild/moderate pain is statistically significant at p<0.05.

[a] Difference between depression with mild/moderate pain and depression only is statistically significant at p<0.1.

[º] Difference between depression with severe pain and depression only is statistically significant at p<0.1.

Table 2.3. Multivariate Estimates of Continuous Outcomes (Median Regression Models)*

	Annual Household Income	Medical Expenditure in the past two years
Depression only	-2765	-87[12]
	(0.04)	(0.48)
Mild/moderate pain only	-2758	1210
	(0.00)	(0.00)
Depression and	-5770	1676
Mild/moderate Pain	(0.01)	(0.00)
Severe Pain only	-8342	1624
	(0.00)	(0.00)
Depression and Severe Pain	-3332	4001[3]
	(0.22)	(0.00)
Age	-977	-0
	(0.00)	(0.98)
Female	-7005	28
	(0.00)	(0.64)
Nonwhite	-5781	-86
	(0.00)	(.27)
Married	16679	148
	(0.00)	(0.04)
Education	3316	85
	(0.00)	(0.00)
Smoking	-3468	-209
	(0.00)	(0.00)
Smoking_missing	-3239	3
	(0.00)	(0.98)
Number of persons in the	601	-13
Household	(0.03)	(0.64)
Number of chronic health	-1622	1066
conditions	(0.00)	(0.00)

* "No depression or pain" is the reference group for all analyses. Estimates of coefficients and correspondent p-values (in the bracket) are reported.

[1] Difference between depression with mild/moderate pain and depression only is statistically significant at p<0.01.

[2] Difference between depression with severe pain and depression only is statistically significant at p<0.01.

[3] Difference between depression with severe pain and depression with mild/moderate pain is statistically significant at p<0.05.

Table 2.4. Predicted values of outcomes across depression/pain subgroups in HRS, 1996

	Neither Depression Nor Pain	Depression Only	Depression with Mild/moderate Pain	Depression with Severe Pain
Not Employed (%)†[123]	39.0	44.1	58.6	72.1
Retired (%)†[a°]	25.4	26.6	32.2	34.9
Median Annual Household Income ($)‡	40460	37695	34691	37128
Median Medical Expenditure ($)‡[123]	2141	2054	3817	6142
Covered by Government Health Insurance (%)†[12]	16.3	19.3	28.2	34.7
Receive Social Security (%)†[12]	25.2	29.5	37.2	44.7
Limitations in ADLs (%)†[123]	3.9	9.4	30.7	43.6
Health limitations affecting work (%)†[12]	17.1	23.0	56.6	56.9

† Predicted probabilities of outcomes across depression/pain subgroups, based on multivariate regression logistic regression of table 2.

‡ Estimated values of outcomes across depression/pain subgroups, based on multivariate median regressions of table 3.

[1] Difference between depression with mild/moderate pain and depression only is statistically significant at p<0.01.

[2] Difference between depression with severe pain and depression only is statistically significant at p<0.01.

[3] Difference between depression with severe pain and depression with mild/moderate pain is statistically significant at p<0.05.

[a] Difference between depression with mild/moderate pain and depression only is statistically significant at p<0.1.

° Difference between depression with severe pain and depression only is statistically significant at p<0.1.

Figure 2.1. Among the Depressed Near Elderly Americans: 1/2 have Pure Depression, 1/2 have Depression with Pain

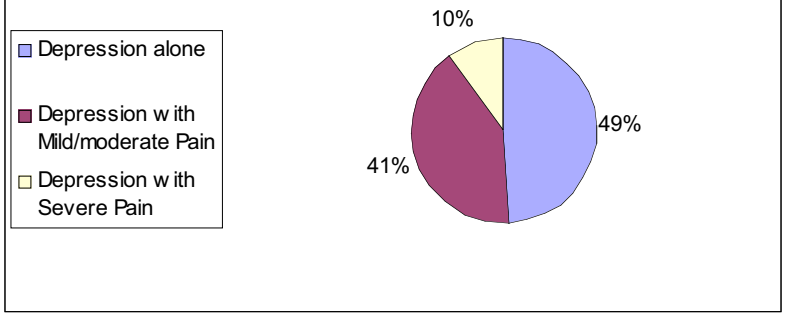


Figure 2. 2. Non-employment:
2/5 is attributable to Pure Depression, 3/5 is attributable to Depression with Pain

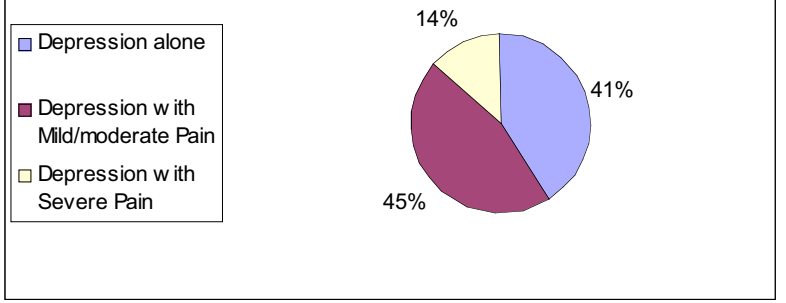


Figure 2.3. Government Helath Insurance: 2/5 is attributable to Pure Depression, 3/5 is attributable to Depression with Pain

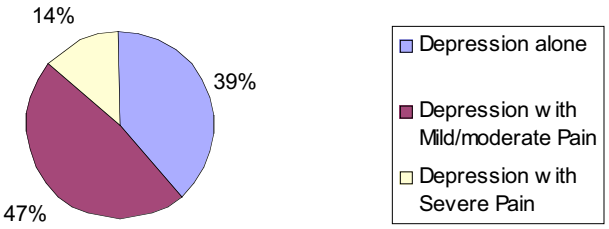


Figure 2.4. Limitations in ADLs: 1/5 is attributable to Pure Depression, 4/5 is attributable to Depression with pain

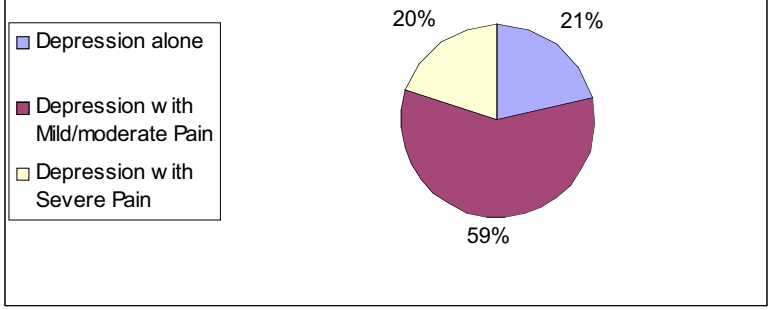
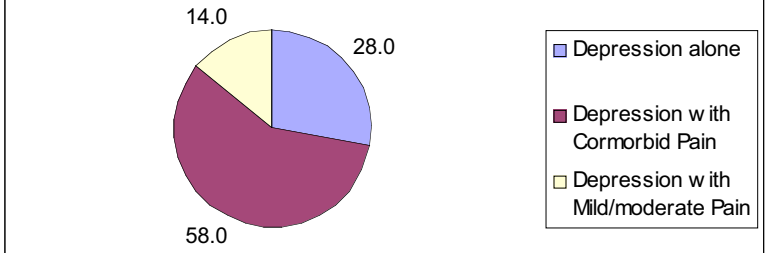


Figure 2.5. Health Limitations Affecting Work: 1/4 is attributable to Pure Depression, 3/4 is attributable to Depression with Pain



CHAPTER 3. MEDICATION BEHAVIOR AND MEDICATION COSTS AMONG AMERICANS WITH DEPRESSION AND PAIN

INTRODUCTION

Depression and painful symptoms are very prevalent among patients and often occur together, and presence of pain among depressed individuals complicates the recognition and treatment of depression (Bair MJ, Robinson RL, Katon W, et al. 2003; Ohayon MM, Schatzberg AF, 2003; Simon GE, Goldberg D, Tiems BG, et al. 1999). The new emphasis on pain as the "fifth vital sign" by both the Joint Commission on Accreditation of Healthcare Organizations and the Veterans Health Administration provides an opportunity for better recognizing and understanding the interaction between depression and pain (Bair MJ, Robinson RL, Eckert GJ. et al. 2004).

However very few studies have focused on how the interaction of depression and pain affect the medication behavior and medication costs of persons with depression and pain (Bair MJ, Robinson RL, Katon WJ, Lin E, Russo J, Unutzer J. 2003; Doan BD, Wadden NP. 1989; Koike AK, Unutzer J, Wells KB 2002). Do individuals with depression and pain use more prescription drugs, over-the counter drugs, and supplements or herbal medications, compared to those with depression or pain only? Do they have a heavier burden in terms of medication costs? Does the pain comorbidity affect medication behaviors such as the use of antidepressants or supplements that are good for depression? Answering these questions will not only have implications for

health care providers but will inform the health policy makers who want to reduce the burden of depression and pain. This is the first study to analyze the association of depression and pain with medication behaviors and medication costs among Americans using nationally representative data set.

METHODS

Data

The study used data from Healthcare for Communities (HCC), a national survey designed to track the effects of the changing health care system for individuals at risk for alcohol abuse, drug abuse or mental health disorders (AMD) (Major depressive disorders, dysthymic disorders, panic disorder, generalized anxiety disorder, harmful alcohol use, abuse of illicit drugs, and abuse of prescription medications). HCC fielded a household survey and linked these primary data with secondary and administrative records on communities. The HCC household survey received a sampling frame consisting of 30,375 adult cases from the Community Tracking Study (CTS), and selected 14,895 participants for a proposed target of 10,000 completed interviews in 1998. HCC over-sampled poor, psychologically distressed, and mental health specialty users among CTS participants (the HCC sampling strategy increased the number of individuals with AMD over 40% compared to a simple random sample and consequently increases the statistical power for analyzing this group compared to a similarly sized random population sample), and the sample was designed to provide sufficient power for national estimates and to allow for an analysis of community variations in outcomes. Within the field of mental health services and substance abuse research, HCC is a unique study in that it puts equal

weight on clinical/epidemiologic and economic/health policy considerations (Sturm R, Gresenz C, Sherbourne CD, et al. 1999).

The study used the first wave data of the household survey component of HCC, which re-interviewed CTS participants about 15 months after the initial interviews. After excluding ineligible cases, the final sample included 9585 observations, with a response rate of approximately 64%. The study further excluded individuals with missing values on depression and pain.[8] Weights to adjust sampling design and non-response rate were developed to obtain nationally representative estimates (Zhang L, Tang L, Liao D, and Klap R. 2003).

Conceptual Framework

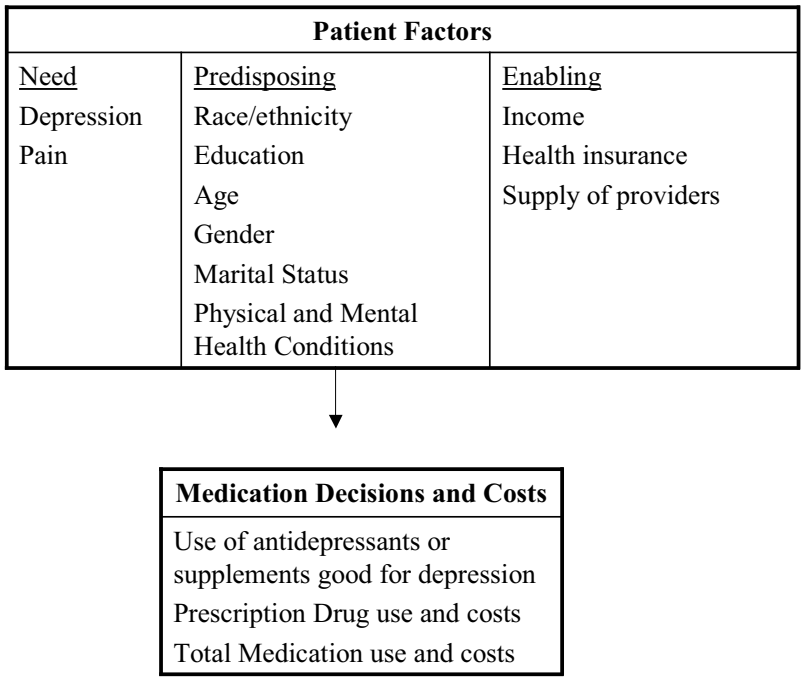
The relationship of depression, pain and the medication decision and medication costs was modeled using Anderson's behavioral framework (Andersen RM, 1968; 1995) which suggests that people's use of health services is driven by a series of variables categorized as 1) need factors representing people's need for health care, 2) predisposing factors that affect people's use of medical care, 3) enabling factors that enable or impede the use of services (Figure 1).

