Title
Pain, Productivity at Work, and Future Medical Expenditures: The Role of Supportive Workplaces

Author
Williams, Jessica Allia

Publication Date
2013

Peer reviewed|Thesis/dissertation

UNIVERSITY OF CALIFORNIA

Los Angeles

Pain, Productivity at Work, and Future Medical Expenditures: The Role of Supportive Workplaces

A dissertation submitted in partial satisfaction of the requirements for the degree Doctor of Philosophy in Health Policy and Management

by

Jessica Allia Williams

2013

ABSTRACT OF THE DISSERTATION

Pain, Productivity at Work, and Future Medical Expenditures: The Role of Supportive Workplaces

by

Jessica Allia Williams

Doctor of Philosophy in Health Policy and Management

University of California, Los Angeles, 2013

Professor Susan Ettner, Chair

Objective: This dissertation describes the complex relationships between health-related employer support, pain, future medical expenditures and productivity at work by answering three research questions: (1) to what extent is health-related employer support associated with productivity at work and future medical expenditures controlling for factors other than pain, (2) to what extent does pain mediate the relationships between health-related employer support and productivity at work and between health-related employer support and future medical expenditures, and (3) to what extent does health-related employer support moderate the relationship between pain and productivity at work and between pain and future medical expenditures. Data: The main analysis used a restricted survey

dataset for a pooled sample of employees from 14 U.S. employers (N=34,359) from 2010 (for one employer, 2008). For five employers, two years of data (2010 and 2011) were available, and for one employer, health insurance claims were also available (N=1,590). Methods: Multiple imputations corrected missing data problems. Regression analyses, including multiple linear regression, multiple logistic regression, and two-part models were used to analyze the relationships. Results: Health-related employer support was not found to be significantly related to future medical expenditures or sick days, regardless of whether the regression controlled for pain. In contrast to the hypothesized direction, lack of health-related employer support was significantly associated with higher self-rated relative productivity, while pain was not significantly associated with self-rated relative productivity. Lack of emotional health-related employer support was significantly associated with increased chance of pain. Pain was significantly associated with increased sick days and increased future medical expenditures. No evidence that health-related employer support moderated the relationship between pain and productivity at work or future medical expenditures was found. Although health-related employer support does not seem to directly affect sick days and medical expenditures, it is related to pain, which in turn is associated with sick days and expenditures. Implications: Pain reduction should improve employers' bottom lines, all else equal, because it would likely lead to lower medical expenditures and decrease the number of sick days taken by employees. Health-related employer support is one potential mechanism under employers' control that is associated with pain.

The dissertation of Jessica Allia Williams is approved.

Emeran A. Mayer

Thomas Rice

Peter Schnall

Frederick Zimmerman

Susan Ettner, Committee Chair

University of California, Los Angeles

2013

To my parents

Table of Contents

Acknowledgments

I would like to thank each member of my dissertation committee for their insightful comments on this dissertation and for their career advice. I would like to thank my dissertation chair, Dr. Susan Ettner for her incredible guidance, support, and enthusiasm throughout graduate school and especially for her tireless work assisting me with this dissertation. I am very grateful to Dr. Thomas Rice and Dr. Frederick Zimmerman, without their incredible advice and support this dissertation would not have been possible. For their wonderful help in planning and executing this dissertation, I would also like to thank Dr. Peter Schnall and Dr. Emeran Mayer.

In addition to my committee members, I would like to thank Dr. Jack Needleman for his support throughout graduate school and for pushing me to place my research in the broader context of Health Services Research. I would also like to thank Dr. Doug Elmendorf for his mentorship.

I am grateful to Dr. Fernando Torres-Gil for his help in acquiring the data for this dissertation and for his excellent career advice. I would also like to thank Healthways LLC, especially Carter Coberley and Jim Pope, for providing me with the restricted data used in this dissertation. This work was funded by the UCLA Graduate Division Dissertation Year Fellowship Award (2012-2013).

VITA

EDUCATION

M.A., Economics, 2008
University of Michigan, Ann Arbor, MI
B.A. with Honors, Economics, 2004
Stanford University, Palo Alto, CA

GRADUATE RESEARCH EXPERIENCE

Graduate Research Mentorship, 2011-2012
Dr. Susan Ettner, UCLA Department of Health Services

Agency for Healthcare Research and Quality (AHRQ) Trainee, 2009-2011
Dr. Susan Ettner, UCLA Department of Health Services

Graduate Student Researcher, 2010-2011
Dr. Fred Zimmerman, UCLA Department of Health Services

Research Assistant, 2007-2009
Dr. Martha Bailey, University of Michigan, Ann Arbor, MI

Research Assistant, 2007-2009
Dr. Puneet Manchanda, Ross School of Business, Ann Arbor, MI

Research Assistant, Macroeconomic Analysis Section, 2004-2006
Federal Reserve Board of Governors, Washington, DC

PROFESSIONAL EXPERIENCE

National Health Foundation, Los Angeles, CA
Consultant – Analysis and Research, 2011-2013

Congressional Budget Office, Washington, D.C.
Special Assistant to the Director, 2009

PEER-REVIEWED PUBLICATIONS

Ettner S.L., M. Schoenbaum and **J.A. Williams**. "The Role of Economic Incentives

in Improving the Quality of Mental Health Care." Chapter 28 in Jones (ed.), *Elgar Companion to Health Economics, 2nd edition*. Edward Elgar, Northampton, MA, 2012.

Williams, J.A., F. Zimmerman and J.F. Bell. "Norms and Determinants of Sleep Time Among U.S. Children and Adolescents," *JAMA Pediatr.* 2013; 167(1):55-60.

Williams, J.A., W.N. Steers, S.L. Ettner, C.M. Mangione, and O.K. Duru. "Cost-related Nonadherence by Medication Type among Medicare Part D Beneficiaries with Diabetes," *Medical Care* Med Care, 2013; 51(2): 193-8.

PRESENTATIONS AND POSTERS

Williams, J.A., W.N. Steers, S.L. Ettner, C.M. Mangione, and O.K. Duru. "Cost-related Nonadherence by Medication Type among Medicare Part D Beneficiaries with Diabetes." AcademyHealth Annual Research Meeting (Poster Session). Orlando, FL, June 2012.

Williams, J.A. "Health-Related Employer Support and Future Medical Expenditures" 4th Biennial Conference of ASHEcon. Minneapolis, MN, June 2012.

Williams, J.A., F. Zimmerman and J.F. Bell. "Norms and Determinants of Sleep Time Among U.S. Children and Adolescents." Population Association of America (Poster Session 1 winner). San Francisco, CA, May 2012.

Williams, J.A., W.N. Steers, S.L. Ettner, C.M. Mangione, and O.K. Duru. "Cost-related Nonadherence by Medication Type among Medicare Part D Beneficiaries with Diabetes." TRIAD Legacy SC Web-Teleconference. Los Angeles, CA, July 2011.

Williams, J.A., W.N. Steers, S.L. Ettner, C.M. Mangione, and O.K. Duru. "Cost-related Nonadherence by Medication Type among Medicare Part D Beneficiaries with Diabetes." 17th Annual NRSA Trainees Research Conference. Seattle, WA, June 2011.

Williams, J.A., "Research Interests and Dissertation Topic." 2011 Joint Workshop in Health Economics. Co-sponsored by Centre for Health Economics, Monash University, Australia and Division of General Internal Medicine & Health Services Research, David Geffen School of Medicine and Department of Health Services, School of Public Health, UCLA, June 2011.

Chapter 1. Introduction

> **"Protection from and relief of pain and suffering are a fundamental feature of the human contract we make as parents, partners, children, family, friends, and community members, as well as a cardinal underpinning of the art and science of healing. Pain is part of the human condition; at some point, for short or long periods of time, we all experience pain and suffer its consequences."** – Institute of Medicine, *Relieving Pain in America: A Blueprint for Transforming Prevention, Care, Education, and Research [1]*

Pain can be a warning, a symptom of an underlying condition or an illness. It can be acute, such as pain after an injury, recurring, or chronic. Pain is a major source of health-related disability and morbidity in the world and in the U.S. [2, 3]. In the U.S., chronic pain has recently become a major national focus because of complex social, health and environmental conditions. Chronic pain is debilitating, and many people now live with chronic pain that is often inadequately treated [1]. According to one estimate, approximately 116 World Health Organization's Perronic pain linked to a condition such as migraine, arthritis, joint pain, fibromyalgia, irritable bowel syndrome, trauma, postsurgical pain, and lower back pain [1]. In addition to causing a massive amount of suffering, chronic pain is also expensive—according to estimates from an Institute of Medicine (IOM) report, the annual incremental cost of health care for chronic pain is at least $261-300 billion and the cost of lost productivity is $297-336 billion a year [1]. Part of the difficulty in alleviating pain is in the nature of pain as a subjective experience that differs from person to person and across situations. It may be both an unpleasant sensory experience and an unpleasant emotional experience. Additional complications

in alleviating pain come from the methods of treatment that sometimes carry risks and are often inadequate. Recently, national attention has turned to the use of opioids and other medications that can create dependency that are increasingly used illicitly with disastrous consequences.

The problem of alleviating pain is further complicated by the fact that pain has physical, social and psychological causes [1]. Some of the causes are underlying medical conditions or injuries—pain often recedes once these conditions are appropriately treated. The social and psychological context of the individual suffering from pain is also important and may influence how much pain is experienced; the distress level caused by pain, and whether the pain subsides or reoccurs (see [1] for a thorough introduction to the topic).

Because pain is often related to work and may severely limit an individual's ability to work, workplace safety is critically important to reducing the burden of pain on society. The policy environment for the role of pain in the workplace depends on occupational and health legislation. In the U.S., most occupational legislation deals with physical or mechanical hazards, rather than psychosocial factors. Public regulations and programs, such as worker's compensation funds, have evolved over time to address the hazards and risk of the work environment. Early regulations of the work environment primarily targeted physical risks and the populations viewed as especially susceptible to them (such as the regulation of child labor). As the economy has shifted more towards the service sector, and technology has become more advanced, the nature of work has changed dramatically for almost all Americans.

While physical hazards of the work environment have become a larger focus, less policy and societal attention has been placed on the psychosocial aspects of the work environment, despite their associations with various health conditions, such as cardiovascular disease and depression [4]. Anti-discrimination and anti-harassment codes are an exception and do try to modify the psychosocial work environment.

Employer- and union-driven changes and health legislation are also important for the context of the work environment primarily because about 61% of Americans got their health insurance from their employer or through a spouse's or parents' employer in 2008/2009 (this percentage has fallen since 1999/2000) [5]. As health insurance and medical care costs have increased, many employers have been trying to contain the increases that affect their profitability. Employee Assistance Programs have been used by employers, primarily large employers, to address employee health and personal issues and were an expansion of the traditional model of workplace safety—giving employers a mechanism to influence employee health in a larger context. More recently, wellness programs have been started at many employers and are an even further expansion in the employer's role in employee health. According to the U.S. Bureau of Labor Statistics, about 40-45% of employees had access to employee assistance programs (from 2005 to 2010) and about 23-31% of employees had access to at least some type of wellness program [6].

The central idea of workplace wellness is that employer support for employees' efforts to make healthy lifestyle choices, usually in the form of wellness programs, may reduce medical expenditures and increase

productivity [7]. This dissertation uses the term health-related employer support to identify the idea that employers support their employees' efforts to make lifestyle choices. Despite some evidence that wellness programs do decrease medical costs [8-11], the degree of employer control over work environment varies, as does individual ability to change behavior, so the links between work environment and health may not always be manipulable. The number and scope of wellness programs are likely to increase because the Affordable Care Act allows employers to use up to 30% of their employees' health insurance premiums to provide outcome-based wellness incentives starting in 2014.

There is little research on the ability of workplace wellness programs to impact pain. Pain is a potentially valuable target for workplace programs since the medical costs and lost productive time from pain affect employers. By not knowing whether workplace wellness programs can impact pain, the potential for additional treatment and alleviation of pain is missed. This is especially the case if the pain is partially caused by workplace factors—it may not be alleviated until those factors are mitigated. The effects of health-related employer support on pain are important to policy makers because of their role in workplace safety and because of the initiatives provided under the Affordable Care Act. They also matter to employees because they are all at risk of pain. Pain's impact on medical costs and productivity are important from the employer's perspective because they affect profitability and survival.

To address the lack of understanding mentioned above, this dissertation seeks to quantify the complex relationships between health-related employer

support, pain, future medical expenditures and productivity at work. Health-related employer support for employees trying to improve their physical and emotional health can influence pain. As a psychosocial factor, health-related employer support may allow employees to manage their symptoms and may decrease pressure on employees—reducing the degree of pain [12]. Treatment of pain may increase future medical expenditures. Pain may affect productivity at work. People in pain may have difficulty performing tasks at work, may need to take time off, and may have a higher cognitive load—all of which may adversely affect their productivity at work. Additionally, pain may also make self-management of other health conditions more difficult, resulting in potentially higher medical expenditures and reduced productivity at work. The research questions and hypotheses that address these relationships are given below:

A) To what extent is health-related employer support associated with productivity at work and future medical expenditures after controlling for additional factors other than pain?

- **Hypothesis A-1 and Rationale:** Greater health-related employer support will be associated with greater productivity without controlling for pain. Health-related employer support should influence productivity at work primarily through pain. Greater health-related employer support should reduce the amount of pain suffered by the workforce, and so be associated with increased productivity.
- **Hypothesis A-2 and Rationale:** Greater health-related employer support will be associated with lower future medical expenditures without controlling

for pain. Greater health-related employer support should reduce the amount of pain suffered by the workforce. This reduction in the incidence of pain is hypothesized to lead to a negative reduced-form (not controlling for pain) relationship between health-related employer support and future medical expenditures because pain is likely to increase future medical expenditures due to treatment.