Depression and pain are categorized as "need factors", whereas other clinical characteristics and health conditions not related to the disease of interest fall under "predisposing factors." Both of these factors influence the medication decision and medication costs directly. The demographic factors such as age, gender, race, education

[8] Since only a small proportion of sample (less than 5%) does not report depression and pain status, I assume that the study sample is still nationally representative.

and marital status are included as predisposing factors. In addition, both the personal (income, health insurance coverage) and community enabling resources must be present for the use of medication to take place.

Figure 3.1. Conceptual Model of Medication Decision and Costs



Measures

Outcomes

HCC surveyed individuals about any prescription, over-the counter (OTC), or supplemental drugs (including vitamins and herbs) that they took at least several times a week for one month or more. Then costs were assigned to these drugs and supplements.

Since the survey was designed only to seek drugs taken for long-term durations, short-term drugs are probably underreported. The study therefore derived outcomes only based on long-term used drugs to reduce bias. These outcomes include:

(1) Any use of antidepressant medication: A derived dummy variable that indicates whether the respondent took any antidepressant medication in the past 12 months.

(2) Any use of effective antidepressant medication: A derived dummy variable that indicates whether the respondent took any antidepressants that are likely to be effective. An effective antidepressant is one that was taken at an adequate daily dose for at least 2 months in the past 12 months.

(3) Any use of St John's Wort: A derived dummy variable that indicates whether the respondent took any St John's Wort.[9]

(4) Medication costs: annual total drug costs (in dollars), including costs for prescription drugs, OTC and supplements.[10]

(5) Prescription drug costs: annual prescription drug costs (in dollars).

[9] There maybe other supplements that are likely to be good for mental health, however there is only rigorous evidence for St John's wort to be effective for depression (Linde K, Ramirez G et al, 1996; Volz H-P 1997).

[10] To calculate a respondent's annual cost for each reported drug, HCC first matched the medications reported by HCC respondents to four data sources (in order of decreasing preference, these data sources were Ingenix, FirstDatabank, Dietary Supplement Database, and Internet sources), each with a different type of cost data. Then used the drug databases to estimate the cost of a daily dose, multiplied this value by an estimate of the average days-per-month a drug was taken by persons in the Ingenix database, and multiplied this product by the number of months the respondent reported taking the drug (Zhang L, Tang L, Liao D, and Klap R. 2003).

Need Characteristics

The main measure of depression was a dichotomous indicator of whether the respondent has a probable major depressive or dysthymic disorder. The HCC survey assessed major depressive and dysthymic disorder using the screening versions of the Composite International Diagnositic Interview Short-Form (CIDI-SF) (Kessler RC , Andrews G Mroczek D, et al. 1998). All those who exceeded the cutoff point (3 or more for major depressive disorders on the 7-item CIDI-SF, and 2 or more for dysthymic disorder on the 4-item CIDI-SF) were treated as having probable depressive disorder.

A dichotomous variable was created to indicate weather the respondent had arthritis, chronic back problems, migraine or chronic severe headaches or other chronic pain conditions. Those who have one of these four physical conditions were treated as having pain symptoms, otherwise not. Based on the above measure of depression and pain, the study classified respondents into four mutually exclusive categories by their depression and/or pain status: depression and pain, depression only (no pain), pain only (no depression), and neither condition. It treated those with neither condition as the reference group and used three dummy variables to indicate each of the other three groups as explanatory variables.

Predisposing Characteristics

HCC data captured a variety of patient socio-demographic characteristics, including age (years, reclassified as categorical variables 18-25, 25-34, 35-44, 45-54, 55-64, 65+), gender, race/ethnicity (white, black, Hispanic, and other races), education (school years, reclassified as a categorical variable: less than high school, high school degree, some college, college or above college degree), marital status, physical health and

mental health conditions. HCC measures the severity of psychological distress by using the mental health inventory (MHI-5) that produces a score based on answering to the five-item mental health scale included in the Short Form 36 (SF-36), which was developed in the Medical Outcomes Study. Possible scores range from 0-100, with higher scores indicating better mental status. It also includes physical health scores, the Physical Component summary (PCS-12) for the SF-12, a short-form generic measure of health status, that reproduces the summary scores derived from the SF-36. The PCS-12 represents the physical dimension of health status. The scale is scored using norm-based methods. It has a mean of 50 and a standard deviation of 10 in the general U.S. population. Thus all scores above and below 50 are above and below the average in the population. A one-point difference is one-tenth of a standard deviation. A higher score means better health.

In addition, the study further controlled for other comorbidities except for pain. The HCC survey asked individuals about the presence or absence of other chronic physical health conditions, including asthma; diabetes; hypertension; physical disability such as loss of arm, leg, eyesight, or hearing; trouble breathing; cancer; neurologic condition; stroke or paralysis; angina/ heart failure/ coronary artery disease, stomach ulcer; chronic liver disease; chronic bladder problems; chronic gynecologic problems (women only). They are reclassified as categorical variables: 0 comorbidity, 1 comorbidity, 2 comorbidities, and 3 plus comorbidities.

Enabling Characteristics

HCC data surveyed individuals on their income and health insurance coverage. We hypothesized that these factors would increase the likelihood that individuals with

depression and/or pain would use medications to treat their condition either directly in the form of non-prescription drugs or indirectly via a physician prescription, thus to increase their medication costs. The study created quartiles for median income based on their distribution in the sample (<$19,000, $19,000-$38,100, $38,100-$65,400, >$65,400). It further classified the insurance status[11] to private employer sponsored health insurance, self-purchased health insurance, Medicare, Medicaid, military health insurance other insurance, and no insurance.

The relationship between the supply of health care providers and medication has not been previously explored for depression. We hypothesized that more supply of health care providers in the community would increase the likelihood of access to care, thus increase the likelihood of use of medication, especially for prescription drugs. From the Area Resource File (ARF)[12], the study linked measures of psychiatric subspecialists supply per 1000 residents to HCC data by state and county of residence. Tertiles were created for this variable to examine the relative supply of psychiatric subspecialists on medication use and medication costs.

Analytical Approaches

The study conducted descriptive analyses of the predisposing characteristics, enabling characteristics, need characteristics, and mediation outcome variables for the

[11] It is a derived variable that indicates the main health insurance plan. If multiple plans are reported, a plan that provides coverage for mental health conditions is selected as the main plan. If none of the plans or more than one of the plans provides mental health coverage, then the respondent was asked to choose the main plan.

[12] The Area Resource File (ARF) is a computerized health resources information system maintained by the Bureau of Health Professions. The dataset includes county level information on the availability of health facilities, health professions, economic activity, and socioeconomic characteristics (Quality Resource Systems Inc, 2003).

study sample. We then compared these variables across four combinations of depression and pain status: neither depression nor pain, depression only, pain only, depression and pain comorbidity. All these estimates were adjusted by sampling weights to be nationally representative. Chi-square tests were conducted for categorical variables and ANOVA was conducted for continuous variables.

Logistic regression models were used to predict the use of medications categorized in three ways: any use of antidepressants, any use of effective antidepressants, and any use of St John's Wort. The study hypothesized that the presence of pain comorbidity distracts[13] depressed patients from using antidepressants or using them effectively, and from using St John's Wort. I used two specifications for depression and pain variables: One specification included four categories of depression and pain status: neither depression nor pain, depression only, pain only, depression and pain comorbidity; another specification included pain, depression and an interaction term of depression and pain. The first specification allows for comparisons between depression and pain subgroups, and the second specification shows the synergistic effect of depression and pain.

A two-part model was used to analyze the cost variables: Logistic regression models were used to analyze the probability of having any medications, and any prescription drugs; and ordinary least squares regression were used to analyze the log of the level of medication costs, conditional on having some use of medication, and prescription drugs (Duan N, Manning WG, Newhouse JP. 1983). The same set of

[13] The dissertation use the term "distract" to describe a situation that the presence of pain causes the patients or doctors to pay no or little attention to the depression symptoms thus decrease the use of antidepressants or even do not use antidepressants.

predictors was used in both parts of the model. This modeling strategy was used in light of the characteristics of the distribution of medication costs: First, many individuals in the population do not use medications during a given year. Second, medication costs among the users are highly skewed. Through much of their range, the positive medication costs are approximately lognormally distributed. Post-hoc Wald tests were conducted for these models to compare the differences between individuals with depression only and those with depression and pain.

Coefficients in nonlinear models are not easily interpreted. To faciliatate interpretation, we ran simulations based on the study sample to provide predicted values of the dependent variables for depression and/or pain subgroups (Korn, E. L. and Graubard, B. I. 1999). All these values were adjusted for confounding differences in predisposing characteristics and enabling characteristics, and are weighted by sampling weights to be nationally representative. Annual total medication costs and prescription drug costs were estimated for depression and/or pain subgroups as well based on the two-part models. The annual medication costs were the product of the predicted probability of any medications and the predicted total medication costs given any medications. In the same way, the annual prescription drug costs were the product of the predicted probability of any prescription drugs and the predicted prescription drugs costs given any prescription drugs. For the second part of model in the two-part models, predicted values on the log scale were retransformed to real dollars with Duan's smearing estimator (Duan N, 1983; Manning WG, Mullahy J. 2001).

The study used the self-reported measure of depression and was subjective to the measurement bias problem. In the main analysis, the study defined depression to be

major depressive disorder and dysthymic disorder based on CIDI-SF measures. Since there is no alternative measures for depression in HCC, the study instead just considered individuals diagnosed by CIDI-SF as the major depressive disorder (ignoring dysthymic disorder) to be the depressed, and conducted sensitivity analysis to test robustness of our main results.

RESULTS

The results of the descriptive analyses are reported in Table 1. There were 9504 observations in the study sample, among which 929 (6.9%) had both depression and pain, 546 (3.6%) had depression yet not pain, 3379 (35.7%) had pain yet not depression, and 4650 (53.8%) had neither depression nor pain.

About 6% of the sample used antidepressant medications, 4.1% used them effectively, and 1.2% used St John's Wort. The depressed patients (with/without pain) were disproportionately more likely to use antidepressants and use them effectively than others, and they were more likely to use St John's Wort too. The mean medication cost of the sample was $ 424, most of which were prescription drug costs ($ 373). Individuals with depression and pain had much higher medication costs and prescription drug costs than other groups. All these differences are statistically significant across the depression and pain subgroups at p=0.01.

The mean age of the sample was 47 years, and individuals with depression and pain and individuals with pain only were older than the other two groups. Just over half the sample was female and the depressed (with/without pain) were more likely to be female. Whites were less likely to be depressed compared to Blacks. The mean education

of the sample was 13.2 years and the depressed subjects with pain had the lowest education. Over half the sample was married and the depressed subjects (with/without pain) were disproportionately less likely to be married than others.

The mean mental health inventory (MHI-5) of the sample was 80.5 and the depressed (with/without pain) had much lower scores than others, among which the depressed with pain had the lowest score. The mean physical health score (PCS-12) of the sample was 46.7 and individuals with depression and pain (with/without pain) had the lowest mean score. The depressed with pain had the highest comorbid disease burden compared to the other groups.

Individuals with depression and pain had the worst personal and community enabling characteristics. They were more likely to be poor (36% of them fell into the lowest quartile of the sample), less likely to be covered by employer sponsored health insurance (42.0% of them had employer sponsored health insurance, compared to 54.8% of the sample) and self purchased health insurance (4.0% of them had self purchased health insurance, compared to 5.8% of the sample). They were more likely to be covered by Medicaid (8.6% of them were covered by Medicaid, compared to 3.2% of the sample), and more likely to have no insurance (19.1% had no insurance, compared to 12.2% of the sample). They were even slightly more likely to reside in counties with fewer supplies of psychiatric sub specialists.

Table 2 presents the results of the logistic regression of medication use and table 3 presents the results of the two part models of medication costs (total medication costs and prescription drug costs). After controlling for predisposing, enabling, and need

characteristics, depression and/or pain were significantly associated with these outcomes (all statistically significant at $p<0.01$ except for pain only on use of St John's Wort).

Individuals with depression and pain or depression only were more likely to use any antidepressants, effective antidepressants and St John's Wort than those with pain only and those with neither depression nor pain (all $p<0.01$). Individuals with depression and pain had lower odds ratio on use of any antidepressants, effective antidepressants and St John's Wort compared to those with depression only, although the post doc Wald test was only marginally significant on the use of effective antidepressants ($p=0.06$). Table 2a presents the results using another specification for depression and pain: depression, pain and interaction of depression pain. It shows that the presence of pain significantly decreased the probability of use of antidepressants and effective use of antidepressant ($p<0.01$) (Table 2a). Figure 2 shows the predicted values on the use of any antidepressants and effective antidepressants. It clearly indicates that the depressed individuals with pain comoridity were substantially less likely to take antidepressant medications (15.3% vs. 18.0%) and use them effectively compared to those with depression only (11.3% vs. 14.1%).

Compared to those with depression only, though individuals with depression and pain did not show statistically significant difference on the use of any medications (Table 3), their level of medication costs was much higher among the users. In contrast, those with depression and pain were more likely to use any prescription drugs, but their level of medication costs for prescription drugs was almost the same compared to those with depression only. In addition, individuals with depression and pain were more likely to use any medication and prescription drug and their level of total medication costs and

prescription drug costs were much higher, compared to those with pain only. Figure 3 shows the predicted annual medication costs and prescription drug costs among the depression and pain subgroups. It clearly indicates that individuals with depression and pain had the highest medication costs and prescription drug costs. The predicted annual medication costs for depressed patients with pain comorbidity was $692, which was more than twice the amount of those with neither depression nor pain ($329), and was substantially higher than those with depression only ($520) and those with pain only ($482). The predicted annual prescription drugs for the depressed patients with pain comorbidity was $498, which was almost twice the amount of those with neither depression and nor pain ($267), and was slightly higher than those with depression only ($446) but much higher than those with pain only ($373).

All of the predisposing characteristics: age, gender, race, education, number of other comorbidities and health conditions were significantly associated with medication use and medication costs. Increasing age, higher education, being female, more comorbid disease, and worse health conditions were associated with increased medication use and medication costs. Blacks and Hispanics and those who were married had reduced medication use and medication costs. Among the enabling characteristics, the availability of insurance or different insurance types was strongly associated with the use of any antidepressants, effective antidepressants and medication costs, while income level was strongly associated with the use of St John's Wort.[14] The supply characteristics were positively associated with the medication use and medication costs although they are not statistically significant in some models.

[14] Since St John's Wort is normally not covered by insurance, maybe that is why richer people buy more.

Appendix I and Appendix II reported results of logistic regression models of medication use outcomes and two-part models of medication costs, in which depression was defined to major depressive disorder as diagnosed by CIDI-SF. There are 4715 (54.3%) had neither depression nor pain, 481 (3.2%) had depression only, 3499 (36.7%) had pain only, and 809 (5.9%) had both depression and pain. It showed very similar results compared to our main analysis, and the differences on the use of any antidepressants and effective antidepressants between individuals with depression and pain and those with depression only become more statistically significant (P=0.06 and $p<0.05$ respectively) in such a specification.

DISCUSSION

The study compared the associations of depression and comorbid pain versus depression alone, pain alone or neither condition on medication behaviors and medication costs in a nationally representative cross-section of Americans. Depression with comorbid pain distracted the depressed patients from the effective use of antidepressants, and was associated with a heavier burden on total medication costs and prescription drug costs, after controlling for predisposing, and enabling characteristics. The simulated results showed that the magnitudes of the adverse effects of comorbid pain on medication behaviors and medication costs were substantial.

Despite advances in antidepressant treatment, including the emergence of selective serotonin reuptake inhibitors (SSRIs) and other newer agents, the treatment rates and treatment response remains suboptimal. The study estimated that the use of antidepressants and effective use of antidepressants were still very low in late 1990s. Not

only so, the presence of pain comorbidity was associated with less use of antidepressants and less effective use of antidepressants. This is consistent with a previous study, which stated that physical symptoms, especially pain, negatively impact adherence to medication for the depressed patients (Keeley R, Smith F, Miller J). One explanation is that patients often attribute their painful physical symptoms to an underlying medical illness and want treatment for their pain. Health care providers frequently accept the patient's request for pain treatment, while neglecting treatment of the patient's underlying depression. Studies showed that depressed individuals with comorbid pain are significantly less likely to seek mental health specialty care, but are more likely to use complementary and alternative treatments with questionable effectiveness than individuals with depression only (Fritzsche K, Sandholzer H, Brucks U et al 1999; Bao Y, Sturm R, Croghan TW 2004).

Our study could not distinguish reasons for antidepressants use. Thus, given antidepressants medication may be effective for pain conditions (specific or unspecific), it is possible that some of the antidepressants are used for treatment of pain without considering the depression condition. If this is the case, then the study might overestimate the likelihood that depressed patients with pain are intentionally taking antidepressants for their depression. Although it is possible that the presence of medical comorbidity might increase the use of antidepressants due to the exposure to the medical doctors (Alan Koike 2002), the study suggest that such a effect could not compensate for the distraction effects caused by pain comorbidity. Although the study could not distinguish the best treatment strategy for depression and pain comorbidity, either pain focused, depression focused or both, the results are still very informative for health care providers.

The treatment of patients with depression and pain comorbidity is an important challenge for primary care. The results of the study showed that depressed subjects with comorbid pain relative to those with depression alone had higher medication costs and prescription drugs costs, but had low rates of use of antidepressants and effective use of antidepressants. Therefore primary care physicians should not only consider pain as a predictor of depression, but also should consider pain as an underlying distraction factor for patients with depression symptoms to receive proper treatment. When physicians see a person with pain, they need to not only treat the pain but also assess whether or not the patient is also depressed, and if so treat the depression as well as the pain. Greater efforts should be made to consider pain as a possible underlying diagnosis for patients with depression and to consider antidepressants as a possible treatment for them.

Medication costs represent a substantial portion of total medical expenditures (Greenberg PE, Leong SA, Birnbaum HG, Robinson RL 2003). This study showed that the burden on total medication costs and prescription drug costs for the depressed subjects with pain was much heavier than for others with either one condition or no conditions. In addition, the study showed that the enabling factors or ability to pay have important implications for the medication use and medication costs, and higher income and better insurance coverage significantly increased medication treatment rates and costs. Since the individuals with depression and pain have poor labor market, income and insurance outcomes as suggested by Chapter 2, they may have worse access to care and poorer treatments, which will further worsen their health status. Therefore social protection programs should consider such populations as targets.

LIMITATIONS

There are two main limitations to this research: 1) the cross-sectional design of the analysis and corresponding constraints imposed by use of survey data, which limit the researcher to existing measures available within the dataset; and 2) the short measure of depression and pain. The cross-sectional study first faces the omitted variable bias problem. There may exist other unmeasured variables that were correlated with depression, pain and outcomes that were not included in the analyses. For example, we were unable to control for individual health beliefs or other social structures. Secondly, the cross-sectional study restricted us from exploring the temporal relationship between depression and/or pain and medication use.

The subjective measure of depression might bias our estimates in both directions as discussed in chapter 2. The study use a clinical screening instrument (the CIDI-SF), not a full diagnostic interview, to measure depression. However, this instrument has been subjected to extensive validity testing and is very specific but not very sensitive (Young AS, Klap R, Sherbourne CD, et al 2001; Murphy JM, Monson RR, Laird NM, et al, 2000). And the study could not distinguish patients with the chronic depression from those who were experiencing the first episode. In addition, the study used single-item questions to define pain and did not consider the nature or severity of the pain symptoms.

Table 3.1. Characteristics of HCC Wave 1 Cohort, by Depression and Pain Status

VARIABLES	Whole Sample	Neither Depression Nor Pain	Depression Only	Pain only	Depression and Pain
	(N=9504)‡	(N= 4,650)	(N= 546)	(N= 3379)	(N=929)
	(100%)‡	(53.8%)	(3.6%)	(35.7%)	(6.9%)
Outcome Variables					
Antidepressant Medications (%)***	6.0	2.2	19.0	6.4	26.7
Effective Antidepressant (%)***	4.1	1.6	15.2	4.0	18.5
St John's wort (%)***	1.2	0.9	3.9	0.8	3.5
Supplements good for depression (%)*	3.7	3.2	5.8	4.1	5.3
Mean medication costs ($) (SD)***	424 (1185)	269 (1310)	429 (949)	573 (896)	861 (1365)
Mean medication costs for prescription drugs ($) (SD)***	373 (1174)	231 (1303)	380 (940)	508 (881)	780 (1352)
Socio-Demographic Characteristics					
Mean Age (Years) (SD)***	47.0 (17.4)	43.0 (16.2)	36.5 (12.5)	54.2 (17.3)	46.6 (15.6)
Female (%) ***	52.5	46.3	63.2	58.4	65.5

Race (%) ***					
White	72.3	71.6	67.6	73.9	71.1
Black	12.0	12.5	16.7	9.8	16.7
Hispanic	9.7	10.0	11.7	9.3	7.9
Other	6.1	5.8	4.1	7.0	7.8
Mean Education Years (Years) (SD)***	13.2 (2.6)	13.5 (2.5)	13.3 (2.4)	12.9 (2.7)	12.2 (2.9)
Married (%) ***	59.1	61.5	39.6	59.6	47.7
Health Characteristics					
Mean Mental Health Inventory (SD)***	80.5 (17.2)	85.3 (12.3)	63.8 (21.5)	80.3 (15.2)	52.6 (23.5)
Mean Physical Health Score (SD)***	46.7 (6.2)	48.8 (4.6)	46.9 (6.0)	44.6 (6.6)	41.1 (7.9)
Mean Comorbidity Count (SD) [1] ***	0.7 (1.1)	0.4 (0.7)	0.7 (1.1)	1.0 (1.2)	1.7 (1.6)
Personal Enabling Characteristics					
Total Family Income (%) ***					
<$19,000	24.8	19.3	26.4	29.0	36.0
$19,000-38,000	25.1	24.7	22.9	25.5	27.0
$38,000-65,000	25.0	26.7	24.5	23.9	21.0
>$65,000	25.1	29.4	26.2	21.5	16.0

Health Insurance (%) ***					
Employer Sponsored Health Insurance	54.8	62.4	57.3	45.7	42.0
Self Purchased Health Insurance	5.8	6.4	7.3	5.2	4.0
Medicare	19.4	12.3	5.3	31.1	20.6
Medicaid	3.2	2.1	7.4	3.5	8.6
Military Health Insurance	1.6	1.5	0.8	1.9	1.3
Other Insurance	1.8	1.8	1.7	1.7	2.9
Insurance Missing	1.2	1.2	0.9	1.0	1.6
No Insurance	12.2	12.3	19.4	9.9	19.1
Supply Characteristics					
Psychiatric sub specialists per 10000 [2] ***					
<0.5	32.7	31.5	27.1	34.7	34.6
0.5-1	33.1	33.4	35.9	32.1	33.5
>1	34.2	35.0	37.0	33.3	31.2

Note: we report mean and standard errors (in parenthesis) for continuous variables, and percentage for categorical variables, which are weighted to be nationally representative

*** p<0.01, **p<0.05 *p<0.1

‡ Number of observations and corresponding weighted percentage.

[1] Based on 9320 observations (184 missing chronic health conditions)

[2] Psychiatric sub specialists per 10000 in resident's County

Table 3.2. Logistic Regression results for Dichotomous variables

Variables	Use of Any Antidepressants Odds Ratio (P-value)	Use of Effective Antidepressants Odds Ratio (P-value)	Use of Any St. John's Wort Odds Ratio (P-value)
Depression and pain	4.46[2]	4.28[12]	2.42[2]
	(0.00)	(0.00)	(0.00)
Depression only	5.48[3]	5.64[3]	2.59[3]
	(0.00)	(0.00)	(0.00)
Pain only	1.92	1.77	1.13
	(0.00)	(0.00)	(0.58)
Age 25 to 34	1.86	1.51	2.29
	(0.00)	(0.08)	(0.06)
Age 35 to 44	3.01	2.50	2.73
	(0.00)	(0.00)	(0.02)
Age 45 to 54	2.67	2.49	3.74
	(0.00)	(0.00)	(0.00)
Age 55 to 64	2.60	2.14	2.02
	(0.00)	(0.00)	(0.14)
Age 65 plus	1.60	1.27	1.07
	(0.06)	(0.38)	(0.93)
Female	1.64	1.57	1.75
	(0.00)	(0.00)	(0.00)
Black	0.39	0.34	0.20
	(0.00)	(0.00)	(0.00)
Hispanic	0.52	0.50	0.39
	(0.00)	(0.00)	(0.07)
Other Races	0.65	0.63	1.22
	(0.02)	(0.03)	(0.54)
High School	1.49	1.45	1.74
	(0.00)	(0.02)	(0.26)
Some College	1.43	1.40	3.35
	(0.01)	(0.04)	(0.01)
College Above	1.70	1.67	2.02
	(0.00)	(0.00)	(0.16)
Married	0.93	0.87	0.66
	(0.42)	(0.15)	(0.02)
1 Chronic disease	1.16	1.25	1.00
	(0.12)	(0.03)	(0.99)
2 Chronic disease	1.52	1.48	1.26
	(0.00)	(0.00)	(0.40)
3 Chronic disease and above	1.57	1.45	0.61
	(0.00)	(0.04)	(0.44)
Chronic disease missing	1.25	1.31	1.41
	(0.35)	(0.31)	(0.53)
PCS 12	0.97	0.97	1.02
	(0.00)	(0.00)	(0.16)
MHI 5	0.98	0.98	0.98
	(0.00)	(0.00)	(0.00)

Income quartile 2	0.98	0.95	1.89
	(0.85)	(0.71)	(0.05)
Income quartile 3	0.97	0.97	3.04
	(0.83)	(0.81)	(0.00)
Income quartile 4	1.15	1.16	2.74
	(0.29)	(0.34)	(0.00)
Employer Sponsored Health	2.39	2.67	0.99
Insurance	(0.00)	(0.00)	(0.98)
Self Purchased Health Insurance	1.59	1.67	1.96
	(0.04)	(0.05)	(0.06)
Medicare	2.63	2.67	0.58
	(0.00)	(0.00)	(0.37)
Medicaid	1.72	1.88	0.52
	(0.02)	(0.02)	(0.39)
Military Health Insurance	2.22	2.52	0.46
	(0.01)	(0.01)	(0.45)
Other insurance	3.28	3.49	0.71
	(0.00)	(0.00)	(0.65)
Main Insurance Missing	2.33	2.50	0.57
	(0.02)	(0.03)	(0.60)
Psychiatric sub specialists per	1.14	1.18	1.77
10000 tertile 2	(0.16)	(0.13)	(0.01)
Psychiatric sub specialists per	1.08	1.18	1.78
10000 tertile 3	(0.44)	(0.13)	(0.01)

* "No Depression nor Pain" is the reference group for all analyses. Estimates of odds ratio and corresponding p-values (in the brackets) are reported.
[1] Difference between depression with pain and depression only is statistically significant at p=0.06.
[2] Difference between depression with pain and pain only is statistically significant at p<0.01.
[3] Difference between depression only and pain only is statistically significant at p<0.01.