- **Competing Hypothesis A-2 and Rationale:** Greater health-related employer support will be associated with higher future medical expenditures without controlling for pain. Instead of health-related employer support impacting pain, in turn affecting future medical expenditures, it may instead be the case that greater health-related employer support may allow employees greater schedule flexibility and/or more generous leave—reducing the opportunity cost of obtaining medical care, increasing future medical expenditures.
- The effect described in hypothesis A-2 should dominate the effect in A-3, leading to its designation as the main hypothesis.

B) To what extent does pain mediate the relationships between health-related employer support and productivity at work and between health-related employer support and future medical expenditures? (Mediation)

- **Hypothesis B-1 and Rationale:** Greater health-related employer support will be associated with reduced chance of pain. Greater health-related support should reduce the prevalence of pain in employees by allowing them greater latitude to take steps to reduce their pain, by providing them with more health related resources or by making

accommodations to employees' work environment (ex. providing ergonomically designed workstations).

- **Hypothesis B-2 and Rationale:** Pain will be associated with lower productivity at work. Pain should directly reduce productivity at work because it makes work-related tasks more difficult to carry out. Pain may also induce employees to seek medical care—increasing absence for treatment.
- **Hypothesis B-3 and Rationale:** Pain will be associated with higher future medical expenditures. Pain is likely to increase future medical expenditures due to treatment. It may also increase the use of additional health care services for two reasons: it may aggravate comorbid conditions and because the non-monetary costs of obtaining care are reduced if the individual is already seeking treatment for pain.
- **Hypothesis B-4 and Rationale**: Controlling separately for pain will attenuate any positive associations of health-related employer support with productivity. Health-related employer support should influence productivity at work primarily through pain. However, it may also indicate greater overall availability of resources to improve productivity so there may be some residual effect.
- **Hypothesis B-5 and Rationale**: Greater health-related employer support will be associated with higher future medical expenditures after controlling for pain. Greater health-related employer support should reduce the amount of pain suffered by the workforce. However, once pain is included in the model greater health-related employer support

may allow employees greater schedule flexibility and/or more generous leave—reducing the opportunity cost of obtaining medical care and thereby increase expenditures.

C) To what extent does health-related employer support moderate the relationship between pain and productivity at work and between pain and future medical expenditures? (Moderation)

- **Hypothesis C-1 and Rationale:** The negative association of pain with productivity at work will be larger for those with health-related employer support than for those without. For employees with pain, greater support should decrease the costs associated with lower productivity—employees with pain will be less motivated to maintain their productivity at its original level if their employer is more supportive.
- **Hypothesis C-2 and Rationale:** The positive association of pain with future medical expenditures will be greater for those with health-related employer support than for those without. More support for employees with pain may increase the amount of treatment they receive by decreasing the opportunity cost of care.

The hypotheses are explained further in the Chapter 3 in the context of the conceptual models. Research questions B and C are closely related but are drawn from distinct viewpoints. From an occupational health perspective, we care about question B because health-related employer support may have a direct impact on employees' pain. This relationship may affect outcomes that matter to employers.

Whether or not an employer is seen as supportive of employee health is something companies may be able to change, in turn potentially generating effects on productivity and medical expenditures that impact company survival. The research question about the potential moderation effect of health-related employer support on the relationship between pain and medical expenditures and between pain and productivity, question C, allows a more nuanced understanding of the role of health-related employer support. Both the mediation of health-related employer support by pain and the moderation of pain's effects by health-related employer support are important to understand from a policy perspective since both may be reflected in the ultimate outcomes of productivity at work and medical expenditures.

The remainder of this dissertation is divided into chapters. Chapter Two reviews the relevant academic literature for each research question. Chapter Three describes the conceptual models that guide the empirical analyses and the hypotheses for each research question. Chapter Four describes the data sources used for the empirical analyses. Chapter Five describes the empirical methods used to test the hypotheses. Chapter Six presents the results of the analyses and Chapter Seven discusses the results and implications.

Chapter 2. Background and Significance

This chapter will describe the background for each of the research questions and discuss this dissertation's significance. Table 1 (see PDF) lists the studies used in this review organized by research question.

2.1 Is health-related employer support associated with productivity at work after controlling for additional factors other than pain?

A few authors have used existing psychosocial models, such as the Karasek demand-control model, to motivate the association of work environment with productivity [13-15]. The measures of employer support used in most studies seem to be related to social support from the employee's boss/supervisor or co-workers rather than to health-related support specifically [4, 11, 16-18].

A longitudinal study done by Rael and colleagues used data from the Whitehall II study to look at the role of social support and chronic stressors (ex. financial problems) in absenteeism [19]. Their study focused on social support from the respondent's "closest person" and found that high levels of confiding/emotional support predicted higher levels of short and long absences [19]. This association increased after controlling for physical and psychological health factors of the respondent [19]. The authors posited that the unexpected direction of effect might reflect illness behavior [19]. The quantitative measure of social network status that included the frequency of social contacts was not statistically significant [19]. Rael and colleagues also found suggestive evidence that health status may be an intervening variable in the relationship between chronic stressors and absenteeism

and that social support may help protect against the effects of chronic stressors [19].

In a study of the French GAZEL cohort, Melchior and coauthors found that below median decision latitude and below median personal social support predicted increases in absenteeism [20]. They further found that low satisfaction with social relations and low social support predicted increases in absenteeism for men [20]. In that study's cohort, all sickness absence had to be verified by a physician. Covariates included age, marital status, educational attainment, occupation, smoking status, alcohol use, BMI and self-reported health status [20]. The authors did not find any evidence of interactions between the work environment variables and the social support variables [20].

A recent systematic review of the impact of health, work, and psychosocial factors on sick days taken by individuals with inflammatory arthritis included studies done in multiple countries [15]. The authors found that 75% or more of the studies of the topic found associations between pain and sick days and between disease severity and sick days [15]. Relatively fewer studies (and more mixed results) were found that reported associations between low control, time pressure and sick days [15].

Support has also been conceived as a workplace flexibility—essentially a measure of employee control [11]. In a meta-analysis, researchers found flextime increased productivity at work in the short-run [18]. After controlling for demographic factors, positive and negative affect, and coping processes, one study found statistically significant associations between certain organizational climate and performance at work [14]. However, other studies have not found relationships

between psychosocial factors and absenteeism after controlling for demographic and other factors such as permanent/temporary status and BMI [13, 14, 21]. One study found life dissatisfaction, poor physical health, job dissatisfaction, and high stress to be significantly associated with presenteeism in a sample of employees working for a large U.S. firm [22]. Job security may also affect productivity—several studies have found that reduced job security is associated with greater productivity loss after controlling for other factors [23, 24] and others have found results of the same sign but that differ in magnitude [25, 26].

2.2 Is health-related employer support associated with future medical expenditures after controlling for additional factors other than pain?

Aggregate future medical expenditures have rarely been used as an outcome in models with work environment factors as independent variables. One study looking at co-worker support found evidence of a relationship between co-worker support and health care utilization, but the nature of the relationship was unclear [27]. A review of the efficacy of employer sponsored health-risk reduction programs found mixed results with respect to medical costs [28]. Occupational health studies generally focus on the impact of workplace factors on health outcomes directly, without using medical expenditures. Additional information about the major theoretical models is discussed in chapter three.

2.3 To what extent is health-related employer support associated with pain?

Pain is a common complaint but varies among occupational groups [1]. Pain can be defined based on its duration, intensity, body area, and quality (ex. sharp, dull). Workplace factors can be physical/mechanical or psychosocial. The majority of studies linking workplace factors to pain have used cross-sectional data [1, 2, 26, 29-34].

Mechanical workplace factors such as rapid work pace, repetitive motion, non-natural body postures, vibration, lifting ratios, lifting postures, and poor ergonomic workstation design have been shown to be associated with pain, particularly in the lower back and neck/shoulder areas [1, 29-33, 35]. While the statistical significance of the estimates differ across work settings, it is likely mechanical factors are the same across countries. Conversely, the role of psychosocial factors seems more likely to differ across countries [36].

Relatively few studies have investigated the role of psychosocial factors in pain. Several studies have found associations between low control and musculoskeletal pain or neck pain after controlling for demographic factors but other studies have not [2, 31, 35, 37]. Poor communications, unsupportive workplace culture, low levels of social support and isolation have been found to increase morbidity of musculoskeletal pain, neck/shoulder pain, or lower back pain [2, 31, 32, 35, 37-39]. There is also some evidence that job insecurity, work-life conflict, and job satisfaction are related to lower back pain and neck/shoulder pain [31, 33, 35]. A meta-analysis that included 79 studies and evaluated the relationship between work stressors—defined closely to the occupational health

concept but not to health-related employer support—and backache, headache, eyestrain, sleep disturbances, dizziness, fatigue, appetite, and gastrointestinal problems [34]. Many of the studies in this area suffer from omitted variable bias, especially with respect to non-work social support and mental and physical health status. None of them included health-related workplace support as part of the work environment.

2.4 To what extent is pain associated with productivity at work? To what extent is pain associated with future medical expenditures?

A search of several academic article databases did not yield any published articles or dissertations that evaluated the potential for chronic pain to be a mediator in the relationship between health-related workplace support and the outcome variables (productivity and medical expenditures). One paper, using the same data that is used for one of the sensitivity analyses in this dissertation[1] included both workplace factors and pain in regression analyses of productivity at work [40]. The data includes two years of survey data for employees from five employers in the U.S. The measures of productivity at work used in the study were as follows: an indicator for whether the employee had any sick days in the last month, a constructed measures of presenteeism (WBA-P), and the employee's rating of their own productivity over the previous month on a 0-10 scale (10 is the highest level) [40]. Many covariates are included in the regression models (multiple regression with individual fixed effects for binary outcome, first difference for continuous outcomes): recurring pain, lack of exercise, emotional health below

[1] The sample used in the paper and in this dissertation, is comprised of U.S. employees from 5 different employers with two time points (survey data).

seven on 0-10 scale, cannot afford healthcare, cannot afford food, cannot afford medical care, high blood pressure, smoking, high cholesterol, unhealthy diet, lack of exercise, heavy alcohol use (more than one drink/day women or two drinks/day for men), wear seatbelt less than 90% of time, emotional health below seven on 0-10 scale, social ties below average, job dissatisfaction, boss treats employee as their boss rather than as their partner, not getting to use strengths on job, environment not open and trusting, perceived organizational care for well-being less than seven on 0-10 scale, sex, age, marital status, education level, manager, job tenure, and employer indicators [40]. The indicator for recurring pain is the same measure as used for this dissertation[2].

Recurring pain is found to be significantly related to lower productivity for each of the three outcomes [40]. The measure of organizational support in the paper by Yuyan Shi and colleagues is more general than the one used in this dissertation, which focuses on health related support. Their general measure of lack of organizational support was statistically significant in the models of job performance and the presenteeism index (WBA-P) [40]. The measure was associated with reduced productivity in both cases [40]. Several of the other measures of negative job characteristics were also associated with increased presenteeism and decreased job performance [40]. While using a similar data source (including the WBA survey given to employees), the data used in this dissertation comes from a larger sample with more employers. The panel sample used for the paper by Yuyan Shi and colleagues is also different from the data used for this dissertation because every employer in the published paper's sample

[2] This variable is discussed in greater detail in Chapter 4.

implemented a "multidimensional workplace wellness program" in between the two survey years—leading to difficultly in attributing the associations between the variables [40]. This dissertation also uses different control variables motivated by its conceptual model.

A recent meta-analysis evaluated 275 effects from 153 studies and found a small positive association between work strain and absenteeism and between illness and absenteeism using structural equation models [26]. An interesting paper using a sample of 105 full-time nurses found that elevations in salivary cortisol mediated the effects of job demands and job control on health care costs measured over a 5-year period [41]. Age, BMI, smoking status, somatic complaints and additional physical reactivity were covariates in the analysis [41]. The study did include mental health care costs separately, but they were not predicted by job demands or physical reactivity [41].

The relationships between pain and productivity at work and between pain and medical expenditures are key components in evaluating the mediation proposed by hypotheses B-2, B-3, B-4, and B-5. The remainder of this section discusses the background for these relationships.

One study found 55% of employees with pain reported at least one additional outpatient visit to a medical provider for pain and large increases in work limitations relative to a very healthy comparison group [42]. Another study that used data from multiple sources such as the Medstat Market Scan Health and Productivity Management database, the Midlife in the United States survey, and the American Productivity Audit, found that musculoskeletal conditions (usually a primary source of pain) were one of the top ten most expensive conditions when

medical and productivity costs were combined [43]. Other researchers have found that pain conditions result in adverse impacts on productivity even after controlling for a variety of factors such as age, gender, smoking status, use of relaxation medications, life dissatisfaction, race/ethnicity, sick pay status, and union membership [22, 44, 45].

There are two main methods of estimating the role of pain in medical expenditures. Under the diagnosis specific method, administrative medical claims are used to define and aggregate all expenditures directly related to pain. Usually, studies in this area rely on International Classification of Diseases (ICD) codes to classify expenditures. This use of ICD codes may underestimate pain-related expenditures because some pain-related care, such as hospitalization for mechanical device problems, is not incorporated [46]. In contrast, the "incremental" method errs on the side of attributing too large a share of expenditures to pain by comparing expenditures of patients suffering from pain to expenditures of patients not suffering from pain despite evidence that patients' expenditures for non-pain related care increase if they are in pain [47]. Studies using the incremental method usually assume that non-pain conditions have the same prevalence in the populations with and without pain (they do not control for additional medical comorbidities).

A study that used the incremental method with Medical Expenditure Panel Survey (MEPS) data, found that those with spine problems had higher medical expenditures than those without, but the difference in expenditures decreased when the authors controlled for comorbidities [46]. Using only data from administrative claims, two studies found higher overall medical expenditures for

individuals in the 1-3 months after an initial doctor's visit for neck or back pain [47]. The relatively short time period implies that these studies were unable to capture a broader picture of total utilization [46, 47]. They also left out many confounding factors that influence utilization such as sex and age [46, 47].