Table 3.2a. Logistic Regression results for Dichotomous variables (Using interaction Term of Depression and Pain)

Variables	Use of Any Antidepressants Odds Ratio (P-value)	Use of Effective Antidepressants Odds Ratio (P-value)	Use of Any St. John's Wort Odds Ratio (P-value)
Depression	5.48	5.64	2.59
	(0.00)	(0.00)	(0.00)
Pain	1.92	1.77	1.13
	(0.00)	(0.00)	(0.58)
Interaction of	0.42	0.43	0.83
Depression and Pain	(0.00)	(0.00)	(0.59)

Table 3.3. Two-Part Model Results for Total Medication Costs and Prescription Drug Costs

Variables	Part I: Probability Any Medication Odds Ratio (P-value)	Part II: Log Medication costs Coefficient (P-value)	Part I: Probability Any prescription Drugs Odds Ratio (P-value)	Part II: Log Prescription Drug costs Coefficient (P-value)
Depression and pain	2.02[2]	0.55[12]	2.17[12]	0.30[2]
	(0.00)	(0.00)	(0.00)	(0.00)
Depression only	1.64	0.31	1.63	0.29
	(0.00)	(0.00)	(0.00)	(0.00)
Pain only	1.51	0.26	1.49	0.15
	(0.00)	(0.00)	(0.00)	(0.00)
Age 25 to 34	1.38	0.23	1.34	0.16
	(0.00)	(0.00)	(0.00)	(0.06)
Age 35 to 44	1.87	0.49	1.49	0.44
	(0.00)	(0.00)	(0.00)	(0.00)
Age 45 to 54	2.64	0.86	2.36	0.56
	(0.00)	(0.00)	(0.00)	(0.00)
Age 55 to 64	4.73	1.09	4.29	0.59
	(0.00)	(0.00)	(0.00)	(0.00)
Age 65 plus	4.90	0.92	3.96	0.48
	(0.00)	(0.00)	(0.00)	(0.00)
Female	1.98	0.18	1.98	-0.09
	(0.00)	(0.00)	(0.00)	(0.00)
Black	0.65	-0.19	0.75	-0.17
	(0.00)	(0.00)	(0.00)	(0.00)
Hispanic	0.63	-0.29	0.60	-0.19
	(0.00)	(0.00)	(0.00)	(0.02)
Other Races	0.87	-0.05	0.86	0.04
	(0.17)	(0.46)	(0.14)	(0.51)
High School	1.35	0.11	1.07	0.12
	(0.00)	(0.08)	(0.42)	(0.03)
Some College	1.63	0.12	1.08	0.08
	(0.00)	(0.06)	(0.43)	(0.16)
College Above	2.03	0.17	1.36	0.11
	(0.00)	(0.01)	(0.00)	(0.07)
Married	0.94	0.04	1.07	0.01
	(0.30)	(0.34)	(0.23)	(0.77)
1 Chronic disease	1.91	0.45	2.46	0.15
	(0.00)	(0.00)	(0.00)	(0.00)
2 Chronic disease	2.38	0.79	3.71	0.40
	(0.00)	(0.00)	(0.00)	(0.00)
3 Chronic disease and above	3.21	1.00	4.19	0.64
	(0.00)	(0.00)	(0.00)	(0.00)
Chronic disease missing	1.31	0.44	1.76	0.33
	(0.13)	(0.00)	(0.00)	(0.00)
PCS 12	0.99	-0.03	0.97	-0.03
	(0.03)	(0.00)	(0.00)	(0.00)
MHI 5	0.997	-0.003	0.996	-0.003

	(0.08)	(0.00)	(0.02)	(0.00)
Income quartile 2	0.97	0.07	0.94	0.11
	(0.65)	(0.17)	(0.40)	(0.02)
Income quartile 3	1.25	0.003	1.06	0.01
	(0.00)	(0.95)	(0.43)	(0.85)
Income quartile 4	1.48	0.11	1.33	-0.02
	(0.00)	(0.06)	(0.00)	(0.65)
Employer Sponsored Health	1.42	0.42	2.05	0.32
Insurance	(0.00)	(0.00)	(0.00)	(0.00)
Self Purchased Health	1.52	0.27	1.57	0.22
Insurance	(0.00)	(0.00)	(0.00)	(0.02)
Medicare	1.69	0.67	2.55	0.49
	(0.00)	(0.00)	(0.00)	(0.00)
Medicaid	1.26	0.43	1.76	0.29
	(0.10)	(0.00)	(0.00)	(0.00)
Military Health Insurance	1.32	0.44	1.71	0.42
	(0.14)	(0.00)	(0.00)	(0.00)
Other insurance	1.58	0.47	2.13	0.37
	(0.02)	(0.00)	(0.00)	(0.00)
Main Insurance Missing	1.25	0.32	1.86	0.23
	(0.31)	(0.06)	(0.00)	(0.15)
Psychiatric sub specialists	0.96	0.06	0.94	0.07
Per 10000 Tertile 2	(0.48)	(0.18)	(0.28)	(0.09)
Psychiatric sub specialists	1.03	0.05	1.04	0.02
Per 10000 tertile 3	(0.61)	(0.21)	(0.52)	(0.61)

* "No Depression nor Pain" is the reference group for all analyses. Estimates of odds ratio and corresponding p-values

[1] Difference between depression with pain and depression only is statistically significant at $p<0.02$.

[2] Difference between depression with pain and pain only is statistically significant at $p<0.01$.

[3] Difference between depression only and pain only is statistically significant at $p<0.01$.

Figure 3.2. Predicted Values for Use of Antidepressants and Effective Antidepressants

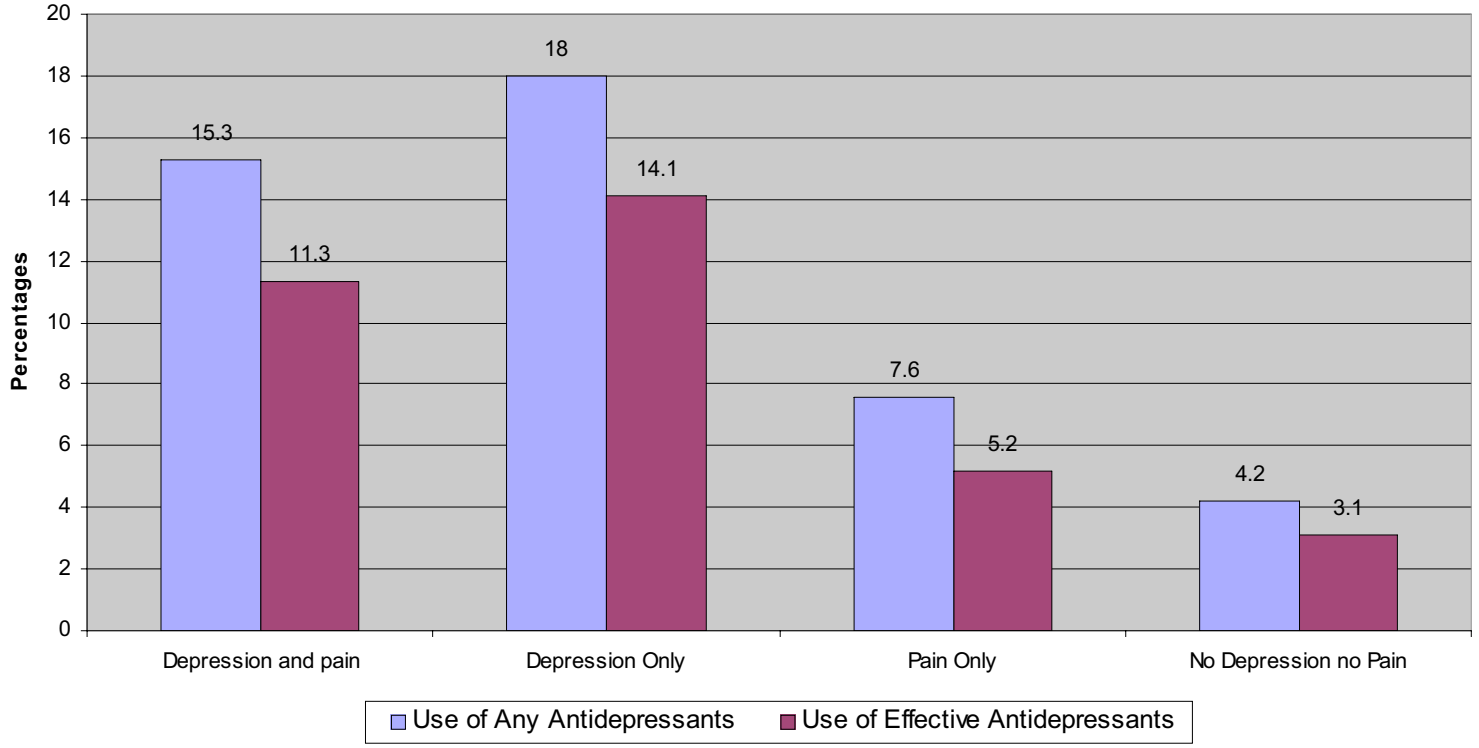
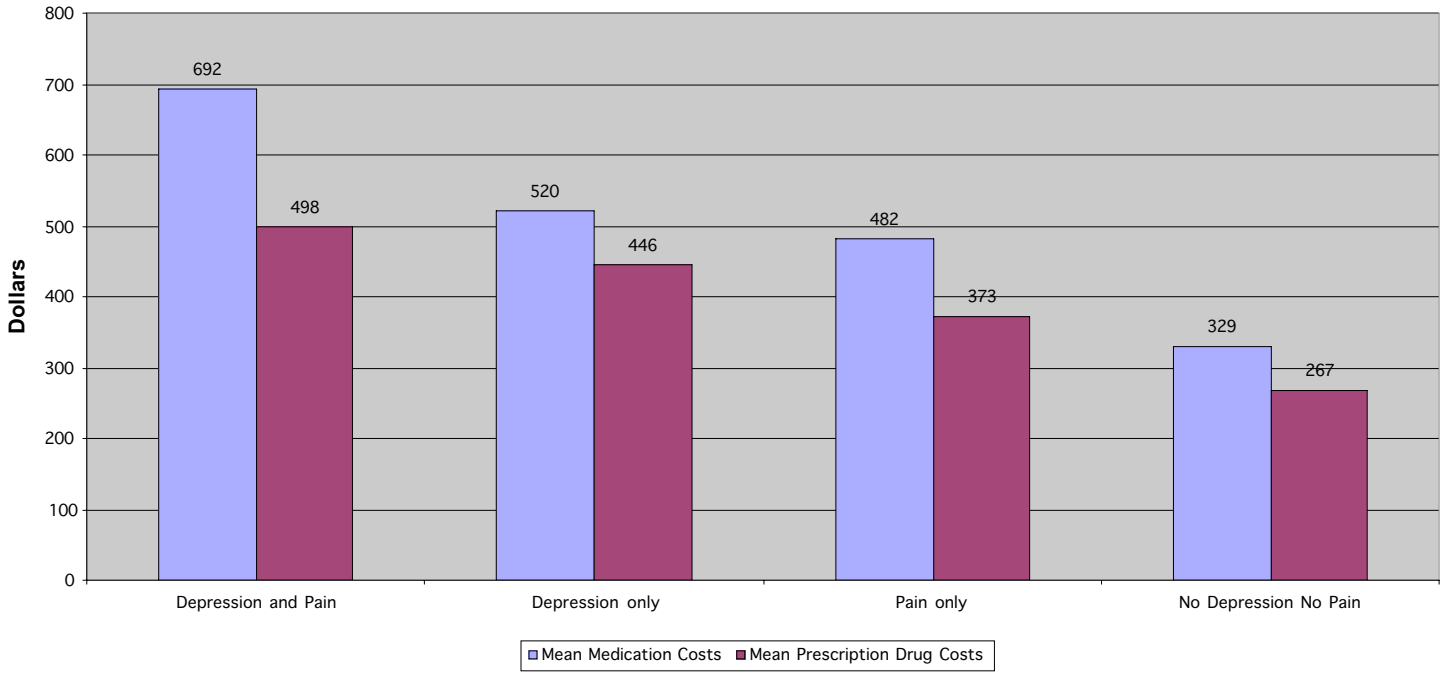


Figure 3.3. Predicted Mean Medication Costs and Mean Prescription Drug Costs



Appendix 1: Logistic Regression results for Dichotomous variables

Variables	Use of Any Antidepressants	Use of Effective Antidepressants	Use of Any St. John's Wort
Depression and pain	4.03[12]	3.82[12]	2.30[2]
	(0.00)	(0.00)	(0.00)
Depression only	5.31[3]	5.38[3]	2.06[3]
	(0.00)	(0.00)	(0.01)
Pain only	1.90	1.74	1.05
	(0.00)	(0.00)	(0.81)
Age 25 to 34	1.82	1.48	2.25
	(0.00)	(0.10)	(0.06)
Age 35 to 44	2.97	2.47	2.70
	(0.00)	(0.00)	(0.02)
Age 45 to 54	2.65	2.48	3.72
	(0.00)	(0.00)	(0.00)
Age 55 to 64	2.54	2.09	1.99
	(0.00)	(0.00)	(0.15)
Age 65 plus	1.53	1.22	1.06
	(0.09)	(0.48)	(0.93)
Female	1.64	1.56	1.75
	(0.00)	(0.00)	(0.00)
Black	0.40	0.35	0.20
	(0.00)	(0.00)	(0.00)
Hispanic	0.54	0.52	0.40
	(0.00)	(0.00)	(0.07)
Other Races	0.65	0.63	1.22
	(0.02)	(0.03)	(0.55)
High School	1.47	1.42	1.71
	(0.00)	(0.02)	(0.27)
Some College	1.41	1.38	3.32
	(0.02)	(0.05)	(0.01)
College Above	1.65	1.62	1.99
	(0.00)	(0.00)	(0.17)
Married	0.93	0.87	0.65
	(0.41)	(0.15)	(0.02)
1 Chronic disease	1.15	1.25	0.99
	(0.14)	(0.04)	(0.97)
2 Chronic disease	1.53	1.50	1.24
	(0.00)	(0.00)	(0.43)
3 Chronic disease and above	1.57	1.45	0.59
	(0.00)	(0.05)	(0.41)
Chronic disease missing	1.22	1.28	1.39
	(0.40)	(0.35)	(0.55)
PCS 12	0.97	0.97	1.02
	(0.00)	(0.00)	(0.17)
MHI 5	0.98	0.98	0.98
	(0.00)	(0.00)	(0.00)
Income quartile 2	0.96	0.93	1.86
	(0.71)	(0.58)	(0.06)

Income quartile 3	0.95	0.94	3.02
	(0.69)	(0.67)	(0.00)
Income quartile 4	1.13	1.13	2.70
	(0.37)	(0.43)	(0.00)
	2.41	2.70	0.99
Employer Sponsored Health Insurance	(0.00)	(0.00)	(0.98)
Self Purchased Health Insurance	1.60	1.69	1.97
	(0.04)	(0.05)	(0.06)
Medicare	2.67	2.71	0.57
	(0.00)	(0.00)	(0.36)
Medicaid	1.75	1.91	0.51
	(0.00)	(0.02)	(0.39)
Military Health Insurance	2.31	2.61	0.46
	(0.00)	(0.00)	(0.45)
Other insurance	3.42	3.66	0.72
	(0.00)	(0.00)	(0.67)
Main Insurance Missing	2.48	2.70	0.57
	(0.00)	(0.02)	(0.60)
Psychiatric sub specialists per 10000	1.14	1.18	1.77
tertile 2	(0.16)	(0.13)	(0.01)
Psychiatric sub specialists per 10000	1.07	1.17	1.78
tertile 3	(0.50)	(0.15)	(0.01)

There are 4715 (54.3%) had neither depression nor pain, 481 (3.2%) had depression only, 3499 (36.7%) had pain only, and 809 (5.9%) had both depression and pain.

* "No Depression nor Pain" is the reference group for all analyses. Estimates of odds ratio and corresponding p-values (in the brackets) are reported.

[1] Difference between depression with pain and depression only is statistically significant at $p<0.06$.

[2] Difference between depression with pain and pain only is statistically significant at $p<0.01$.

[3] Difference between depression only and pain only is statistically significant at $p<0.02$.

Appendix 2: Two-Part Model Results for Total Medication Costs and Prescription Drug Costs

Variables	Any Use of Medication Odds Ratio (P-value)	Level of Medication costs Coefficient (P-value)	Any Use of prescription Drugs Odds Ratio (P-value)	Level of prescription drug costs Coefficient (P-value)
Depression and Pain	2.24[2]	0.55[1 2]	2.36[1 2]	0.32[2]
	(0.00)	(0.00)	(0.00)	(0.00)
Depression Only	1.73	0.34	1.76	0.32 [3]
	(0.00)	(0.00)	(0.00)	(0.00)
Pain Only	1.49	0.26	1.48	0.15
	(0.00)	(0.00)	(0.00)	(0.00)
Age 25 to 34	1.38	0.23	1.33	0.16
	(0.00)	(0.00)	(0.00)	(0.00)
Age 35 to 44	1.87	0.49	1.49	0.44
	(0.00)	(0.00)	(0.00)	(0.00)
Age 45 to 54	2.65	0.87	2.37	0.56
	(0.00)	(0.00)	(0.00)	(0.00)
Age 55 to 64	4.74	1.09	4.31	0.60
	(0.00)	(0.00)	(0.00)	(0.00)
Age 65 plus	4.93	0.92	3.98	0.48
	(0.00)	(0.00)	(0.00)	(0.00)
Female	1.98	0.18	1.98	-0.09
	(0.00)	(0.00)	(0.00)	(0.00)
Black	0.66	-0.19	0.76	-0.16
	(0.00)	(0.00)	(0.00)	(0.00)
Hispanic	0.64	-0.29	0.60	-0.19
	(0.00)	(0.00)	(0.00)	(0.02)
Other Races	0.87	-0.05	0.86	0.04
	(0.18)	(0.46)	(0.15)	(0.50)
High School	1.34	0.10	1.06	0.12
	(0.00)	(0.09)	(0.47)	(0.03)
Some College	1.62	0.12	1.07	0.08
	(0.00)	(0.07)	(0.49)	(0.17)
College Above	2.02	0.16	1.35	0.10
	(0.00)	(0.02)	(0.00)	(0.08)
Married	0.95	0.04	1.07	0.01
	(0.32)	(0.34)	(0.20)	(0.79)
1 Chronic disease	1.91	0.45	2.46	0.15
	(0.00)	(0.00)	(0.00)	(0.00)
2 Chronic disease	2.38	0.79	3.71	0.41
	(0.00)	(0.00)	(0.00)	(0.00)
3 Chronic disease and above	3.18	1.00	4.17	0.64
	(0.00)	(0.00)	(0.00)	(0.00)
Chronic disease missing	1.31	0.44	1.75	0.33
	(0.13)	(0.00)	(0.00)	(0.00)
PCS 12	0.99	-0.03	0.97	-0.03
	(0.04)	(0.00)	(0.00)	(0.00)
MHI 5	1.00	0.00	0.997	0.00
	(0.09)	(0.00)	(0.02)	(0.00)

Income quartile 2	0.96	0.07	0.94	0.11
	(0.62)	(0.17)	(0.37)	(0.02)
Income quartile 3	1.24	0.00	1.06	0.01
	(0.00)	(0.98)	(0.46)	(0.86)
Income quartile 4	1.47	0.11	1.33	-0.03
	(0.00)	(0.06)	(0.00)	(0.63)
Employer Sponsored Health	1.42	0.42	2.05	0.32
Insurance	(0.00)	(0.00)	(0.00)	(0.00)
Self Purchased Health	1.52	0.28	1.57	0.22
Insurance	(0.00)	(0.00)	(0.00)	(0.02)
Medicare	1.69	0.68	2.56	0.49
	(0.00)	(0.00)	(0.00)	(0.00)
Medicaid	1.28	0.44	1.79	0.30
	(0.08)	(0.00)	(0.00)	(0.00)
Military Health Insurance	1.33	0.45	1.73	0.42
	(0.13)	(0.00)	(0.00)	(0.00)
Other insurance	1.59	0.48	2.16	0.37
	(0.01)	(0.00)	(0.00)	(0.00)
Main Insurance Missing	1.27	0.32	1.89	0.22
	(0.28)	(0.06)	(0.00)	(0.15)
Psychiatric sub specialists	0.96	0.06	0.94	0.07
Per 10000 Tertile 2	(0.47)	(0.17)	(0.28)	(0.09)
Psychiatric sub specialists	1.03	0.05	1.04	0.02
Per 10000 tertile 3	(0.64)	(0.22)	(0.55)	(0.63)

There are 4715 (54.3%) had neither depression nor pain, 481 (3.2%) had depression only, 3499 (36.7%) had pain only, and 809 (5.9%) had both depression and pain.

* "No Depression nor Pain" is the reference group for all analyses. Estimates of odds ratio and corresponding p-values

[1] Difference between depression with pain and depression only is statistically significant at $p<0.02$.

[2] Difference between depression with pain and pain only is statistically significant at $p<0.01$.

[3] Difference between depression only and pain only is statistically significant at $p<0.01$.

CHAPTER 4. EFFECT OF DEPRESSION AND COMORBID PAIN ON RETIREMENT: GENDER DIFFERENCES

INTRODUCTION

Depression is common in older adults and often coexists with comorbid pain symptoms, which may complicate the recognition and treatment of depression (Blazer D, Hughes DC, George LK, 1987; Montano CB, 1999; Clark JD, 2002; Beekman ATF ea al., 1999; Blazer D, 1994; Copeland JRM et al., 1992; Gurland BJ, 1992; Penninx BW, Geerlings SW, et al., 1999; Penninx BW, Leveille S, et al., 1999; Linda A, et al., 2004). Studies have shown that individuals with depression and pain have worse functional limitations, work functioning, higher health-care utilization, and higher health care costs, compared to those with either condition alone (Lamb SE, Guralnik JM, Buchner DM, et al 2000; Bertrus PA, Elmore Sk, Hamilton PA 1995; Engel CC, Von Korff M, Katon WJ, 1996; Katz and Yelin, 1994; Greenberg PE, Leong SA, Birnbaum HG, Robinson RL 2003; Emptage NE, Sturm R, Robinson RL 2005). However, very few studies specially addressed the effect of depression and pain on retirement and examined the relative effects of depression with pain to depression.

There is an extensive literature on the relationship between chronic medical problems and retirement, but the effects of psychiatric disorders on labor market among the near-elderly or elderly have not yet been studied. One reason for the absence of economic research on depression and retirement is that depression is commonly perceived to be an illness that affects younger individuals. Studies by economists have

focused on indicators employment (Hamilton, Merrigan, and Dufresne, 1997; Alexandre & French, 2001; Marcotte et al., 2000; Ettner, Frank, and Kessler 1997; Mullahy and Sindelar, 1990; Mitchell and Anderson 1989; Ruhm, 1992), rather than on decisions to leave the labor force. Another reason is the lack of data. Most studies on depression and pain are based on clinical data, which usually do not have good measures of labor market outcomes. It is unusual to have data that simultaneously includes depression, pain and retirement outcomes.

The study contributes to the growing literatures in several respects. Firstly, it uses data from the Health and Retirement Study (HRS), a national survey of near-elderly or elderly Americans, which included simultaneously measures of depression, pain and retirement outcomes. Secondly, the study investigates the impact of depression and pain on the retirement behavior of older adult Americans from a longitudinal perspective. Longitudinal data do not automatically solve the reverse causality issue[15], but repeated observations on the same individual help us to understand the temporal patterns between retirement, depression and pain. Thirdly, the study compared the effect of depression with pain and "pure" depression on retirement. By considering depression and pain simultaneously, the study may shed new light on previous research relating to the economic burden of depression. The economic burden of depression might be misinterpreted for the elderly Americans if the effect of depression mainly comes from the depressed with comorbid pain but not from those with depression alone.