The health economics literature generally focuses on the share of employer costs that are attributable to different conditions without accounting for the potential influence of health-related employer support and other psychosocial workplace factors [1, 43, 48-51]. One study that used MEPS data and adjusted for age, gender and other characteristics found those with work-limiting pain had more missed work, fewer hours, and lower wages than those without pain as well as higher medical expenditures [1].

Many studies that evaluate the costs of health conditions, find that for certain kinds of pain there are relatively greater losses from reduced productivity at work than from medical expenditures [43, 49]. These other costs include short-term disability, workers' compensation, incidental absence and turnover as well as direct productivity loss. A review of lower back pain studies published between 1997 and 2007 found that among studies reporting total costs, the costs from lost productivity (indirect costs) were greater than the costs of medical care (direct costs) [48]. The review also found differences in estimated shares depending on the methods used to calculate the productivity related costs [48].

Using data from surveys of employees and medical claims, the authors of another very large study (about 49,000 respondents) found that back/neck pain had relatively higher medical costs compared to productivity costs [51]. While this finding was atypical for the literature, the authors compared the coefficients of

stratified linear regressions and used a 1 to 10 scale of work performance as their measure of presenteeism, methods different from much of the previous literature [51]. The regressions did control for age, gender, and occupation but the authors only compared people with one of the focal conditions (ex. back/neck pain) to people with none of the conditions and separately to people with other conditions but not the focal condition (each condition was a separate regression) [51]. In addition to problems arising from using a linear model for medical expenditures, this estimation strategy did not allow for estimates of the relative contributions of different factors and estimated very different parameters than much of the previous literature.

2.5 To what extent does health-related employer support moderate the relationship between pain and productivity at work after controlling for additional factors? To what extent does health-related employer support moderate the relationship between pain and future medical expenditures after controlling for additional factors?

Despite a thorough search of the literature, no studies of the moderation effect of health-related employer support on the relationships between pain and productivity at work or future medical expenditures were found. This section discusses the literature that is conceptually closest to the topic of the research questions. A measure of the psychosocial safety climate predicted changes in employee engagement and moderated the relationship between emotional demands at work and emotional exhaustion in one study [52]. A study of Finnish trade-union members (n=884) used the match between respondents' desired and actual weekly work hours and whether efficiency was the most important factor in work situations

to predict absenteeism and presenteeism after stratifying based on the respondent's health status (0-7 poor or 8-10 good) [53]. Age, sector of economy, size of establishment, respondents' estimate of their own replaceability, and whether or not the respondent had to obtain certification for medical absence were covariates [53]. The authors found agreement between desired and actual hours reduced both productivity outcomes for respondents with poor health [53]. They also found that efficiency demands increased presenteeism for respondents with good health [53]. Absenteeism was defined as an indicator of whether the employee had been absent at least 2 times because of illness in the year preceding the study [53]. A search of several academic article databases did not yield any additional published articles or dissertations looking at the potential for health-related employer support as such moderating factors.

2.6 Significance

This dissertation contributes to the literature in a number of ways. The questions it asks are different than have been asked in previous studies, the data and some of the measures are new, and the methods are also different than have been used in some of the previous literature. The remainder of this section describes each area of contribution in turn.

Research Questions

This dissertation evaluates pain as potential mediator for health-related employer support in its relationships with medical expenditures and productivity at work. These relationships have been neglected in the literature. In a recent review, Schultz and coauthors found only 3 studies—discussed earlier in this review—that included healthcare expenditures, pharmacy expenditures, absenteeism costs, and

presenteeism costs in their assessment of condition-specific costs but they did not include work environment and chronic conditions as potential confounders [54]. Moreover, this dissertation examines health-related employer support as a potential moderator of the relationships between pain and future medical expenditures and between pain and productivity at work. Employees with pain may be less motivated to maintain their productivity because health-related employer support may decrease the costs associated with lower productivity. Employees with pain may also obtain more medical treatment because health-related employer support may lower their opportunity cost of time.

Data and Measures

The sample used for this dissertation provides evidence for U.S. workers rather than for workers in other countries, who may have very different cultural circumstances surrounding pain, different public policies, different health care environments, and different reactions to different psychosocial work environments. A cross-sectional pooled dataset of Well-being assessments (WBA) from 40,036 employees across 15 different companies compose the data for this dissertation (an additional 2,725 individuals are dependents). For 5 of these companies, two WBAs from consecutive years form an additional longitudinal pooled dataset.

Medical, pharmacy, and mental health claims are also available for one employer in the cross-sectional sample. Previous studies have generally included only expenditures for physical health care or included only administrative claims data with no linked survey component. Excluding mental health expenditures may lead to different conclusions than including them because people may seek out different types of care in response to pain and workplace stress. This study will use

the incremental method to compare medical expenditures but will control for comorbidities to avoid some of the biases of previous work.

This paper differs from the wellness program literature because it uses employee-level survey data that allow for variation within worksite, whereas other studies have used worksite-level measures. The health-related employer support measures used in this dissertation may capture perceptions not captured by the traditional psychosocial or workplace safety measures.

The measurements of pain and of relative self-rated performance are different in this study from much of the previous literature. Because pain is often not diagnosed [1] or occurs in conjunction with diagnosed medical conditions, this study captures a more complete picture of the role of pain in the workplace than others have because of its broader definition. Other measures of presenteeism may not account for employees' efforts to "make up the time" whereas employees are more likely to include this substitution in their own assessments or their relative productivity.

Methods

While a few other studies have looked at both future medical expenditures and productivity using the same sample, which reduces omitted variable bias and increases efficiency, they used definitions of pain that that included work-impairments (ex. defining pain as "pain that limits your ability to work") rather than evaluating how much pain interferes with work by measuring pain and work separately [1, 48]. This study includes analyses with a constant sample for all research questions as a sensitivity analysis. The sample for the research questions that do not use medical expenditures as an outcome are larger than most in the

literature and also include a greater geographic and occupational diversity for the U.S.

Additionally, this study controls for more individual-level factors than has been done in previous individual-level studies, thereby reducing omitted variable bias. For example, non-work social support may substitute for health-related employer support, so not including it might lead to bias in estimates of the coefficient on health-related employer support. This study also includes statistical methods such as multiple imputations that have not been used in previous studies of similar topics—hopefully reducing bias.

Chapter 3. Conceptual Model

This chapter describes the overarching conceptual model and then describes the conceptual models that guide the empirical work for each outcome, pain, productivity at work, and future medical expenditures. The models for each outcome mirror the "shape" of the overarching model for clarity. To keep the conceptual models simpler, only the most critical relationships are shown as paths but some of the many other possible relationships between predictors are addressed in sensitivity analyses.

3.1 Overarching Conceptual Model

Each path in the overarching conceptual model is labeled with a number that corresponds to the research questions (Figure 2). The two reduced form research questions: (A-1) is health-related employer support associated with productivity at work after controlling for additional factors other than pain and (A-2) is health-related employer support associated with future medical expenditures after controlling for additional factors other than pain. These research questions evaluate the total impact of health-related employer support on productivity at work (paths 1, 2, and 2") and on future medical expenditures (paths 1, 3, and 3"), including both the indirect effects and direct effects. There are also five mediation research questions: (B-1) to what extent is health-related employer support associated with pain (path 1), (B-2) to what extent is pain associated with productivity at work (path 2), (B-3) to what extent is pain associated with future medical expenditures (path 3), (B-4) to what extent does controlling for pain attenuate the association between health-related employer support and productivity at work (path 2"), and

(B-5) to what extent does controlling for pain attenuate the association between health-related employer support and future medical expenditures (path 3”). The two moderation research questions: (C-1) to what extent does health-related employer support moderate the relationship between pain and productivity at work after controlling for additional factors, and (C-2) To what extent does health-related employer support moderate the relationship between pain and future medical expenditures after controlling for additional factors, evaluate paths 2’, and 3’, respectively.

3.2 Conceptual Model of Pain

This first section discusses the conceptual model of pain because the relationship between health-related employer support and pain underlies several of the other research questions. The dominant conceptual model in chronic pain research is the “biopsychosocial model,” which recognizes that the context for pain is biological, psychological, social/family, and cultural [55]. The conceptual model of pain in this dissertation recognizes a similar set of factors as contributing to pain. Starting at the top-middle of Figure 3, health-related employer support may affect pain (Figure 3, path 1). Health-related employer support may take many forms, support for employee efforts to improve their physical and emotional health that is the focus of this dissertation. Employees with this type of health-related employer support may have greater access to health resources and may be able to secure modifications to their work environment or schedule that allow them to better manage and prevent ill health. While pain is highly individualized, modifications to work and living environments may help reduce pain for many people [1]. The potential role of health-related employer support to allow employees to improve

health combined with the potential for pain to be modifiable, leads to the following hypothesis for research question **B-1: greater health-related employer support will be associated with reduced chance of pain** (arrow 1). Greater health-related support should reduce the prevalence of pain in employees by allowing them greater latitude to take steps to reduce their pain, by providing them with more health related resources or by making accommodations to employees' work environment (ex. providing ergonomically designed workstations).

Psychosocial Workplace Factors Moving counter-clockwise to the top-left of the figure, other psychosocial workplace factors have been shown to be related to a variety of health outcomes, such as cardiovascular disease and mental health, and may also affect pain [4]. The Demand-Control Model, as first written about by Karasek in 1979, emphasized two aspects of the work environment: the employee's level of control over their work and the employee's level of demands [56]. Karasek developed this model for work environments where chronic stressors were the product of organizational decisions. Workers with above average demands and below average decision latitude are said to have "job strain" [56, 57]. While many studies have found significant positive relationships between job strain and coronary heart disease, poor mental health and increased work systolic ambulatory blood pressure, the results are mixed for other behaviors and health outcomes [4, 57].

The concept of Iso-strain adds social support to the Demand-Control Model in an attempt to capture additional psychosocial factors leading to healthy or unhealthy work environment [4, 58]. Social support at work comes from supervisors, coworkers or both groups. Social support can be further classified into

the instrumental and the emotional [4]. Iso-strain occurs when there is both job strain and a lack of social support. While not a lot of work has tied iso-strain to health outcomes, there is some suggestive evidence that high social support may moderate the effects of job strain on health and that iso-strain increases risks of poor health outcomes (including pain) above the risks of job strain alone [4, 58].

Another model of psychosocial factors, the Effort-Reward Imbalance Model developed by Siegrist "claims that lack of reciprocity between 'costs' and 'gains' defines a state of emotional distress, which can lead to the arousal of the autonomic nervous system and associated strain reactions"[59]. Effort-Reward Imbalance (ERI) has extrinsic and intrinsic components. The extrinsic components include demands/obligations and motivation[4, 60]. The intrinsic components are labor income, career mobility/job security, esteem/respect, and motivation. Over-commitment, a part of motivation, may prevent people from appropriately assessing the costs and gains of their position and may lead to continued ERI.

As mentioned, low control, job satisfaction, and job insecurity are examples of psychosocial factors that have been found to be associated with different types of pain. It is likely that there are biobehavioral mechanisms that create the relationship between psychosocial workplace factors and pain. The possibility that psychosocial workplace factors and health-related employer support affect other dimensions of health, such as obesity, is represented by the arrows that go around the most of the diagram. While these relationships are important, they are not explicitly modeled in the empirical analysis because physical and mental health status is controlled for in the regression model.

Moving counter-clockwise around Figure 3, non-work responsibilities, non-work social support, physical and mental health status, physical health behaviors, and physiology are additional factors that may affect pain.

Non-Work Responsibilities Starting at the bottom-left of the figure, non-work responsibilities, such as caregiving, may entail lifting outside of work (ex. transfers from bed to wheelchair) and may put individuals at an increased risk of pain [61, 62]. Other elements of non-work responsibilities, such as parenthood, may also increase risk of pain [63]. Non-work responsibilities may also aggravate other conditions that cause pain, such as arthritis.

Non-Work Social Support Non-work social support may directly affect an individual's level of pain and their ability to cope with pain they experience [1]. Moving to the right in the figure, having social support outside of work decreases the risk of pain and may improve individuals' abilities to cope with pain. This has been shown in literature primarily through acute pain, including experimentally, but has also been found to be associated with chronic pain [1, 64, 65]. The relationship with chronic pain is more complicated because individuals with chronic pain may also withdraw due to pain—reducing their available level of social support [1].

Physical and Mental Health Status Particular health conditions, such as diabetes or cancer, may cause pain directly, and overall health may be a factor in susceptibility to pain (box is at the bottom-middle of Figure 3) [1]. Pain can also be caused by efforts to repair or mitigate the effects of other health conditions, such as persistent post-surgical pain caused by coronary artery bypass surgery [66]. The emotional context for pain, for example the presence of negative emotions, has been shown to be a risk factor for both acute and chronic pain [1]. Mental health

disorders are often comorbid with chronic pain, especially depression, anxiety and substance abuse disorders [55, 67]. Furthermore, pain may influence mental health, such as by increasing anxiety, since it is an emotional experience [1, 67].

Physical Health Behaviors Continuing to move counter-clockwise, physical health behaviors, such as exercise, may increase or decrease individual risk of pain. While pain can limit physical activity, there has been documentation of beneficial effects of safe exercise on chronic pain [1]. Other physical health behaviors, such as drug and alcohol use may also be related to pain and mental health. Alcohol use in particular has been shown to reduce pain—as much as 28% of people with chronic pain use alcohol to reduce pain, despite the risks and potential health consequences [68]. Physical health behaviors also have a reciprocal relationship with physical and mental health status and are addressed with sensitivity analyses [69].