Finally, previous studies have often shown gender to be an important determinant of prevalence and outcomes of depression. Though it was demonstrated that males and

[15] Though economists speculate that depression results in early retirement, psychologists believe that retirement may result in depression (Szinovacz ME and Davey A, 2004; Kim JE and Moen P, 2002). There exists reverse causality problem when study the relationship between depression and retirement.

females differed considerably in their mental illnesses and labor market outcomes (for example Ettner et al., 1997; Alexandre PK et al, 2004, Gresenz C.R. and Sturm R, 2004), the relationship between depression, pain and labor market behavior for both males and females has not been studied. This study follows the long tradition of labor economists to separately analyze retirement behavior for older men and older women, and treat gender differences as a central element of the analysis.

LITERATURE REVIEW

There is no research in the labor and health economics literature that studied the effect of depression and pain on retirement according to our current knowledge. However many studies have been conducted on the relationship between health (mainly physical health) and retirement, and on the relationship between mental illness and employment outcomes of younger individuals.

Poor Physical Health and Retirement

Economists and other social scientists have long treated poor health as an important factor that determines the timing of retirement. On the one hand, poorer health has a negative impact on productivity and reduces earnings, and increases the demand for non-work time to care for one's health, which increases the relative utility of leisure and causes earlier retirement. On the other hand, poorer health increases the marginal utility of consumption relative to leisure, which causes later retirement. Health may also affect individuals' remaining time horizon, in that some conditions alter life expectancy and

hence years to choose between retirement and work (Grossman, 1972). Though theoretically the predicted effects of poor health on the retirement age are ambiguous (Sammartino, 1987), many empirical studies suggest that poor health leads to earlier retirement because its effects on preferences and productivity dominate (Loprest, Rupp, and Sandell, 1995; Bound, 1991; Sickles and Taubman, 1986, Anderson and Burkhauser, 1985; Bazzoli, 1985).

In all these studies, researchers tried to address issues on the measurement of health and endogeneity of health to obtain unbiased estimates, however most of their studies were focused on the effect of physical illness on retirement. Such studies are suggestive, but do not fully predict the retirement impact of depression and pain in older workers.

Mental illness and employment

Since the time of the Great Depression, social scientists have been studying the relationship between employment status and mental health (Eisenberg & Lazarsfeld, 1938). While psychologists are more interested in the detrimental psychological effects of unemployment (Dooley et al., 2000; Theodossiou, 1998; Fergusson et al., 2001; Montgomery et al., 1999), Economists want to know the adverse effects of mental illness on employment outcomes.

Due to the lack of nationally representative data, earlier studies of mental illnesses and labor market outcomes relied on utilization-based measures of psychological disorders (Bartel and Taubman, 1979, 1986; Benham and Benham, 1982), or community-based samples (Mullahy and Sindelar, 1990; Mitchell and Anderson 1989). In the 1990s,

NIMH funded the National Comorbidity Survey (NCS) and studies based on the NCS data have provided better evidence on the relationship between mental illness and employment. Using instrumental variables, Ettner et al. (1997) found strong evidence that any mental illness reduces the likelihood that a woman is employed by 11%, and the effects for men are somewhat smaller though still large. Marcotte et al (2001) studied the effect of affective disorder on labor market outcomes and found large earnings and employment losses, particularly for depression among women. In addition, using other datasets, some studies used instrumental variables to measure causal directions from mental illness to employment (Hamilton, Merrigan, and Dufresne, 1997; Alexandre & French, 2001).

Previous studies examined the relationship between mental illness and employment outcomes and found evidence that mental illness was associated with worse employment and earning losses. However very few studies concentrated on depression, and they did not address the effects of depression on retirement in older workers either.

DATA AND VARIABLES

The study uses data from Health and Retirement Study (HRS), a longitudinal survey that face-to-face interviewed individuals who were 51-61 years of age in 1992 (http://hrsonline.isr.umich.edu/) and then conducted follow-up interviews by telephone every second year, with proxy interviews after death. Since depression was measured consistently starting in 1994, we focus on data from 1994 to 2002 (wave 2 (1994), wave 3 (1996), wave 4 (1998), wave 5 (2000) and wave 6 (2002)).

For a longitudinal analysis that explores the differential effects of depression and pain on transition from employment to retirement, we included persons who were employed (either full-time or part-time) between wave 2 and wave 6 to achieve a sufficient number of cases for our complex analyses. Thus, we include individuals who were employed either between waves 2 and 3 or between waves 3 and 4 or between waves 4 and 5 or between waves 5 and 6. In each case, data from the earlier wave serve as baseline and data from the later wave serve as the outcome variable (retirement or not). For example, for workers between wave 2 and wave 3, wave 2 was used for baseline and wave 3 for outcome; for workers between wave 3 and wave 4, wave 3 was used for baseline and wave 4 for outcomeWe further restricted the study to primary respondents who reported their depression and pain status in the baseline (1994, or 1996, or 1998, or 2000) and reported their retirement outcome in the later wave; dropping those with missing values. The final study sample includes 15279 observations, among which 7,599 are female and 7,680 are male.

The dependent variable in this study is whether or not older American workers fully retired over the course of two years. We define the fully retired as those who reported that they are retired, and that they are not working or not looking for work in the later wave. Any other kind of labor market outcomes are defined as not fully retired, including employed, unemployed, partly retired, disabled, and not in the labor force for other reasons.

The key independent variables are depression and pain status in the baseline. Since 1994, the measure of symptoms of depression by HRS consists of a subset of 8 items from the Center for Epidemiologic Studies Depression Scales (CES-D), whose

original scales include 20 items (Radloff, 1977). These 8 items are reporting feeling depressed, feeling as though everything was an effort, restless sleep, inability to "get going", feeling lonely, feeling sad, enjoying life (reverse-coded), and feeling happy (reverse-coded). Scores on each item were added to form a composite scale ranging from zero to eight. We turned this composite scale into a dichotomous variable, using 4 items or higher as a cutoff point to indicate "significant" depressive symptoms and named the category "depression" for simplicity. One study suggests that the cutoff point of 4 or more symptoms in the 8 item CES-D scales is approximately equivalent to the traditional cutoff point of 16 or higher in the full 20-items CES-D score (Steffick DE, 2000). To measure pain status, HRS asked respondents whether or not they are often troubled with pain (yes/no). For each individual who reported that they are often troubled with pain (yes), we treated them as having pain. We therefore identify four exclusive groups characterized by the presence of depression and/or pain: individuals with depression and pain, individuals with depression only (no pain), individuals with pain only (no depression), and individuals with neither condition. In our study, we treat those with neither condition as the reference group and use three dummy variables to indicate each of the other three groups.

METHODS

We used five sets of multivariate logistic regression models subset by gender to estimate the effect of depression and pain on the transition from employment to full retirement. In all of these models, explanatory variables are measured at baseline.

In the first model, the probability of a retirement transition can be written:

$$\Pr(\mathrm{RT}_{i,t+2} \mid \mathrm{EM}_{i,t}) = \alpha + \gamma_1 D_{i,t} + \gamma_2 P_{i,t} + \gamma_3 DP_{i,t} + \beta_1 X1_{i,t} + \varepsilon_{i,t} \quad ,$$

where $\mathrm{EM}_{i,t}$ is employment at baseline, $\mathrm{RT}_{i,t+2}$ is retirement status in the later wave. $D_{i,t}$ represents "pure" depression, $p_{i,t}$ represents "pure" pain, and $DP_{i,t}$ represents depression with pain at baseline. $X1_{i,t}$ is a vector of socio-demographics and physical health conditions. The socio-demographic conditions controlled for included age (specified as nonlinear by including a quadratic term, centered at age 60), gender, ethnicity (White, Black, Hispanic and other races, taking White as a reference group), marital status (married or not), education (less than high school, GED, high school graduate, some college, and college and above, taking less than high school as reference group), and census region (northeast, Midwest, west and south, taking west as reference group). Physical health was measured by individuals' response to the questions about the presence or absence of the following seven physical health conditions: high blood pressure/hypertension, diabetes, cancer, lung disease, heart problems, stroke and arthritis/rheumatism, each of which is treated as a dummy variable.

Our second model was constructed according to economic considerations relating to important factors influencing retirement behavior, such as the opportunity cost of individual's time and wealth constraints. We use current earnings as a proxy for the opportunity cost of time ($/100,000) and annual family income ($/100,000) as a proxy for wealth constraints. We also control for the availability of private insurance (yes/no). The probability of a retirement transition can be written:

$$\Pr(\mathrm{RT}_{i,t+2} \mid \mathrm{EM}_{i,t}) = \alpha + \gamma_1 D_{i,t} + \gamma_2 P_{i,t} + \gamma_3 DP_{i,t} + \beta_2 X1_{i,t} + \beta_1 X2_{i,t} + \varepsilon_{i,t}$$

where $\beta_2 X2_{i,t}$ represents these economic variables.

In the third model, we further control for job history: current working status (working full-time versus part-time) and current job occupation. A full-time worker might have higher earnings, more job satisfactions or additional incentives to work than a part-time worker, and thus be less likely to retire. Different job characteristics will influence retirement decisions because workers retire from unpleasant, difficult jobs at a different rate than from pleasant, easy jobs (Hurd M). HRS codes occupations into 17 categories (managerial specialty, professional specialty, sales and so on) and we create dummy variables for each category and take the professional specialty as our reference group.

The probability of a retirement transition can be written:

$$\Pr(\mathrm{RT}_{i,t+2} \mid \mathrm{EM}_{i,t}) = \alpha + \gamma_1 D_{i,t} + \gamma_2 P_{i,t} + \gamma_3 DP_{i,t} + \beta_1 X1_{i,t} + \beta_2 X2_{i,t} + \beta_3 X3_{i,t} + \varepsilon_{i,t}$$

where $\beta_3 X3_{i,t}$ represents these job characteristics.

The study pooled workers between wave 2 and wave 6 to jointly study their retirement transition, and in all the previous three models we assume the probability of retirement is the same across all years, ceteris paribus. However, this may not be the case since retirement decisions may be influenced by economic fluctuations or other kinds of time trends. Thus, we control for the year fixed effects in the fourth model and create dummy variables for transitions in 1996-1998, 1998-2000, 2000-2002, taking 1994-1996 as references, which allows the intercept to be different across years. The probability of a retirement transition can be written:

$$\begin{aligned}\Pr(\mathrm{RT}_{i,t+2} \mid \mathrm{EM}_{i,t}) = {} & \alpha + \gamma_1 D_{i,t} + \gamma_2 P_{i,t} + \gamma_3 DP_{i,t} + \beta_1 X1_{i,t} + \beta_2 X2_{i,t} + \beta_3 X3_{i,t} \\ & + \lambda_{1996} + \lambda_{1998} + \lambda_{2000} + \varepsilon_{i,t}\end{aligned}$$

where λ_{1996} is dummy for the fixed effect of 1996-1998, λ_{1998} is dummy for the fixed effect of 1998-2000, and λ_{2000} is dummy for the fix effect of 2000-2002.

Finally since our analysis is based on panel data, we need to consider that the individual heterogeneity in the error term might distort the estimation of the coefficients and standard errors. In our fifth model we use random effects estimators to adjust for individual heterogeneity. The probability of a retirement transition can be written:

$$\Pr(\mathrm{RT}_{i,t+2} \mid \mathrm{EM}_{i,t}) = \alpha + \gamma_1 D_{i,t} + \gamma_2 P_{i,t} + \gamma_3 DP_{i,t} + \beta_1 X1_{i,t} + \beta_2 X2_{i,t} + \beta_3 X3_{i,t}$$
$$+ \lambda_{1996} + \lambda_{1998} + \lambda_{2000} + \mu_i + \varepsilon_{i,t}$$

where μ_i represents the individual specific constant terms that are randomly distributed across cross-sectional units.

The results of the above five models allow us to see the relative effects of different factors and the robustness of results to the model specification. We will use the fifth model as our main model. In order to show real magnitudes of effects of depression and pain on retirement, we provided predicted probabilities of retirement based on the fifth model for the four distinct groups subset by gender: neither depression nor pain, depression alone, pain alone, depression with pain.

RESULTS

In our sample, 3.5% of older adult workers have depression and pain, 5.6% of them have depression but no pain, 16.1% of them have pain but no depression, and 74.7% of them have neither condition (Table 1). In general, older workers with depression and pain are more likely to retire. They are more likely to be female, less likely to be married, have less education and higher rates of physical health conditions, and have less earnings and annual family income.

Table 2 reports the retirement status subset by gender, conditional on depression and pain status. Compared to women with neither condition (15.3%, difference=5.3%, $p<0.01$) or with depression only (16.7%, difference=3.9%, $p<0.11$), women with depression and pain are more likely to retire (20.6%). However though men with depression and pain reported higher percentages to be retired than those with neither condition, the differences are not statistically significant (18.4% vs 14.9%). The differential retirement rates between men with depression and pain and men with depression only are very small (18.4% vs 17.3%).