Physiology Aspects of physiology may also influence pain. Genetic factors can influence the way that pain-related information is processed by the central nervous system, may affect the strength of the nociceptive response (how nerves transmit signals of pain to the brain), and be partially responsible for the observed gender differences in the perception, tolerance and response to pain[3] [1, 66, 70, 71]. There is also some evidence that genetic factors influence individual likelihood of addiction to opioids that can be used to treat chronic pain [72].

[3] Gender differences may also be linked to hormones, serotonin, dopamine, "gender roles", and other factors. According to recent work, the distinction between the biologic and psychosocial aspects of differences in pain by gender or sex, may be artificial 70. Fillingim, R.B., et al., *Sex, Gender, and Pain: A Review of Recent Clinical and Experimental Findings.* The Journal of Pain, 2009. **10**(5): p. 447-485.

Physical Load At Work Physical load at work, including lifting, bending, maintaining awkward postures, and twisting directly influence pain as discussed in chapter two and is shown at the top-right of Figure 3 (counter-clockwise from last box). Repetitive motion is another physical load aspect of work that has been shown to cause pain and increase the risk of injury. Of course, individuals with pain are also less likely to select jobs that have a high physical load. This means that in the cross-section the relationship between pain and physical load might be smaller than it would be without the effects of selection.

3.3 Conceptual Model of Productivity

Productivity at work is another of the major conceptual outcomes and is affected by a variety of factors. Models of productivity at work share some features in common with model of labor supply. In a classical economics framework, employees choose the amount of time they spend working (labor supply) and partially determine their level of human capital [73-76]. Generally, human capital is a person's stock of resources or knowledge that is either innate or acquired that furthers their productivity [77-79]. More recently, the literature has also begun to assess the role of psychosocial factors as the area of "human resource management" [80]. However, the factors are different than those commonly studied in occupational health. From an occupational health perspective, production and management processes (work environment) play a critical role in both productivity and employee health. In the model used in this dissertation (Figure 4), productivity at work is influenced by pain and health-related employer support as well as by other factors that can either be viewed as aspects of human capital or as environmental.

Pain Beginning with one of our concepts of interest (middle-left of Figure 4), pain should directly reduce productivity at work because it makes work-related tasks more difficult to carry out. Pain may also induce employees to seek medical care—increasing absence for treatment. **Hypothesis B-2, having pain will be associated with lower productivity at work** is for testing this relationship (arrow 2).

Health-Related Employer Support Moving clockwise around the figure, health-related employer support should influence productivity at work primarily through pain. Greater health-related employer support should reduce the amount of pain suffered by the workforce, and so be associated with increased productivity. This idea corresponds to **Hypothesis A-1: greater health-related employer support will be associated with greater productivity without controlling for pain** (arrows 1, 2, and 2”). The direct effect of health-related employer support after controlling for pain is shown by arrow 2” and corresponds to **Hypothesis B-4: controlling separately for pain will attenuate any positive associations of health-related employer support with productivity at work.** As shown in the Figure, this conceptual model also posits that health-related employer support may moderate the relationship between pain and productivity at work (shown by arrow 2’). For employees with pain, greater support should decrease the costs associated with lower productivity—employees with pain will be less motivated to maintain their productivity at its original level. The relevant **hypothesis is C-1: the negative association of pain with productivity at work will be larger for those with health-related employer support than for those without.**

Psychosocial Work Environment Continuing to move clockwise around the figure (bottom-left) psychosocial aspects of the work environment may also affect productivity [81, 82]. Employees are likely to be less productive if engaged in interpersonal conflict or if the psychosocial environment affects their ability to concentrate and perform job tasks [52, 83]. Interestingly, many of the production models that have increased production, such as lean production, may have also increased the psychosocial hazards of work, although there is heated debate in this area [4, 84].

Technology/Firm Capital and Human Capital According to basic economic theory, each worker's productivity depends on their level of human capital as well as on the level of capital they can use on the job (technology/firm capital). The level of capital (or technology) can directly affect the productivity of each worker—for example, using a calculator compared to an excel spreadsheet to generate product forecasts. Human capital is generally thought of as having two components, one based on the worker's individual skills and knowledge and the other based on the worker's level of firm specific knowledge [75, 79]. Individuals with more skills and greater knowledge of their jobs have the capacity to be more productive than individuals with fewer skills and less knowledge.

Physical and Mental Health Status Moving clockwise, physical and mental health status may affect the type and quality of work tasks as well as the speed with which tasks are accomplished. Individuals with worse physical and mental health are likely to be less productive than individuals with better health, all else equal [85-87].

Non-Work Responsibilities Greater non-work responsibilities may cause employees to shirk their responsibilities at work or may distract them while they are at work or increase their cognitive load, making them less effective at work.

3.4 Conceptual Model of Medical Expenditures

Future medical expenditure, a function of prices and utilization, is the other major outcome in the overarching conceptual framework. There are a few different theoretical frameworks for determining the consumption of health services, and therefore expenditures. One of the most dominant models in health services research is the Anderson model of health. Initially, this model had predisposing characteristics, enabling factors, and need as inputs into health services utilization [69, 88]. The Anderson model currently divides factors contributing to outcomes (perceived health status, evaluated health status, consumer satisfaction) into interrelated categories: environment (health care system, environment), population characteristics (predisposing, enabling, need), and health behaviors (personal health factors, use of health services) [69, 88].

Economic theory primarily approaches health services utilization in two main ways. From the perspective of traditional consumer theory, medical care utilization is determined by both supply-side and demand-side factors (demand for health/Grossman model) [89, 90]. From the perspective of principal-agent models, the agent-physician determines utilization for the principal-patient [91-93]. The model used in this dissertation is most similar to the Grossman and Anderson models in its determinations of factors that affect future medical expenditures (Figure 5).

Pain As shown on the right-hand side of Figure 5, pain is likely to increase future medical expenditures due to treatment. It may also increase the use of additional health care services for two reasons: it may aggravate comorbid conditions and because the non-monetary costs of obtaining care are reduced if the individual is already seeking treatment for pain. These ideas are tested by **Hypothesis B-3: pain will be associated with higher future medical expenditures** (arrow 3).

Health-related Employer Support As discussed for the conceptual model of pain, health-related employer support is hypothesized to reduce pain in employees (move counter clockwise in the figure). This reduction in the incidence of pain is hypothesized to lead to a negative reduced-form relationship between health-related employer support and future medical expenditures: **(A-2) greater health-related employer support will be associated with lower future medical expenditures without controlling for pain** (arrows 1, 3 and 3”). However, it may instead be the case that greater health-related employer support may allow employees greater schedule flexibility and/or more generous leave—reducing the opportunity cost of obtaining medical care. Competing hypothesis A-2 follows this logic: greater health-related employer support will be associated with higher future medical expenditures without controlling for pain**. Hypothesis B-5: greater health-related employer support will be associated with higher future medical expenditures after controlling for pain** (arrow 3”) also follows this logic. The conceptual model also allows for the possibility that health-related employer support might moderate the relationship between pain and future medical expenditure after controlling for additional factors (arrow 3’). More support for

employees with pain may increase the amount of treatment they receive by decreasing the opportunity cost of care. **Hypothesis C-2** refers to this potential moderation: **the positive association of pain with future medical expenditures will be greater for those with health-related employer support than for those without.** Additional factors that influence future medical expenditures are loosely divided into demand-side factors (bottom-right) and supply-side factors (bottom-left).

Supply-Side Factors Moving counter clockwise around the figure; provider density, facility density, area practice patterns, and area input prices are supply-side factors that may influence future medical expenditures. If certain types of care are scarce because of low densities of providers or facilities, medical expenditures might be lower because individuals may not be able to access those types of care (their non-monetary costs are high). Of course it is also possible that the relative scarcity of these resources may drive up the reimbursements offered to providers and be passed on to individuals through benefit structures. There is some evidence from regional samples that areas with greater supply have greater utilization overall, although it is mostly based on correlations [94-96]. While practice patterns are additionally likely to influence individuals' utilization [96, 97], they should not influence prices paid by individuals in the short run. Area input prices should influence reimbursement policies (and potentially individual benefit structures) [96], but should have relatively less impact on utilization.

Psychosocial Work Environment Moving to the bottom-middle of Figure 5, aspects of the psychosocial work environment may be confounders in the relationship between health-related employer support and future medical

expenditures. Psychosocial workplace factors may affect health, in turn affecting future medical expenditures, and may also affect expenditures directly. For example, Individuals who suffer from severe time constraints at work, or who work very long hours may have lower medical expenditures because their time to seek medical care might be constrained (these individuals are also likely to have worse health because of workplace factors). Adverse psychosocial conditions may also make it difficult for individuals to take time off to receive medical care. Another example is that of individuals who are unsatisfied with their current job and who may access more medical care before leaving the position and presumably their health insurance.

Monetary Resources And Out-Of-Pocket Prices If medical care is viewed as a normal good (demand increases with income), then as the out-of-pocket price of medical care rises, individuals should consume less if everything else stays the same [89, 90]. Individual out-of-pocket prices vary with the type of insurance. Insurance that is more generous translates into relatively lower out-of-pocket prices for each episode of care. The structure of benefits, such as whether the plan uses a gatekeeper model, may also influence an individual's utilization of care. Empirical evidence supports the notion that those with more insurance use more medical care [98, 99]. Moving down further in the diagram, monetary resources influence utilization through the individual's budget constraint [89, 90]. Individuals with greater financial resources are able to afford more medical services, all else being equal.

Preference for Health Care Moving counter clockwise around the figure, an individual's preference for health care is an important demand-side factor because

individuals with different preferences for health care may have different levels of utilization and expenditures even if they are otherwise identical [100, 101].

Physical And Mental Health Status Individuals with greater physical or mental illness are likely to have higher future expenditures[4] because they are more likely to seek and get medical treatment. This is shown in the diagram by the box for physical and mental health status.

[4] Function of total prices and utilization.

Chapter 4. Data and Measurement

These data are from a restricted-use dataset that includes health insurance claims and a questionnaire designed to assess well-being and health risks (WBA). Healthways LLC provided the dataset free of charge for this particular project (agreement between Susan Ettner and Healthways LLC). The UCLA IRB (IRB#11-003195) approved the study. This chapter describes these data and the particular samples used for each of the research questions. This chapter also describes how the measures relate to the conceptual models discussed in Chapter three.

4.1 Study Design & Setting

This dissertation primarily uses a pooled sample of employees from 15 U.S. employers. State of residence information is missing for every employee of one of the 15 employers, so that employer is dropped from all analyses. Employees for 13 of the remaining 14 employers took the WBA in 2010; employees of the other employer took it in 2008. Of the 13 employers whose employees took the WBA in 2010, five administered an additional WBA in 2011—giving two years of linked survey data for five employers. Both time points are used for some sensitivity analyses. Administrative medical claims, including mental health claims, are available for employees of the employer with the 2008 WBA. These medical and mental health claims for eligible employees span the period 1/1/2007 to 12/31/2009.

There is some variation in employer size and location in the productivity sample. Eight of the employers each have between 150 and 500 respondents. Four of the employers have between 1,000 and 3,000 respondents each. The majority of

the sample is made up of two large employers that each have between 10,000 and 15,000 respondents. The sample is also spread out geographically, as seen in Figure 6. There are respondents in every state, but most of the sample is concentrated in California, Iowa, Illinois, and New York (the data shown in the map are from the final sample—i.e. the exclusion criteria have already been applied).

4.2 Merging Claims and WBA data

Each employee within each employer has an encrypted identification number. The claims data and the monthly health insurance eligibility data identify employees with the same encrypted identification number. These numbers were used to link the claims and the WBA data for the appropriate employees.

4.3 Participants

The estimation samples differ by research question and are named for the relevant outcome variables. This section discusses the exclusion criteria and descriptive statistics for the different estimation samples. Table 4.1, below, summarizes the exclusion criteria for the different estimation samples.

Table 4.1: Exclusion Criteria for Estimation Samples Listed by Outcome

Outcome Variable: Analysis Description	**Applicable Research Questions**	**Individuals are excluded from the estimation sample if:**	**Estimation Sample Size**
Productivity at Work: Original	A-1, B-2, B-4, C-1	1. They were a dependent of an employee 2. They did not report working for their employer for at least 12 months 3. Information on their state of residence was	14 employers N= 34,359

		missing	
Pain: Original	B-1	1. They were a dependent of an employee 2. They did not report working for their employer for at least 12 months 3. Information on their state of residence was missing	14 employers N= 34,359
Future Medical Expenditures: Original	A-2, B-3, B-5, C-2	1. They were a dependent of an employee 2. They did not report working for their employer for at least 12 months 3. Information on their state of residence was missing 4. They were not continuously eligible for health insurance for 12 months after survey	1 employer N= 1,584
Future Medical Expenditures: Sensitivity Analysis controlling for previous medical expenditures	A-2, B-3, B-5, C-2	1. They were a dependent of an employee 2. They did not report working for their employer for at least 12 months 3. Information on their state of residence was missing 4. They were not continuously eligible for health insurance for 12 months after survey 5. They were not continuously eligible for health insurance for 12 months before survey	1 employer N= 1,371
Future Medical Expenditures: Sensitivity Analysis using all available claims data	A-2, B-3, B-5, C-2	1. They were a dependent of an employee 2. They did not report working for their employer for at least 12 months 3. Information on their state of residence was	2 employers N= 9,767

		missing 4. They were not eligible for health insurance for *any* of the 12 months after survey	
Productivity at work: Sensitivity Analysis controlling for drug and alcohol use	A-1, B-2, B-4, C-1	1. They were a dependent of an employee 2. They did not report working for their employer for at least 12 months 3. Information on their state of residence was missing 4. Their employer's survey did not include questions about drug and alcohol use	13 employers N= 32,603
Productivity at work: Sensitivity Analysis using employees of 1 employer that has dependents	A-1, B-2, B-4, C-1	1. They were a dependent of an employee 2. They did not report working for their employer for at least 12 months 3. Information on their state of residence was missing 4. Their employer's survey did not include dependents	1 employer N=11,368
Productivity at work: Sensitivity Analysis using dependents of employees of 1 employer that has dependents	A-1, B-2, B-4, C-1	1. They did not report working for their employer for at least 12 months 2. Information on their state of residence was missing 3. Employer's survey did not include dependents 4. They were an employee	1 employer N=1,826
Pain: Sensitivity Analysis controlling for drug and alcohol use	B-1	1. They were a dependent of an employee 2. They did not report working for their employer for at least 12 months 3. Information on their	13 employers N= 32,603

		state of residence was missing 4. Their employer's survey did not include drug and alcohol use questions	
Pain: Sensitivity Analysis controlling for race/ethnicity	B-1	1. They were a dependent of an employee 2. They did not report working for their employer for at least 12 months 3. Information on their state of residence was missing 4. Their employer's survey did not include questions about race/ethnicity	10 employers N= 17,975
Pain: Sensitivity Analysis using employees of 1 employer that has dependents	B-1	1. They were a dependent of an employee 2. They did not report working for their employer for at least 12 months 3. Information on their state of residence was missing 4. Their employer's survey did not include dependents	1 employer N=11,368
Pain: Sensitivity Analysis using dependents of employees of 1 employer that has dependents	B-1	1. They did not report working for their employer for at least 12 months 2. Information on their state of residence was missing 3. Their employer's survey did not include dependents 4. They were an employee	1 employer N=1,826
Pain: Sensitivity Analysis using two time points	B-1	1. They were a dependent of an employee 2. They did not report working for their employer for at least 12 months 3. Information on their	5 employers N=18,140

		state of residence was missing 4. They did not have two years of survey data	

The first three exclusion criteria apply to all of the original analyses and most of the sensitivity analyses: (1) They were a dependent of an employee; (2) They did not report working for their employer for at least 12 months; and (3) Their information on state of residence was missing. Most exclusion criteria apply to both of the estimation samples. Employees' dependents are excluded from the main analyses because their information is available for only one employer and the employers of those dependents are unknown, making it impossible to control for employer effects. Employees that had not been working for their current employer for at least 12 months at the time of the survey are excluded because of the recall length of the measure of recurring pain. This criterion is even used for the research questions that do not control for pain so that the estimates of the association between health-related employer support and productivity at work and future medical expenditures are comparable to the estimates when controlling for pain. Employees without information on state of residence are excluded because we could not match them to state-level characteristics needed for some of the analyses (one employer is entirely missing data on state of residence[5]). For the samples used to estimate future medical expenditures, there are two additional criteria that are common to almost all of the analyses: employees must belong to an employer group with available claims and eligibility data, and employees who were not

[5] The state information for this employer is not been available.

continuously eligible for health insurance are excluded because their medical expenditures are likely to be incomplete.

Additional exclusion criteria are used for some of the sensitivity analyses. Sensitivity analyses that control for additional variables, such as drug and alcohol use or race/ethnicity, have smaller samples because not all of the original employers included every survey question. For the sensitivity analyses of pain and productivity at work that include two time points, employees are excluded if they do not have both years of survey data. This excludes employees who work for employers that administered the survey only once, as well as those who were hired or left the employer during the year in between surveys or who chose not to fill out the survey in one or both years. The biases that might stem from these exclusion criteria are discussed in chapter seven.

For a few of the sensitivity analyses, the exclusion criteria are very different that for the original analyses. The future medical expenditures sensitivity analysis using all available claims data uses a much larger sample than the original future medical expenditures analysis. It includes claims data from a second employer that are incomplete because not all 12 months after the survey are available. Instead of requiring that all employees in the sample are continuously eligible for health insurance, this sensitivity analysis includes any employee who was eligible for at least one month of health insurance during the year after the survey. In the sensitivity analysis of future medical expenditures that controls for previous expenditures, the exclusion criteria of the original analysis are expanded to exclude individuals who were not continuously eligible for health insurance during the year before the survey (claims are aggregated across the year before the survey was

administered to obtain previous expenditures). For some sensitivity analyses of productivity at work and pain, the sample is restricted to one employer that had dependents take the survey as well as employees. Figures 7 and 8 illustrate how the exclusion criteria affect the sample size for the primary samples.

4.4 Measurement Models and Variable Construction

This section describes the measures of key concepts in the literature and gives details of the measures used in the analyses by linking them to the conceptual models presented in Chapter Three. For reference, Table 9 lists the measures that are used in the analyses by research question. The remainder of this section describes the measures, variable construction and descriptive statistics for each variable used in the analyses, organized by the measurement models.

4.4.1 Measurement and Variable Construction for Model of Pain

The measurement model corresponding to the conceptual model of pain is given in Figure 10. The outcome of the model is pain in the last 12 months, shown in the middle of the diagram. According to the International Association for the Study of Pain, pain is: "An unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage....Pain is always subjective....It is unquestionably a sensation in a part or parts of the body, but it is also always unpleasant and therefore also an emotional experience." [1] Pain with sudden onset that is "expected to last a short time" is called acute [1]. Acute pain may reoccur, so that experiences of pain and pain-free periods are intermixed [1]. In contrast, chronic pain is usually defined to last more than a few months (three to six) [1].

In this dissertation, the variable for pain is constructed from responses to a three-part question asking if the individual has had recurring pain in the past 12 months due to a neck or back condition, knee or leg condition, or other. Employees were able to respond with yes, no or don't know for each of the three choices (neck or back, knee or leg, and other). As can be seen in Figure 11, about 29% of individuals in the sample reported pain in one of the three areas, about 11% reported pain in two areas, 3% reported pain in all areas, 55.64% reported no pain, and 1.93% reported that they didn't know or had missing values. For the main analyses, the pain variable is coded as a binary indicator for whether an employee answered yes to any of the three areas of the question. "Don't know" answers were coded as missing[6]. Using this coding, a large proportion of the sample, 44.43%, reported that they had suffered from recurring pain in the past 12 months while 55.64% reported no pain and 1.93% reported that they didn't know or had missing values. In sensitivity analyses, pain is analyzed by the body areas mentioned in the original question.

This definition of pain likely captures individuals who suffer from either recurring acute pain or from chronic pain. The question does include "recurring" but chronic pain may last for as few as three months and so may reoccur within a year (the length of recall for the question). In sensitivity analyses, the question about pain is combined with a question about pain in the previous day. If an employee answered that they did suffer from pain in the previous day and answered that they suffered from recurring pain in the last 12 months (the variable defined for the original analysis) then they are coded as suffering from pain. Overall, 15.88% of

[6] Very few people responded "don't know" or had missing data.

employees reported suffering from pain in the past day. Using that to redefine the dependent variable (and not including employees who were missing answers to either question), 12.44% of employees are classified as having pain.

Physical Load at Work Unfortunately, physical load at work was not measured in the survey instrument (top-right of Figure 10). Occupation codes could not be linked to O*Net data to provide an estimate of physical labor because the categories were not similar enough. Education level has been found to be significantly negatively related to validated measures of physical activity at work and has been used to proxy for physical load when no measure of physical load is available [44, 102]. Education is used to partially proxy for physical load at work (the specific variable and coding are discussed later in the section). Occupation codes are also used to partially measure physical load. Several occupation classes are also represented in the sample. Table 13 gives the percent of the sample by the following categories:

- Professional worker
- Manager, executive, or official,
- Clerical or office worker,
- Manufacturing or production worker,
- Service worker,
- Sales worker,
- Business owner,
- Installation or repair worker,
- Transportation worker,
- Construction or mining worker,
- Farming, fishing, or forestry worker,
- Other, and
- Prefer not\Don't Know\Missing.

About 78% of the sample works in occupations that fall in the professional worker, manager\executive\official, or clerical\office worker categories. There is relatively less representation of more physically demanding jobs, although the smallest

category still has 97 employees from five employers. In the analyses, professional worker is used as the reference category with binary indicators for the other occupation categories listed above (Prefer not\Don't Know answers are treated as missing). Because physical load may also differ by employer and work-site, indicators for employer and census region are added as additional proxy measures.

Health-Related Employer Support Moving counter clockwise in Figure 10, health-related employer support is the main predictor of interest in the analysis of pain. Health-related employer support has previously been measured in the literature by direct observations of programs/spaces/facilities, by surveying key individuals in companies to determine their policies and programs, or by asking employees about the programs provided at their workplace [10, 103]. Currently available tools, such as HeartCheck, WorkingWell, and EAT focus on site level/organizational factors and provide very detailed information on available resources for people with specific health conditions at different worksites [103, 104]. Another measurement tool with fewer items has been used to measure health and safety climate, but focuses on “stress” and “physical health/disease” more generally [105, 106]. Other instruments such as the Health-Promoting Lifestyle Profile were designed to measure individual lifestyles with little consideration for the work environment [107, 108].

In the survey used here, health-related employer support is measured using two binary variables indicating employer support for employee change. The variables are the Yes/No/Don’t know answers to the following questions:

- "If you wanted to make changes to be physically healthier (such as trying to lose weight, quitting smoking, etc.), would the place where you work support you, or not?" (Yes, No, Don't know)
- "If you wanted to make changes to be emotionally healthier (such as trying to reduce stress, balancing work and home life, dealing with financial concerns, reducing anxiety or depression, etc.), would the place where you work support you, or not?" (Yes, No, Don't know)

Unpublished factor analyses done by Gallup-Healthways give some indication that these two questions (and an additional question about whether the employer supports employees' well-being) are closely related and distinct from other workplace factors in their survey [109]. There have not been any analyses that compare the Gallup-Healthways measures to the organizational measures used in the literature and mentioned above. Of the measures used in the literature, the closest conceptually are the measures that describe the work environment by direct observations of programs/spaces/facilities, by surveying key individuals in companies to determine their policies and programs, or by asking employees about the programs provided at their workplace.

However, these measures are different because they ask about specific supports for health, such as gym access, rather than general climate. They are more likely to accurately measure specific features of the work environment that are generally thought to be supportive of health, such as the presence of healthy snacks at meetings, than the Gallup-Healthways measures used here. Additionally, such measures of specific features are not likely to vary within worksite and do not capture aspects of the work environment, such as actual ability to take time off for

medical reasons or unofficial accommodations made for employees with pain, that may differ within worksite by factors such as managers or shift—elements that should be captured in the individual level perceptions of the Gallup-Healthways measure.

In the analyses here, "don't know" answers are treated as missing. Because support for emotional and physical health are likely to be related, four binary variables are created from the survey questions that combine the separate answers as follows: both physical and emotional support (both), neither physical nor emotional support (neither), emotional support but no physical support (no physical), and physical support but no emotional support (no emotional). Most employees, 53.87%, reported that their employer was supportive of their making change to better both their physical and emotional health (see Table 12). In contrast, only 1.13% of employees reported that their employer was *only* supportive of their emotional health. Respectively, 6.85% and 6.39% of employees reported that their employer was supportive of *only* their physical health or not supportive at all. Many employees, 31.76% reported "don't know" or had missing values for at least one of the questions about health-related employer support. Sensitivity analyses will treat the "don't know" answers as their own category (rather than as missing) to address the possibility that a "don't know" answer means something more than a randomly unanswered question[7].

Psychosocial Work Environment Continuing to move counter clockwise around Figure 10, additional psychosocial work environment measures may influence pain as described earlier in the conceptual model. Despite the rapid

[7] This does not affect sample size because "don't know" values are imputed for the main analysis.

evolution in the measurement of psychosocial workplace factors in the past few decades, there are still many different measures [31, 35, 38, 110]. The most common measures that correspond to the conceptual models discussed in chapter three are the Job Content Questionnaire, the JCQ and the NIOSH generic job stress instrument, the Effort-Reward Imbalance Index, and the Maslach burnout inventory [56, 111-113] . The level of employee control (decision latitude) is measured by the levels of decision authority and skill discretion. Job demand is measured using the following domains: excessive work, conflicting demands, insufficient time to work, working hard, working fast, intense concentration, often interrupted, very hectic, and waiting on others. Burnout, as defined by the Maslach instrument, includes the domains of emotional exhaustion, depersonalization, and personal accomplishment [114].

There are several questions that measure aspects of the psychosocial work environment in the survey used for this dissertation [25]. They measure some of the aspects of the psychosocial measures used in the literature as described above and of the measures of employee engagement used in the literature [52, 83, 115]. Employees' job satisfaction, whether they get to use their strengths at work, and whether their supervisors create a trusting and open environment are the available measures of work environment used in the analysis of pain [25, 26]. The answer choices were basic variations of yes/no/don't know. As for health-related employer support, "don't know" is treated as missing. Nearly 82% of employees were satisfied with their jobs (see Table 12). Nearly 75% reported that they used their strengths at work, and about 81% reported that their supervisor created a "trusting and open environment." Each measure is entered into the estimation models as an

indicator where respectively one is equal to being unsatisfied, not getting to use strengths, and not having a trusting and open environment respectively. They are coded this way to match the direction of the coding of health-related employer support with having both types of support as the reference category.

Non-work Responsibilities Moving to the bottom of Figure 10, on the left, non-work responsibilities are concretized with two measures. One measure is the number of children in the household and the other denotes whether the surveyed individual provides care for an elderly or disabled person. As mentioned previously, the level and type of non-work responsibilities may affect an individual's risk of injury. The average number of children under age 18 in the household is just less than one in the estimation sample (see Table 12). About 16% of employees reported that they provide informal care for someone who is elderly or disabled. The number of children is entered into the estimation model as the raw number, while an indicator variable for providing informal care to an elderly or disabled person is used, with the reference category of not providing informal care.

Non-work Social Support Moving counter clockwise, marital status—whether or not the individual is currently married or has a domestic partner and whether the individual has friends/family they can rely on in an emergency (strong social ties) measure non-work social support that can influence perception of pain. Almost ¾ of the sample, 71%, are either married or live with a partner. Over 95% of employees responded that they could count on friends and/or family in an emergency. Both variables are entered into the estimation model as indicators.