Table 3 contains multivariate regression results from five sets of models described in the last section for women and men separately, in which only estimates of depression and pain variables are reported for simplicity. All these estimates have almost the same pattern and same magnitude. We report multivariate estimates of the main models for both women and men in table 4. According to these results, depression and pain status has differential impacts on retirement for women workers and men workers. Depression with pain predicts early retirement for women, but not for men. Older women workers with depression and pain are more likely to be fully retired in two years (OR =1.42,

p=0.03) compared to neither condition. Although the estimated odds ratio (OR) of retirement for older adult workers with depression and pain is higher than those with either condition alone, they are not statistically different. The effect of pain dominates the effect of depression for men workers. Men with pain only are more likely to be fully retired compared those with neither condition (OR = 1.25, p=0.03). Though men with depression and pain also reported higher odds ratio of retirement than either condition alone, they are not statistically significant. This is probably due to the lack of power of our data since only very few men workers have depression with pain. In addition, for both men and women, depression alone does not predict retirement.

Figure 1 and figure 2 shows the simulated percentage of retirement for female and male respectively, based on model 5. After adjustment, 19.1 percent of older women workers with depression and pain fully retired over the course of two years, 16.7 percent of those with "pain only" fully retired, 15.7 percent of those with "depression only" fully retired, while only 14.6 percent of those with "neither condition" fully retired. The retirement difference between older women workers with "depression and pain" and those with neither condition is large (4.5%). The retirement difference between individuals with depression and pain and individuals with depression only is substantial (3.4%) too though it is not statistically significant. For older men workers, 17.2% of those with depression and pain retired, 17.0 percent of those with "pain only" fully retired, 15.8 percent of those with "depression only" fully retired, while only 14.3 percent of those with "neither condition" fully retired.

Other explanatory variables have expected effects (table 4). Individuals are more likely to retire as they age (OR=6.26 for female, OR=13.14 for male, both p=0.00), but at

a decreasing rate (OR=0.99 for female, OR=0.98 for male, p=0.00). Hispanic women are less likely to retire (OR=0.67, p=0.03). Married females are more likely to retire (OR=1.32, p=0.03), but married males are less likely to retire (OR=0.84, p=0.08). More educated workers are less likely retire (For example, OR=0.64 for college above for male workers, p=0.00). Workers with physical health conditions in general are more likely to retire, but few diseases exhibit a statistically significant effect, probably due to the sample issue (For example Diabetes female workers, OR=1.33, p=0.04). In addition, workers with private health insurance are more likely to retire (OR=1.13 for female; p=0.15, OR=1.59 for male, p=0.00), but workers with full-time jobs are less likely to retire (OR=0.74 for female; p=0.00, OR=0.59 for male, p=0.00). Finally, year fixed effects exist (For females: OR=0.70 for year 1998-2000, p=0.00; OR=0.74 for year 1998-2000, p=0.01).

DISCUSSION

Poor health is an important influence on older workers' retirement decisions. However, the effects of mental health conditions (such as depression) on retirement are not well understood. While the literature increasingly recognizes the interaction between depression and pain, few studies have jointly analyzed the relationship between depression, pain and retirement. This study, using HSR data, fills the gap by longitudinally assessing the effect of depression and pain and their interactions on the full retirement decisions of older workers. We find that the presence of depression and pain are associated with a 4.5% increase in retirement among the female workers over the two years, compared to those with neither condition. The presence of depression and pain are also associated with a 3% increase in retirement among male workers relative to neither condition, but we cannot detect the statistical difference between them due to sample size. The effect of pure depression is small and not statistically significant for both men and women, relative to neither condition. And we did not detect statistically differential effects between depression with pain and either condition alone. Our results can be generalized to the near older population.

As suggested by previous literature, the younger women are more likely to have depression and the depressed women are more sensitive to labor market participation (Ettner, Frank, and Kessler 1997; Gresenz CR and Sturm R, 2004). Our study clearly indicated that this phenomena may be extend to the older women in their retirement decision. However, our study also suggests that one should consider the heterogeneity among the depressed older women while studying the impact of depression on retirement. It shows that the effect of "pure" depression may not be that large but the effect of

depression with comorbid pain may be. Individuals with depression and comorbid pain are a considerable subset of the depressed older Americans and may be a significant cluster that drives female to retire. Retirement costs of depression and pain are probably high for older women since early retirement usually implies a decrease in an individual's earnings and possible loss of insurance (if individuals are still not qualified for Medicare or do not have retiree insurance). Therefore older American women with depression and pain deserve special policy consideration.

There are two main limitations to this research. The first is the constraints imposed by use of subjective measure of depression and pain status, which we already addressed in the previous chapter. Here we particularly worry about the use of a dichotomous measure of depression when the study sample is small. Actually we re-estimated the models by using a score of 3 or more on the 8-items CES-D scales to indicate significant depressive symptoms (Data not shown). We found similar estimates for females; but for males, the effect of depression and depression with pain is a little bit larger and become statistically significant. Since the total number of people with depression or depression with pain is low among the male workers, a few observations may change the estimation. Therefore our estimations for males are not quite reliable. Secondly, though the longitudinal study is good to address the temporal relationship between depression/pain and retire outcomes, it is not causal. Even though we had several waves of data, as we look at the transition out of employment among this age group, the analysis would already exclude individuals who retired because of depression and/or pain.

Table 4.1. Characteristics of Working Older Americans: Depression and Pain, Depression only, Pain only or Neither Condition

	Depression with Pain	Depression Only	Pain only	Neither Condition	Total Study Sample
Full retired in two years (%)	20.3 (1.77)	17.5% (1.33)	18.0 (0.82)	15.3 (0.35)	16.0 (0.31)
CESD-8	5.6 (0.06)	5.2 (0.04)	0.8 (0.02)	0.5 (0.01)	0.98 (0.01)
Age (years)	59.5 (0.16)	59.9 (0.13)	59.6 (0.08)	59.7 (0.04)	59.7 (0.03)
Female (%)	64.4 (2.10)	62.6 (1.69)	52.8 (1.07)	46.3 (0.49)	48.9 (0.42)
White (%)	76.6 (1.60)	71.9 (1.40)	87.6 (0.61)	84.3 (0.31)	83.8 (0.27)
Black (%)	11.1 (1.14)	15.8 (1.08)	6.5 (0.44)	9.5 (0.24)	9.4 (0.20)
Hispanic (%)	11.3 (1.13)	9.9 (0.85)	4.1 (0.36)	4.2 (0.17)	4.8 (0.15)
Other Race (%)	1.0 (0.37)	2.5 (0.54)	1.7 (0.27)	2.0 (0.14)	2.0 (0.12)
Married (%)	55.2 (2.18)	55.8 (1.71)	74.6 (0.92)	74.6 (0.42)	72.9 (0.37)
Less than high school (%)	29.6 (1.95)	25.5 (1.43)	16.4 (0.78)	14.2 (0.33)	15.8 (0.30)
GED (%)	8.2 (1.23)	5.2 (0.75)	4.7 (0.45)	4.6 (0.21)	4.8 (0.18)
High School Graduate (%)	33.4 (2.08)	34.3 (1.66)	34.2 (1.02)	33.0 (0.47)	33.3 (0.40)

Some College (%)	17.3	18.2	25.4	22.3	22.4
	(1.70)	(1.36)	(0.93)	(0.41)	(0.36)
College and Above (%)	11.4	16.8	19.3	25.8	23.7
	(1.41)	(1.35)	(0.85)	(0.44)	(0.37)
High Blood Pressure (%)	45.5	39.1	39.7	34.1	35.7
	(2.18)	(1.68)	(1.05)	(0.46)	(0.40)
Diabetes (%)	13.1	10.0	11.6	7.7	8.6
	(1.42)	(1.01)	(0.68)	(0.25)	(0.23)
Cancer (%)	10.3	6.5	7.0	5.9	6.3
	(1.35)	(0.88)	(0.55)	(0.23)	(0.21)
Lung Diseases ()	15.4	6.9	7.8	3.5	4.8
	(1.64)	(0.89)	(0.58)	(0.18)	(0.18)
Heart Problems (%)	22.7	9.5	14.2	9.7	10.9
	(1.88)	(1.03)	(0.75)	(0.29)	(0.27)
Stroke (%)	2.5	1.5	2.6	1.6	1.8
	(0.67)	(0.39)	(0.34)	(0.12)	(0.11)
Arthritis (%)	74.4	41.7	67.8	33.4	40.9
	(1.90)	(1.71)	(1.01)	(0.46)	(0.42)
Earnings ($)	18993	22449	24571	30028	28327
	(818)	(961)	(572)	(592)	(456)
Income ($)	44943	53796	64563	74364	70573
	(2387)	(2799)	(1724)	(1247)	(990)
Private Insurance (%)	59.1	56.4	61.0	63.0	62.2
	(2.18)	(1.74)	(1.07)	(0.48)	(0.42)
Fulltime	69.8	71.7	68.5	72.5	71.7
	(2.00)	(1.54)	(1.00)	(0.44)	(0.38)
Sample size	590	946	2,375	11,368	15,279
Weighted Percentage	3.6	5.6	16.1	74.7	100

In parentheses are the standard errors of the means. All estimates are adjusted to be nationally representative.

Table 4.2. Retirement Transition among Women and Men Elders by their Depression and Pain Status

	Depression with pain (%)	Depression Only (%)	Pain only (%)	Neither Condition (%)	All (%)
Women Workers					
Retired (n)	20.6 (79)	16.7(101)	18.5(236)	15.3(817)	16.2(1233)
Other (n)	79.4 (304)	83.3(504)	81.5(1040)	84.7(4518)	83.8(6366)
Total (n)	100 (383)	100 (605)	100 (1276)	100 (5335)	100 (7599)
Men Workers					
Retired (n)	18.4 (38)	17.3 (59)	17.8(196)	14.9(901)	15.5(1594)
Other (n)	81.6 (169)	82.7(282)	82.2(903)	85.1(5132)	84.5(6486)
Total (n)	100 (207)	100 (341)	100 (1099)	100 (6033)	100(7680)

TABLE 4.3. Multivariate Logistic Regression (odds ratios)

Variables	Model 1	Model 2	Model 3	Model 4	Model 5
Women Workers					
Depression and pain	1.41*	1.41*	1.39*	1.39*	1.42*
	(0.015)	(0.017)	(0.020)	(0.022)	(0.033)
Depression only	1.06	1.07	1.06	1.08	1.09
	(0.606)	(0.592)	(0.641)	(0.532)	(0.519)
Pain only	1.17	1.16	1.15	1.14	1.19
	(0.081)	(0.084)	(0.107)	(0.136)	(0.089)
Men Workers					
Depression and pain	1.19	1.22	1.24	1.24	1.27
	(0.376)	(0.08)	(0.281)	(0.282)	(0.254)
Depression only	1.10	1.11	1.13	1.13	1.13
	(0.551)	(0.496)	(0.442)	(0.440)	(0.457)
Pain only	1.21*	1.22*	1.21*	1.21*	1.25*
	(0.044)	(0.033)	(0.042)	(0.046)	(0.032)

Odds ration and standard errors (in parentheses) are reported
*Statistically significant at p=0.05

Table 4.4. Multivariate Logistic Regression (odds ratios) of Model 5

Variables	Female	Male
Depression and pain	**1.42 (0.03)****	**1.27 (0.25)**
Depression Only	**1.09 (0.52)***	**1.13 (0.46)**
Pain only	**1.19 (0.09)***	**1.25 (0.03)****
Age	1.27 (0.00)***	1.27 (0.00)***
Age-squared[1]	0.99 (0.00)***	0.98 (0.00)***
Black	0.90 (0.37)	0.93 (0.56)
Hispanic	0.67 (0.03)**	1.01 (0.04)**
Other Race	0.64 (0.16)	0.83 (0.53)
Married	1.32 (0.00)***	0.84 (0.08)*
GED	1.05 (0.81)	1.00 (1.00)
High School Graduate	0.81 (0.08)*	0.94 (0.59)
Some College	0.78 (0.08)*	0.79 (0.08)*
College and Above	0.88 (0.44)	0.64 (0.00)**
Northeast	1.13 (0.38)	0.94 (0.65)
Midwest	1.04 (0.76)	1.06 (0.62)
South	1.21 (0.12)	0.97 (0.82)
High Blood Pressure	1.19 (0.04)**	1.02 (0.78)
Diabetes	1.33 (0.04)**	1.13 (0.27)
Cancer	1.11 (0.44)	1.33 (0.07)*
Lung Diseases	1.09 (0.60)	1.17 (0.35)
Heart Problems	1.10 (0.49)	1.31 (0.01)**
Stroke	1.26 (0.40)	1.32 (0.21)
Arthritis	1.18 (0.04)**	1.03 (0.72)
Earnings (100,000$)	1.18 (0.48)	1.06 (0.50)
Income (100,000$)	1.03 (0.63)	0.97 (0.50)
Private Insurance	1.13 (0.15)	1.59 (0.00)**
Fulltime	0.74 (0.00)**	0.59 (0.00)**
Year 1996-1998	0.85 (0.12)	0.87 (0.19)
Year 1998-2000	0.70 (0.00)**	0.92 (0.44)
Year 2000-2002	0.74 (0.01)**	1.03 (0.83)
Occupation Dummies §		

§ This does not report the coefficients of the occupation categories. Most of them are not significant at p=0.05. But jointly the occupation categories are statistically significant at p=0.05.