Physical and Mental Health Status As shown in the bottom-middle of the diagram, physical and mental health status are proxied using several different

variables: BMI (calculated from reported height and weight), health conditions, smoking status, an emotional health index developed and tested by the data provider, and a general health status "ladder" measured on a 0-10 scale. Age is also included to adjust for possible differences in the ladder of self-reported health. Body mass index was calculated from reported height and weight and the sample average is near the upper end of the overweight category, 28.31 (standard deviation 6.27). BMI was entered into the estimation model as a number. The health conditions are based on questions about whether the employee had "ever been told" that they had the listed conditions. High blood pressure (22.34%) and high cholesterol (24.12%) were the most commonly reported conditions. In order of prevalence, 11.78% of employees reported depression, 9.67% reported asthma, 5.29% reported diabetes, 3.71% reported cancer, and 0.77% reported acute myocardial infarction (AMI). In answer to a question about current smoking status, 8.54% of employees reported being a smoker (question was yes/no/don't know). Health conditions and being a current smoker are entered into the estimation model as indicators.

The emotional health index is based on employees' feelings and experiences during the entire day before the survey [116]. The components of the index are whether an employee: smiled or laughed a lot yesterday, learned or did something interesting, were treated with respect all day, experienced enjoyment during a lot of the day (DLD), experienced happiness DLD, experienced worry DLD, experienced sadness DLD, experienced anger DLD, experienced stress DLD, and diagnosed with depression [116].

These items were found by Healthways to be significantly related to one another and distinct from other factors in the survey using factor analysis [109,

116]. Using data from telephone interviews with randomly sampled adults (at least 18) from all 50 states and the District of Columbia and including Spanish-speaking respondents and cell phone users, the emotional health index had a Cronbach's alpha of 0.75 at the individual level and 0.91 at the state level [116]. The average score on the 0-100 scale of emotional health was 74.47 (SD 27.84). For this dissertation, the score on the emotional health index is divided by 10 to better match the scales of the other variables. The question about general health uses a ladder metaphor where the step zero represents the "worst" health and 10 represents the "best" health [117]. The average score in the sample is 7.44 (SD 1.78). For estimation, the general health ladder is entered as number (0-10).

Physical Health Behaviors Moving to the bottom-right of Figure 10, physical health behaviors are measured by smoking status and the number of days the individual exercised in the previous week. Employees were asked how many times they had exercised in the previous week for at least 30 minutes. Rather than being entered into the estimation models as a number, exercising 0 times a week (22.2% of sample) is used as the reference category for a categorical variable. The other categories are 1 or 2 times (27.66%), and 3 or more times (50.14%). Since intensity is not measured, the categories could not be parsed into groups based on recommendations from the Centers for Disease Control and Prevention or from the American Heart Association. The categorical variable is split up into dummy variables for each category.

In sensitivity analyses, drug use and alcohol use are included as additional covariates in the regression model for the employees who were asked the relevant

survey questions[8]. Employees are asked the number of alcohol drinks they consume "in a typical week" [117]. The number of drinks is divided into a categorical variable for the analysis. The reference category is zero drinks in a week (38.94%), the other categories are 1-7 drinks (46.96%), and 8 or more drinks (14.10%)—the remainder are missing (each category except the reference is entered into the empirical model as a dummy variable). Employees were also asked about often they used drugs or medication "which affect your mood or help [them] relax" [117]. The answer "rarely or never" (78.08%) is the reference category for analysis, with indicators for the categories of "sometimes" (6.20%) and "almost every day" (10.61%)[9]. Unfortunately, this question could be interpreted to include mood regulating prescription drugs prescribed by a licensed mental health provider.

Physiology Physiology is proxied for by gender and age because both have been found to be associated with biomechanical factors that affect pain as discussed in the conceptual model chapter. 51.26% of the sample is male (represented by an indicator for male in the estimation model). The average age is 42.82 years (SD 10.86) and is entered numerically in the estimation model. Race/ethnicity is added as an additional proxy in sensitivity analyses because it is not available for all employees in the sample and may also be associated with pain due to differences in the underlying prevalence of medical conditions that cause pain, such as sickle cell anemia. The reference category is Caucasian/White (71.45% of sample). The other categories are included as dummy variables as follows: African American/Black (8.58%), Hispanic (7.48%), Asian (5.32%), Native Hawaiian/Pacific Islander

[8] Not every employee had these questions on their survey.
[9] Missing values were recorded for 5.11% of the sample.

(0.37%), American Indian/Native American (0.26), Latin American (0.48), Multi-racial (2.32), prefer not to say or don't know (3.75%).

4.4.2 Measurement and Variable Construction for Model of Productivity at Work

In the literature, productivity is often measured using absenteeism and presenteeism, especially when no physical measure such as calls per minute can be observed. While absenteeism may be defined as any days missed from work, most studies of condition-specific costs use a narrower definition—days missed from work for health reasons [1, 21, 43, 54, 118]. Presenteeism is often defined in the U.S. literature as "working while ill" [119-121]. The ill employee may view presenteeism negatively if working while ill aggravates medical conditions or damages quality of life [122, 123]. Conversely, the ill employee may view presenteeism positively if s/he derives benefits such as additional employment security or satisfaction from helping coworkers [4, 122, 124]. Employees may also choose to work while ill because they feel their job has special significance, or because of negative reactions from coworkers and supervisors in the event of absence [123, 124]. Of course, financial consequences are another important factor in the decision to work while ill.

There are a few validated presenteeism scales, such as the Work Limitations Questionnaire (WLQ) [125], the World Health Organization's Performance Questionnaire (HPQ) [126], and the Stanford Presenteeism Scale (SPS) [119]. The HPQ and SPS are designed to assess presenteeism related to health conditions whereas the WLQ has additional domains. Although their validity has been questioned, algorithms have been used to translate the results of these scales into

measurements of lost work time [120]. Various self-rated performance questions have also been used to measure presenteeism [51, 121, 127]. Health-related productivity loss has also been measured by counting disability days or by counting days of received worker's compensation [9, 43, 49, 128]. However, the threshold severity level needed to trigger such claims and the necessity that they be demonstrably work-related limits their use in the literature.

The measurement model corresponding to the conceptual model of productivity at work is given in Figure 14. In this dissertation, absenteeism is measured by the number of days missed in the last month because of the individual's own health (sick days, middle-right of figure). The number of days is measured by self-report[10]. All of the employers in the sample offer at least some paid sick leave so no additional indicator is added to denote its availability[11]. As a dependent variable, the number of sick days is just entered as the raw number reported by the employee. The average number of days missed due to health reasons is about ½ a day (SD 1.88). The vast majority of employees in the sample, 81%, did not report missing any days in the past 28 (see Figure 15). About 10% of employees reported missing one day, and the remaining employees reported missing more than one day.

Another measure of productivity used in this dissertation is self-rated relative productivity. It is based on the difference between self-rated productivity and self-rated productivity of a hypothetical "usual worker" in a job "similar to theirs" based on the last 28 days [129]. The ratings are on a 0-10 "ladder" scale where 0 is the

[10] No administrative data set can be linked to the current sample.
[11] The employers are de-identified so it cannot be determined how much leave they offer.

worst job performance, and 10 is the highest level of performance (of a "top worker"). Employees' average rating of their own work performance is 8.36 (SD 1.20, see Figure 16). Employees' average rating of the hypothetical usual worker is lower, 7.36 (SD 1.44). Many more responses are missing for the rating of a usual worker than for the self-ratings. The difference between self-rated productivity and rating of the "usual worker" is called self-rated relative productivity and is the dependent variable used for analysis [130]. As can be seen from the histogram of self-rated relative productivity (Figure 17), most individuals did rate themselves higher than the usual worker but the absolute value of the difference is generally under five. Moving clockwise in the diagram, the measures of the psychosocial work environment were explained in the previous section.

Technology/Firm Capital The level of technology (technology/firm capital) available to employees may differ between industries and so indicators for the firms are used to partially measure the level of technology. However, within firms, the amount of technology available to each employee may also differ, so occupation codes are also used to proxy for the level of technology.

Human Capital Human capital is measured by the employee's highest level of education and their tenure under their current employer. These two measures are empirical proxies for the individual's level of human capital and firm-specific experience. The average education level in the sample is relatively high; with 38.05% of the sample having graduated college and 17.60% of the sample having post graduate work or a degree (see Table 12). Only 5.43% of the sample reported having less than a high school diploma. 10.63% reported having a high school degree or diploma, 5.46% reported technical or vocational school and 21.85%

reported having some college. In the estimation model, less than high school is the reference category and the other categories are entered as a set of dummy variables. The average length of time at the current job is 11.72 years (SD 9.76), keeping in mind that employees with tenure of less than a year are excluded from the sample. Continuing to move clockwise, the measures of non-work responsibilities and physical and mental health status were explained previously.

4.4.3 Measurement and Variable Construction for Model of Future Medical Expenditures

Figure 18 presents the measurement model for future medical expenditures. Starting at the top left of the Figure, future medical expenditures are measured using administrative claims data that cover inpatient, outpatient, mental health[12] and pharmaceutical insurance claims. The survey was taken in January 2008 but the exact dates are not known. Because the exact dates are not known, the date is assumed to be January 1, 2008 for all individuals and then claims are aggregated[13] for each eligible individual during a 12-month period after the survey (in this case the calendar year). Sensitivity analyses will use an alternative date (January 31, 2008) to see if the results are sensitive to the exact date. The expenditure information in the data reflects the amounts paid by the employer. Average future medical expenditures are $7,874 (SD $22,220) (see Figure 19 for a histogram). Summary statistics for the medical expenditures subsample are presented in Table

[12] Mental health services includes both services provided in a primary care setting and services provided in mental health specialty settings (this was verified by checking the data for ICD and CPT codes that are usually billed to carve-out mental health insurance plans).
[13] Prior to be aggregated, claims were adjudicated to get rid of duplicate claims. After adjudication, claims amounts that were still negative were dropped from the analysis (less than 0.34% of claims).

20. Moving to the top-right on the Figure, health-related employer support is measured as described previously. An overwhelming majority of the sample reported having both physical and emotional support (80.43%). About 6.38% of the sample reported not having either type of support, 8.65% reported having only physical support and 2.34% reported having only emotional support. Pain is also measured as described previously, and 46.09% of sample reported pain.

Supply-side Factors Moving counter clockwise around Figure 18, the measures of health services supply are at the state level. All of the measures come from the Area Resource File [131]. Compiled by the Health Resources and Services Administration, the Area Resource File "integrates data from numerous primary data sources including: the American Hospital Association, the American Medical Association, the American Dental Association, the American Osteopathic Association, the Bureau of the Census, the Centers for Medicare and Medicaid Services (formerly Health Care Financing Administration), Bureau of Labor Statistics, National Center for Health Statistics and the Veteran's Administration" [131]. Three different measures are used to proxy for "provider density" (bottom-left quarter of the diagram). The number of primary care providers per 10,000 people in the employee's state includes general and family practice physicians, general internal medicine physicians, and pediatric physicians. The sample average is 3.00 (SD 0.68) active family, general, general internal medicine, and pediatric physicians per 10,000 people in the state. The numbers of psychiatrists and specialty physicians per 10,000 people in the state are additional measures, with averages of 10.69 (SD 1.16) and 0.68 (SD 0.16) respectively. Facility density is measured using the number of hospital beds per 1,000 people in the state, with a

sample average of 3.37 (SD 0.66). Moving back towards the bottom-middle of the diagram, indicators for the employee's Census region are proxies for area input prices and practice patterns, with almost all of the employees residing in the Midwest region (97.34%).

Psychosocial Work Environment Moving to the bottom-middle of the diagram, the measures of the work environment that were described earlier are included. In this sample, 6.09% of employees are unsatisfied with their job, 17.07% reported not getting to use their strengths at work, and 19.70% reported that their supervisor does not create a trusting and open environment. Some additional measures are available for the medical expenditures subsample[14] that include: number of hours typically expected to work in a week, whether the employee learns or does interesting things in their job, whether the employee has fun at work, whether the employee has enough resources to do their job well, and if the employee faces job insecurity. Typical hours per week are measured by the number of hours employees reported that they were expected to work each week [117]. The average number of hours reported in the sample is 40.82 (SD 9.84). 16.24% of employees reported that they did not get to learn or do interesting things in their jobs. When asked about having fun at work, 25.14% of employees reported that they did not have fun at work. The measure of whether the employee has enough resources to do their job well was dichotomized so that employees who reported that they "agreed" or "strongly agreed" that they had enough resources are coded as "having enough resources" while those reporting that they "disagreed" or "strongly disagreed" are coded as "not having enough resources." Exactly 12% of

[14] These additional measures are not available for the entire sample.

employees reported that they did not have enough resources to do their job well. The measure of job security is adapted from employee responses to a question about whether their employer was increasing, decreasing, or maintaining the size of its workforce[117]. Employees are coded as facing insecurity if they reported that their employer was decreasing the size of its workforce, 8.68% in this sample [117]. All other measures are entered as binary indicators.

Monetary Resources Continuing to move counter clockwise through the diagram, monetary resources are measured using household monthly income categories harmonized between surveys to yield the following categories: up to $2999 (reference, 6.38%), $3000 to $3999 (9.03%), $4000 to $4999 (12.18%), $5000 to $7499 (12.25%), $7500 to $9999 (20.52%) and $10000 and over (13.07%). Household size is not available in the survey, so the number of children in the household under 18 and marital status are used so that the level of resources more closely approximates the monetary resources available to the individual employee.

Out-of-Pocket Prices Out-of-pocket prices are not observed. The type of health insurance plan is used to proxy for out-of-pocket prices. PPO, HMO-gatekeeper, HMO-Open Access, HMO - POS, and Indemnity are the major plan types in the data. PPO is used as the reference category, with 64.97% of employees in this type of plan. Indicators are used in the estimation model for employees who have HMO-gatekeeper plans (18.82%), HMO-Open Access or HMO-POS plans[15]

[15] These HMO categories were combined because the employees in the HMO-POS plan all had the same value for whether they had any expenditure—it was completely determined.

(12.68%) and Indemnity plans (3.53%). The 3.41% of individuals without plan type had their plan type imputed.

Preference for Health Care The only possible proxies for an individual's preference for using healthcare that were available in the dataset were gender and age (previous medical expenditures are used in a sensitivity analysis but are not used in the main analysis because it would be over-controlling because previous expenditures are likely to be a mediator). In the medical expenditures subsample, 41.35% of employees are male and the average age is 45.76 years (SD 10.98).

Physical And Mental Health Status Continuing to move counter clockwise through the figure, physical and mental health statuses are measured using the variables described previously (BMI, health conditions, smoking status, emotional health index, general health status "ladder," and age), with an additional variable derived from the 1997 claims data, the Charlson Comorbidity Index [132]. Figure 21 is a histogram of the scores on the Charlson Comorbidity Index. Because everyone with a score higher than one on the index had future medical expenditures, an indicator for whether the employee has a score of at least one on the Charlson Comorbidity Index is used in the regressions (otherwise some employees' results would be completely determined). The average Index score is 0.43 (1.15) with a range of zero to 11. Because some of the conditions used in the Charlson Index are the same as some of the self-reported conditions an abbreviated list of the self-reported conditions is used for estimation to avoid duplication (asthma, depression, high blood pressure and high cholesterol). Asthma is reported by 15.29% of employees, 16.86% report depression, 24.95% report high blood pressure, and 25.09% report high cholesterol. Current smoking is reported by

12.69% of employees and the average BMI is 28.28 (SD 6.33). The average score on the emotional health index is 84.53 (SD 22.63) and the average score on the general health ladder is 8.19 (SD 1.58).

4.5 Differences between Included and Excluded Individuals

This section discusses some of the differences between included and excluded individuals. Because the sample exclusion criteria included a requirement for the number of months spent at work, there are likely to be differences, especially among work environment variables.

4.5.1 Differences between Included and Excluded Individuals

For the sample used to estimate the models of productivity and pain, excluded individuals were different from included individuals on some measures but not for others (even small differences in means are statistically significant because of the large sample size). Excluded individuals were different from included individuals in terms of their self-rated relative productivity (0.87 versus 0.98, p-value<0.01) [16]; being unsatisfied with their job (0.15 versus 0.18, p-value<0.001); not getting to use strengths at work (0.22 versus 0.25 p-value<0.001); not having a trusting and open environment (0.16 versus 0.19, p-value<0.001); reporting having physical health support (0.93 versus 0.90, p-value<0.001); reporting having emotional health support (0.85 versus 0.78, p-value<0.001). Excluded individuals are also different than included individuals with respect to age (42.3 versus 42.82, p-value<0.001); emotional health index (77.6 versus 74.47, p-value 0.006); proportion male (0.41 versus 0.52, p-value<0.001); AMI (0.01 versus 0.01, p-

[16] P-values were obtained used paired t-tests of the hypothesis that the means of the two groups are equal.

value 0.001); asthma (0.11 versus 0.10, p-value<0.001); depression (0.15 versus 0.12, p-value<0.001); diabetes(0.06 versus 0.05 p-value 0.008); high blood pressure (0.20 versus 0.22, p-value<0.001); high cholesterol (0.23 versus 0.24, p-value 0.02); BMI (27.79 versus 28.31, p-value<0.001); social help (0.96 versus 0.96, p-value 0.02) and education (excluded higher, p-value 0.04). Excluded individuals were not significantly different in terms of their sick days, having pain in the last 12 months, informal care giving, spouse/partner, smoking, and cancer.

For the medical expenditures subsample, excluded individuals were different from included individuals in terms of their age (48.26 versus 45.76, p-value<0.001); emotional health index (81.51 versus 84.53, p-value 0.006); proportion male (0.49 versus 0.41, p-value<0.001); typical work hours (39.02 versus 40.82, p-value 0.003); being unsatisfied with their job (0.10 versus 0.06, p-value 0.005); AMI (0.03 versus 0.01, p-value 0.004); depression (0.22 versus 0.17, p-value 0.01); general health ladder (7.91 versus 8.19, p-value<0.001); pain in last year (0.52 versus 0.46, p-value 0.01); and income (p-value<0.01). Excluded individuals were not significantly different from included individuals in terms of their proportion reporting having physical health support, proportion reporting having emotional health support, not learning interesting things at work, not having fun at work, not having enough resources, not getting to use strengths at work, not having a trusting and open environment, job insecurity, BMI, asthma, high blood pressure, high cholesterol, and smoking.

Chapter 5. Empirical Methods

This chapter discusses the statistical methods used to test the hypothesis that were explained in chapter three. The first part of the chapter discusses statistical issues that span all of the analyses, while the second part discusses the specific analyses for each research question.

5.1 General Statistical Issues for All Analyses

5.1.1 Missing Data

There are two types of missing data. First, because the sample is not random and only includes working individuals, data from entire groups of people are systematically missing. Second, some data are also missing at the item level.

The largest source of sample selection bias is from individuals who are not in the pool of employees available for analysis—adversely affecting the generalizability of the results. Because the sample is not random, the results are not generalizable to the U.S. population or even to the U.S. working population as a whole. However, given the limited existing research in this area—much of it coming from individual employers—this study still adds value. Sensitivity analyses using the available dependents of employees may yield some additional understanding of how the analyses might differ in the general population.

In addition to the problem of individuals being missing from the sample entirely, there are individuals in the sample who are missing data for particular variables. In general, the missing values are "ignorable" if they are missing at random—the probability that the value is missing is unrelated to the value itself after controlling for all of the other variables in the analysis—and if the parameters

that "govern the missing data process are unrelated to the parameter to be estimated" [133]. This assumption and a few others, allow multiple imputation via the multivariate normal model to provide estimates that are consistent, asymptotically efficient, and asymptotically normal [133]. For the multivariate normal model to be appropriate, all the variables need to be distributed normally, and each has to be able to be represented as a linear function of all of the other variables (with a normal, homoscedastic error term) [133]. However, this technique also seems to perform well with transformed variables or variables that are not normally distributed.

The missing values were imputed using a multivariate normal imputation model that included all of the variables in the regression models, tenure at work, and a work environment index. Following recommendations in the literature for samples with larger proportions of missing data, ten imputations are used[134]. Continuously predicted values were assigned to categories using the method described by Allison [133]. Singly imputed data were used in selecting models since tests of model fit have not been developed for complicated models in the context of multiple imputations.

5.1.2 Correlation within Groups

It is extremely likely that employee data are correlated within employer group. There are several possibilities for statistically adjusting for clustering. Because the sample only includes 14 employers, methods requiring large numbers of clusters, such as Generalized Estimating Equations (GEE), would not be appropriate. Another possibility to control for clustering is to use random effects or fixed effects models. Fixed effects models generalize only to the specific clusters being studied, here the

employers. Although random effects models are designed to generalize to the entire underlying population, they are not appropriate in cases in which the clusters cannot plausibly be viewed as a random sample from the underlying population. In addition, fixed effects are usually preferred when the individual-level predictors of interest are likely to be correlated with unobserved heterogeneity at the cluster level. This dissertation uses indicator variables for employers to control for the possibility that heterogeneity at the employer level is correlated with the employee-level predictors of interest, health-related employer support in particular[17].

5.2 Methods for Specific Research Questions with Productivity at Work and Future Medical Expenditures as Outcomes

The three major research questions are: (A) to what extent is health-related employer support associated with productivity at work and future medical expenditures without controlling for pain, (B) to what extent does pain mediate the relationships between health-related employer support and future medical expenditures and between health-related employer support and productivity at work, and (C) to what extent does health-related employer support moderate the relationships between pain and future medical expenditures and between pain and productivity at work. Because the outcome variables are the same for each question, the regression methods stay the same but the specifications change because the predictors of interest vary by research question. The tests of the hypotheses differ because of the different variables of interest. The remainder of this section discusses the models used for the research questions with productivity

[17] Not controlling for employer yields virtually identical average marginal effects of not having health-related employer support (with very small increases for some of the statistically significant indicators).

at work and future medical expenditures as the outcomes and the relevant sensitivity analyses.

5.2.1 Methods for Research Questions with Outcome of Productivity at Work

The three research questions that have productivity at work as an outcome are:

(A-1): Is health-related employer support associated with productivity at work after controlling for additional factors other than pain,

(B-2): To what extent is pain associated with productivity at work,

(B-4): Does controlling separately for pain attenuate any positive associations of health-related employer support with productivity, and

(C-1): To what extent does health-related employer support moderate the relationship between pain and productivity at work after controlling for additional factors?

Two different measures of productivity: sick days (due to one's own health) and self-rated relative productivity are used to test the hypotheses that correspond to the research questions listed above.

Outcome: Sick Days

The number of sick days is a count variable, with 80.8% of employees reporting zero days absent from work for health. Because there is a large proportion of zeroes, analyses with this outcome use a two-part model. The first part uses a logit regression model to predict whether the employee has any sick days. The second part of the model is a Poisson regression that models the number of sick

days conditional on having any sick days[18]. The selection of regression model was conducted using the specification for research question A-1 (see above) and then the same model was used to estimate sick days in testing hypotheses B-2, B-4 and C-1, so that the results could be compared. Based on a likelihood ratio test, the negative binomial model does *not* fit the data better than the Poisson model [135, 136]. Additionally, the Poisson model fits the data better than the negative binomial using the Bayesian information criterion and the value of the Log-likelihood [135, 137].

The two-part model of outcome sick days is as follows: $\mathrm{E[SickDays]} = \mathrm{pr(SickDays} > 0) * E[SickDays|SickDays > 0] + pr(SickDays = 0) * E[SickDays|SickDays = 0]$ but since the second term equals zero (because $\mathrm{E[SickDays|SickDays} = 0]$) we are left with: $\mathrm{E[SickDays]} = \mathrm{pr(SickDays} > 0) * E[SickDays|SickDays > 0]$.

The first part of the model, here a logit, is given by: $pr(AnySickDays = 1) = 1 - pr(\varepsilon \leq -X\beta) = \frac{e^{X\beta}}{(1+e^{X\beta})}$ where AnySickDays is a binary variable equal to one if the employee has any sick days, and the errors, ε are distributed logistically. $X\beta$ is the matrix representation of the covariates in the model (X) and their coefficients (β) (explained in more detail later). The second part models the number of sick days given positive sick days. Following the presentation in Cameron and Trivedi [136], the i^{th} observation is given by (y_i, $\mathbf{x}_i$) where y_i is the number of sick days and $\mathbf{x}_i$ is the vector of covariates. Here, the Poisson regression model is used, so y_i given $\mathbf{x}_i$ is Poisson-distributed with density given by: $f(y_i|\boldsymbol{x}_i) = \frac{e^{-\mu_i}\mu_i{}^{y_i}}{y_i!}$, $y_i = 1, 2, 3, 4, \ldots 28$ with the conditional mean function, $E[y_i|\boldsymbol{x}_i] = \mu(\boldsymbol{x}_i, \theta)$ where θ represents the

[18] Using a zero-truncated Poisson model did not alter the results.

parameters[19]. The covariates for both parts of the model are the same. Table 9 lists the covariates by research question/hypothesis. For hypothesis A-1, the covariates are as follows (show by Xs in the A-1 column of the table): health-related employer support (reference category is both types of support), neither type of support, no physical support, no emotional support; unsatisfied at work, does not get to use strengths at work, work environment is not trusting and open, occupation (reference category is professional worker) manager/executive/official, sales worker, clerical or office worker, manufacturing/production worker, business owner, service worker, construction/mining worker, transportation worker, installation/repair worker, farming/fishing/forestry worker, other worker; tenure on the job in years, number of children under 18, provides informal care, spouse/partner, number of times exercised in the past week (one or two times, exercised three or more times; reference category is zero times), current smoker, completed education (high school degree or diploma, technical/vocational school, some college, college graduate, post graduate work or degree; reference category is less than high school diploma), age, BMI, AMI, asthma, cancer, depression, diabetes, high blood pressure, high cholesterol, emotional health index, and general health ladder.

For hypothesis B-2, an additional covariate, pain in the last 12 months, is added to the regression model as a binary variable equal to one if the employee reports pain. For hypothesis C-2, pain is interacted with each of the indicators of not having health-related employer support (Pain*NoSupport, Pain*NoPhysicalSupport,

[19] In STATA this is implemented as a GLM model with log link function and Poisson distribution.

Pain*NoEmotionalSupport) so three terms are added to the regression model that includes the indicator for pain.

Three set of results are presented for each analysis (A-1, B-2, B-4 and C-1). Each can be described as an average marginal effect. For categorical variables in the first part of the model, such as the indicators of not having health-related employer support, the change in the probability of having any sick days as the variable changes from zero to one is calculated for each observation (also called a risk difference). For continuous variables, such as BMI, the average marginal effect in the first part of the model is the instantaneous rate of change in the probability of having any sick days. These estimated effects are averaged to get the average marginal effects for the first part of the model. For the second part of the model, the estimated effects are the differences in the number of sick days conditional on having at least one sick day, given different values of the covariates for categorical variables (conditional margin) and the instantaneous rates of change in the number of sick days for continuous variables. Again, the effects are calculated for each observation and then averaged to get the average marginal effect.

To ease the interpretation of the results and comparison to other models, the net overall average marginal effects are also presented for each covariate (unconditional margin). The net overall effect of not having either type of support, subtracts the unconditional expectation of sick days (the predicted probability times the conditional expectation) with both types of support (all indicators of lack of health-related employer support equal to zero) from the unconditional expectation of sick days with neither type of support (indicator for having neither type of support is equal to one and the remaining indicators equal zero) [138]. The net

overall effect is calculated for the remaining variables in a parallel fashion. These marginal effects are averaged across observations to get the average marginal effect for the combined model.