[1]ages are centered at 60.

*** Statistically significant at p=0.01

** Statistically significant at p=0.05

* Statistically significant at p=0.1

Figure 4.1. Percentages of Female Workers Retired over Two years by Depression and Pain Status: Health and Retirement Survey (1994-2002)

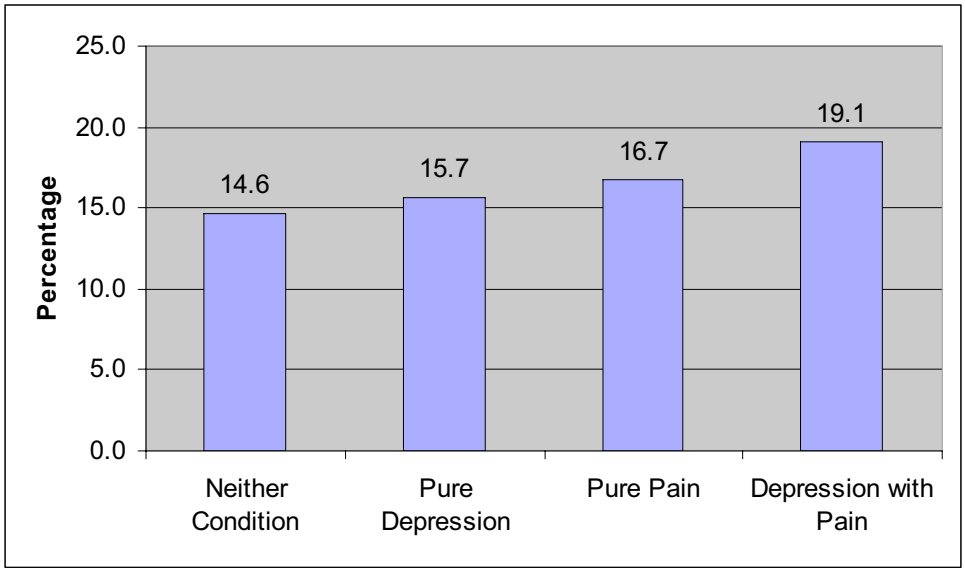
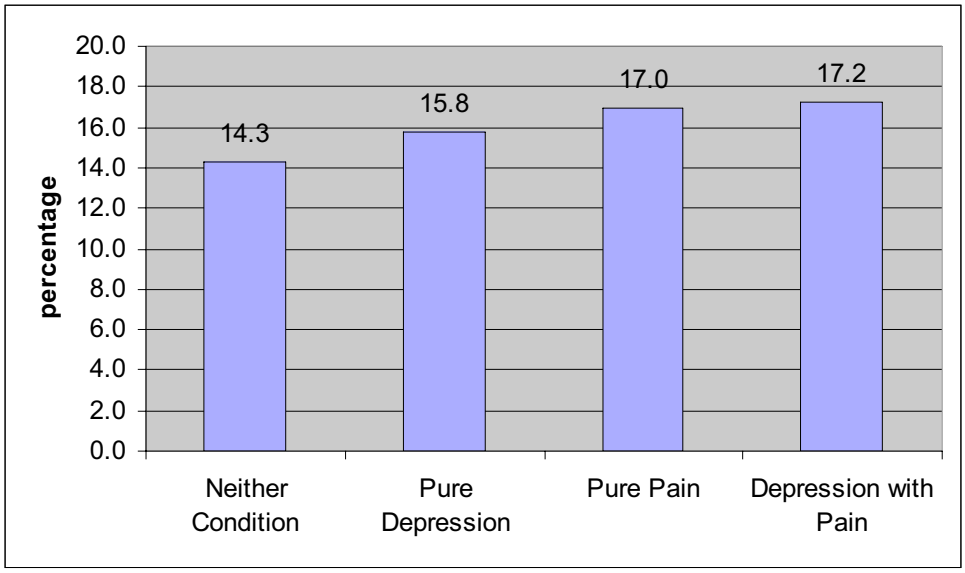


Figure 4.2. Percentages of Male Workers Retired over Two years by Depression and Pain Status: Health and Retirement Survey (1994-2002)



CHAPTER 5 DISCUSSION AND CONCLUSIONS

Pain is common among depressed persons. Depression and its social and economical impacts have been well documented in the past decades, the role of pain comorbidity is far less understood. Based on two recent national survey datasets, Health and Retirement Study, and Healthcare for Communities, this dissertation investigates the interaction of depression and pain and its impact on labor market, financial, insurance, disability, medication decision, and medication costs outcomes.

The dissertation first examines the relationship between depression and pain, and labor market, financial, insurance and disability outcomes among Americans aged 55-65, using wave 3 of Health and Retirement Survey. It found that depression and comorbid pain was associated with worse labor market, financial, insurance and disability outcomes compared to depression alone. The simulated results showed that the magnitudes of the adverse effects were attributed disproportionally to individuals with depression and comorbid pain versus "pure" depression. Of those with depression, 51% had comorbid pain. Yet, this subgroup of depressed individuals accounted for 59% of those not employed, 61% of those with government health insurance, 79% of those with limitations in ADLs, and 72% of those with health limitations affecting work.

The third chapter examines the relationship between depression and pain, and medication behavior and medication costs outcomes in a nationally representative cross-section of Americans, using first wave of Healthcare for Communities survey. It found that depressed individuals with pain comoridity were substantially less likely to take antidepressant medications (15.3% vs. 18.0%) and use them effectively (11.3% vs.

14.1%), compared to those with depression only. And pain comorbidity was associated with a heavier burden on total medication costs and prescription drug costs, after controlling for predisposing and enabling characteristics. The predicted annual medication costs for depressed patients with pain comorbidity was $692, which was more than twice the amount of those with neither depression nor pain ($329), and was substantially higher than those with depression only ($520). The predicted annual costs of prescription drugs for the depressed patients with pain comorbidity was $498, which was almost twice the amount of those with neither depression and nor pain ($267), and was slightly higher than those with depression only ($446).

Chapter 4 seeks to understand the role of gender in studying the effect of depression and pain on retirement outcomes. It used longitudinal data from Wave 2 to wave 6 of the Health and Retirement Survey, to analyze the effect of depression and comorbid pain on the transition from employment to full retirement among older adult workers, and compared differential effects between male and female workers. It found that depression and pain status had differential impacts on retirement for women workers and men workers. Depression and comorbid pain predicted early retirement for female workers. But the effect was not statistically significant for males, probably due to the lack of power. After adjustment, 19.1 percent of older women workers with “depression and pain” fully retired over the course of two years, 16.7 percent of those with “pain only” fully retired, 15.7 percent of those with “depression only” fully retired, while only 14.6 percent of those with “neither condition” fully retired. However depression alone did not predict fully retirement for either female workers or male workers.

This dissertation not only makes an important contribution to our understanding of depression and pain comorbidity in terms of its prevalence in the general population, and its effect on treatment and access to care, it will also inform health policy makers who want to reduce the burden of depression and pain, and has implications for health care providers and practitioners to improve the quality of care for depression and pain comorbidity. It may also inform the current debates on some policy initiatives, such as mental health parity laws.

Firstly, it contributes to our understanding of the economic burden of depression and pain. Previous studies have shown that the economic burden of depression is large in terms of direct costs and indirect costs. The dissertation suggests that individuals with depression are not homogenous and the adverse effects of comorbid pain on depression were substantial in terms of outcomes such as disability, employment, retirement, insurance, medication costs, medical expenditures and economic status. Depression with comorbid pain, not just "pure" depression, especially drives these adverse outcomes. Programs focused on depression alone may not achieve policy goal for the depressed with comorbid pain and so have a smaller than expected effect on all these adverse consequences. This is especially the case for females who have higher prevalence, less treatment, and are more sensitive to labor market participation as suggested by chapter 4.

Secondly, it contributes to quality improvement efforts at a policy, organizational or clinician level. The dissertation suggests that depression with comorbid pain distracted the depressed patients from the use and adherence to antidepressants even though many studies have showed the beneficial effects on such medication treatment. This message can inform the primary care physicians and health care providers in their management of

patients. Depressed patients with pain comorbidity may attribute their painful physical symptoms to an underlying medical illness and want treatment for their pain. Primary care physicians and healthcare providers should not only consider the pain as a predictor of depression, but also should consider pain as something to look out for in insuring their depressed patients receiving proper treatment, including antidepressants. Greater efforts should be made to consider pain as a possible underlying diagnosis for patients with depression and to consider antidepressants as a possible treatment for them. However, pain is often measured broadly in research, treatment data usually focuses on a specific condition. This makes application of evidence based medicine challenging. Despite the high percentage of depressed patients that present soley with unexplained pain, there is little data about the best practices for treating this population. Most current studies focus on treating one condition in the presence of another, and some also suggest treating both conditions will improve overall outcomes. Although our study provided no information on the adequacy of care for depression and pain, it suggested that public health and policy should target clinical practice guidelines for depression and pain and identify more adequate and efficient care (either pain management, depression management, or both).

Thirdly, though costs of treatment for both depression and pain conditions might be higher, these social outcomes and large economic costs conversely imply a higher economic return for policies that aid in the identification and treatment of depression and comorbid pain. Employers and other payers need to become more aware of the fact that appropriate treatment of depression and pain, while costly, can have higher benefits. A treatment mode that incorporates assessment and treatment of both depression and pain is urgent and might be cost-effective. Not only so, improve quality of care for depression

and pain comordidity might be desirable too in terms of value of care. Sturm and Wells have argued that the best strategy for making care more cost-effective is through quality improvement, not through changing specialty mix (Sturm R, and Wells KB. 1995). Unfortunately there is little evidence on the best practices for treating people with depression and comorbid pain. As suggested by Bair and colleagues: "more research should is needed to determine whether alleviation of pain helps the patients' depressive symptoms and, likewise, whether relief of depressive symptoms improves pain and its related comorbidity or whether a common third factor is related to the severity and response of both pain and depression. In the future, dual therapy trials are needed to assess whether adequate treatment of both depression and pain, rather than an exclusive focus one or another, improve patients outcomes" (Bair MJ, Robinson MR, Eckert GJ, et al. 2004). This dissertation shows that payoff from such research could be high. For example, the RAND-UCLA *Partners in Care* efforts show that modest, practical, quality improvement programs, as implemented by diverse managed care organizations under usual practice conditions, can decrease the personal and societal burdens of depression (Miranda J, Duan N, Sherbourne C, et al 2003; Schoenbaum M, Miranda J, Sherbourne C, et al 2001; Wells K, Sherbourne C, Schoenbaum M, et al 2004). The dissertation suggests that similar interventions for depressed and pain comorbidity could be cost-effective.

Fourthly, the dissertation suggests that the depressed patients with pain comordity had large employment and earning costs, and had worse access to care, which present a public policy challenge. In past several years, the majority of states and the federal government made parity mandates to require equal coverage for both mental health and

medical conditions. However, since depressed patients with pain comorbidy were more likely to leave employment or retire early, given the central role of employer-sponsored health insurance within U.S. health care system, leaving employment as a consequence of depression and pain may worsen access to care. The attempt to improve the quality of insurance coverage for depressed patients with pain may be inadequate in an economy where insurance is often tied to employment. On the other hand, since many depressed patients with pain comordity have public insurance, with the evolving state of Medicare (particularly its Medicare Modernization Act provisions) and in Medicaid with states that have mental health exemptions for psychotropic drugs, broad formulary access to mental health treatments might be considered.

Finally, the dissertation demonstrates that near elderly Americans with depression and comorbid pain were particularly vulnerable, especially for females. They were at a higher risk of disability and the negative influences disability may have on household income. Since depression with pain was negatively associated with employment and therefore employment-based insurance, these individuals may have reduced access to care. With limited household income, near elderly Americans with depression and comorbid pain may be more likely to find health care unaffordable before they make the transition into Medicare. This, in turn, leads to even greater progression of worsening health status for them. Such population deserves special policy consideration.

In conclusion, the dissertation not only inform health policy makers who want to reduce the burden of depression and pain, and but also calls for health care providers and practitioners to improve the quality of care for depression and pain comorbidity.

Future research should focus on improving measurement of depression and pain comorbidity and causality of depression and comorbid pain on economic outcomes.

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