For the average marginal effects, confidence intervals are calculated using a first-order Taylor Series expansion (delta method). The delta method creates confidence intervals using a linear approximation of a function for which it is too complex to calculate the variance analytically [130, 139].

The hypotheses are tested by the size and sign of their average marginal effects on the covariate(s) of interest and their level of Type I error being below the 5% level. The most important is the net overall average marginal effect but the average marginal effects for both parts of the model are also relevant because covariates may only have an impact in one part or the other, or may have opposite effects that wash out the net overall effect, such as increasing the probability of having sick days but reducing the number of sick days conditional on having at least one. For Hypothesis A-1, this means that we look at the average marginal effects of the indicators of not having health-related employer support and see if the null hypothesis that they are zero can be rejected at the 5% level. To provide support for the hypothesis, the average marginal effects need to be positive for the outcome of sick days (less support → more sick days). Hypothesis B-2 is tested by whether any of the average marginal effects of pain on sick days are positive (pain→ more sick days) and statistically significant at the 5% level. Hypothesis B-4 is tested using the average marginal effects of the indicators of health-related employer support when pain is controlled for (same regression that is used to test B-2). While the hypothesis does not specify complete mediation of the effect of

health-related employer support on productivity at work (implying the average marginal effects will not be distinguishable from zero), it does entail comparing the estimated average marginal effects with those estimated for hypothesis A-1, to see if they have smaller magnitudes. Hypotheses B-2 and B-4 are part of the research question about whether pain mediates the effect of the health-related employer support on productivity—the overall answer to this research question is discussed later in this chapter after the methods for testing hypothesis B-1 have been explained.

Hypothesis C-1, the negative association of pain with productivity will be larger for those with health-related employer support than those without, is tested by using the net overall effects since these are most closely aligned with the concepts expressed in the hypothesis. This hypothesis is tested by comparing the effect of pain on sick days when both types of support are present to the effects of pain on sick days when both or one type of support is lacking (three separate comparisons). According to the hypothesis, the effects of pain on sick days when both or one type of support is lacking should be less than the effect of pain on sick days when both types of support are present. In other words, the difference between the effects of pain on sick days when both or one type of support is lacking and the effect of pain on sick days when both types of support are present should be negative.

With X representing the covariates not otherwise specified, the effect of pain on sick days when both types of support are present is given by the following:

E[SickDays | Pain=1, NoSupport=0, NoPhysicalSupport=0, NoEmotionalSupport=0, X] -
E[SickDays | Pain=0, NoSupport=0, NoPhysicalSupport=0, NoEmotionalSupport=0, X]

The effect of pain on sick days when there is neither type of support is present is given by the following:

E[SickDays | Pain=1, NoSupport=1, NoPhysicalSupport=0, NoEmotionalSupport=0, X] -
E[SickDays | Pain=0, NoSupport=1, NoPhysicalSupport=0, NoEmotionalSupport=0, X]

The effect of pain on sick days when there is no physical support is present is given by the following:

E[SickDays | Pain=1, NoSupport=0, NoPhysicalSupport=1, NoEmotionalSupport=0, X] -
E[SickDays | Pain=0, NoSupport=0, NoPhysicalSupport=1, NoEmotionalSupport=0, X]

The effect of pain on sick days when there is no emotional support is present is given by the following:

E[SickDays | Pain=1, NoSupport=0, NoPhysicalSupport=0, NoEmotionalSupport=1, X] -
E[SickDays | Pain=0, NoSupport=0, NoPhysicalSupport=0, NoEmotionalSupport=1, X]

With X representing the covariates not otherwise specified, the moderation effect of not having either type of support is given by:

(E[SickDays | Pain=1, NoSupport=1, NoPhysicalSupport=0, NoEmotionalSupport=0, X] -
E[SickDays | Pain=0, NoSupport=1, NoPhysicalSupport=0, NoEmotionalSupport=0, X]) -
(E[SickDays | Pain=1, NoSupport=0, NoPhysicalSupport=0, NoEmotionalSupport=0, X] -
E[SickDays | Pain=0, NoSupport=0, NoPhysicalSupport=0, NoEmotionalSupport=0, X])

According to the hypothesis, this difference should be negative and statistically significant—the difference between the effect of pain with neither type of support and the effect of pain with both types of support will be negative. Parallel equations and signs apply to not having physical support and not having emotional support.

To simplify the calculations, a singly imputed version of the data is used to estimate the differences in expectations given above, along with their 95% confidence intervals calculated using the bias-corrected accelerated bootstrap

procedure [138, 140]. If the 95% confidence interval does not include zero, it will be concluded that the moderation is statistically significant. If moderation appears to occur for one of the indicators of not having support (no support, no physical support, no emotional support) that will be construed as partial support of the hypothesis. Ideally, the moderation effects will be present for each of the indicators.

Outcome: Self-rated Relative Productivity

The multiple linear regression model for hypothesis A-1 is given by the equation below (the reference categories are the same as for the sick days regressions discussed above and $d(\ )$ indicates a dummy variable) :

$$Selfrated\ Relative\ Productivity = \propto + \beta_1 \cdot d(No\ Support)\ + \beta_2 \cdot d(No\ Physical\ Support) + \beta_3 \cdot d(No\ Emotional\ Support) + \beta_4 \cdot d(unsatisfied) + \beta_5 \cdot d(does\ not\ get\ to\ use\ strengths\ at\ work) + \beta_6 \cdot d(not\ trusting\ and\ open\ environment) + \beta_7 \cdot tenure\ on\ the\ job\ in\ years + \beta_8 \cdot d(manager) + \beta_9 \cdot d(sales\ worker) + \beta_{10} \cdot d(clerical\ worker) + \beta_{11} \cdot d(production\ worker) + \beta_{12} \cdot d(business\ owner) + \beta_{13} \cdot d(service\ worker) + \beta_{14} \cdot d(construction\ worker) + \beta_{15} \cdot d(transportation\ worker) + \beta_{16} \cdot d(installation\ worker) + \beta_{17} \cdot d(farming\ worker) + \beta_{18} \cdot d(other\ worker) + \beta_{19} \cdot number\ of\ children\ under\ 18 + \beta_{20} \cdot d(provides\ informal\ care) + \beta_{21} \cdot d(spouse) + \beta_{22} \cdot d(high\ school\ degree) + \beta_{23} \cdot technical\ school) + \beta_{24} \cdot d(some\ college) + \beta_{25} \cdot d(college\ graduate) + \beta_{26} \cdot d(post\ graduate\ work) + \beta_{27} \cdot d(exercised\ 1\ or\ 2\ times\ in\ past\ week) + \beta_{28} \cdot d(exercised\ 3\ or\ more\ times\ in\ past\ week) + \beta_{29} \cdot d(current\ smoker) + \beta_{30} \cdot d(AMI) + \beta_{31} \cdot d(asthma) + \beta_{32} \cdot d(cancer) + \beta_{33} \cdot d(depression) + \beta_{34} \cdot d(diabetes) + \beta_{35} \cdot d(high\ blood\ pressure) + \beta_{36} \cdot d(high\ cholesterol) + \beta_{37} \cdot age + \beta_{38} \cdot BMI + \beta_{39} \cdot emotional\ health\ index + \beta_{40} \cdot general\ health\ ladder + \varepsilon$$

For hypotheses B-2 and B-4, an additional covariate, pain in the last 12 months, is added to the regression model as a binary variable equal to one if the employee reports pain. For hypothesis C-2, pain is interacted with each of the indicators of not having health-related employer support (Pain*NoSupport, Pain*NoPhysicalSupport, Pain*NoEmotionalSupport) so three terms are added to the regression model.

Standard errors are corrected for correlation within employers and states (GEE-independent) [130, 141]. To test Hypothesis A-1, we will look at the average marginal effect of the indicators of not having health-related employer support and see if the null hypothesis that they are zero can be rejected at the 5% level. To provide support for the hypothesis, the average marginal effects need to be negative for the outcome of self-rated relative productivity (less support → less productive). Hypothesis B-2 is tested by whether the average marginal effect of pain on self-rated relative productivity is statistically significant at the 5% level and is negative (more pain→less productive). Hypothesis B-4 is tested by whether the average marginal effect of pain on self-rated relative productivity is statistically significant at the 5% level; if it is not, then there might be complete mediation. However, hypotheses B-2 and B-4 are also part of the research question about whether pain mediates the effect of the health-related employer support on productivity—the overall answer to this research question is discussed later in this chapter.

Hypothesis C-1 assesses whether health-related employer support moderates the relationship between pain and self-rated relative productivity. Because the estimation model is linear, the coefficient on the interaction terms can be tested

directly to determine whether there is an interaction—it measures how much the effect of pain changes as health-related employer support changes from having both to missing one or both types [142, 143]. Each is tested individually since there are three separate concepts of lack of support but a joint test (F-test) of their significance is also conducted. The sign of the interaction effects need to be positive in order to support Hypothesis C-1 (the negative association of pain with productivity will be larger for those with health-related employer support than those without). A positive coefficient on the interaction terms indicates that the effect of pain on self-rated relative productivity is larger without health-related employer support than with it. Of course, this sign depends on the estimated impacts of pain and not having health related employer support having negative effects on self-rated relative productivity (negative coefficients) without taking the interaction into account.

Sensitivity Analyses for Productivity Outcomes

Sensitivity analyses are used for research questions A-1, B-2 and B-4. They address concerns about omitted variable bias, sample selection, measurement, and reverse causality. Each category of sensitivity analysis is discussed in turn. The focus of these sensitivity analyses is whether the signs, magnitudes and statistical significance of the average marginal effects of health-related employer support and pain change substantially from the original estimates. Some of the sensitivity analyses use subsamples of the data so that additional variables can be added (not every question was on every employer's survey). The initial stage of sensitivity analysis will compare the estimated average marginal effects of health-related employer support and pain in the sensitivity analysis with the original analysis. If

the effects are not different, then it is assumed that they would not be different even if the whole sample were available for the sensitivity analysis. If the estimated average marginal effects are different, then the original analysis is run on the smaller sample to determine whether the difference was due to the sample or to the addition of variables for the sensitivity analysis.

Omitted Variables Bias: Controlling for Alcohol and Relaxing Drug Use

To address some of the concerns about omitted variables bias, sensitivity analyses are run that control for recreational drug and alcohol use. These variables are not available for all employees so they are added as covariates for the subsample of employees for whom these data are available (5 employers, N=32,603).

Sample Selection: Dependents of Employees

At one employer, adult dependents of employees were also asked to take the WBA. To partially address concerns about sample selection, sensitivity analysis will compare the results of productivity analyses that use working adult dependents to the results of productivity analyses that use the employees from the employer collecting data from both groups. Of course, we cannot control for employer in the sample of dependents because we do not have this information. Appendix 1, Figure 1 contains the sample flowchart and Table 2 contains the descriptive statistics for the dependents sample.

Measurement of Health-related Employer Support

A large proportion of employees answered that they did not know whether their employer would support their efforts to improve their health. In the primary analyses, these individuals are treated as if their answer to the questions about

health-related employer support are missing—and so are imputed. However, by doing this, information about health-related employer support may be lost because an answer of not knowing about support may be informative about the level of perceived support (or lack thereof). Because there many missing values, sensitivity analyses are done to assess whether there is information in the "don't know" answers that differentiates them from "yes" or "no" answers. It is also possible that "don't know" answers imply that support is lacking—it seems unlikely that employees with health-related employer support would not know. Separate sensitivity analyses treat not knowing if you have health-related employer support in two ways: first, not knowing is coded as a distinct answer category, and second, not knowing is coded as not having support.

Measurement of Health-Related Employer Support: "Trusting and Open Environment"

One question asking whether the employee's supervisor creates a "trusting and open environment" (one of the psychosocial work environment variables described earlier). This question is conceptually similar to the idea of health-related employer support. The indicator for having an environment that is *not* "trusting and open" is negatively correlated with having both dimension of employer support (-0.22) and positively correlated with not having either type of support (0.18). Although the VIFs were less than two, another set of sensitivity analyses do not control for whether the employee reports that their supervisor creates a "trusting and open environment" for completeness.

Reverse Causality: Employer-State Averages

To address the issue of reverse causality, another sensitivity analysis averages the values of the health-related employer support indicators within employers and states (employer-state combinations) in place of individual employee measures (in case perceptions of productivity influence employee perceptions of health-related employer support).

Differential Effects of Pain by Gender

As mentioned in the conceptual model of pain, there is evidence that pain may have different effects by gender. To test this, an additional sensitivity analysis is conducted for each of the productivity at work outcomes that stratifies the analysis by gender when pain is included in the regression.

5.2.2 Methods for Research Questions with Outcome of Future Medical Expenditures

The three research questions that have future medical expenditures as an outcome are:

(A-2): Is health-related employer support associated with future medical expenditures after controlling for additional factors other than pain,

(B-3): To what extent is pain associated with future medical expenditures,

(B-5): Is greater health-related employer support associated with higher future medical expenditures after controlling for pain, and

(C-2): To what extent does health-related employer support moderate the relationship between pain and future medical expenditures after controlling for additional factors?

As is often seen with medical expenditure data, some employees (7.2%) did not have any future expenditure and the distribution among users was highly skewed, with a slightly heavy right tail (about 10% had expenditures greater than twice the sample mean). To appropriately model the medical expenditures, the analysis is conducted using a two-part model [144-146]. Parallel to the two-part model introduced earlier, the expected value is given by:

$$\mathrm{E}[FutureMedicalExpenditures] =$$

$$\mathrm{pr}(FutureMedicalExpenditures > 0) *$$

$$\mathrm{E}[FutureMedicalExpenditures | FutureMedicalExpenditures > 0].$$

The first part of the model, again a logit, is given by: $pr(AnyExpenditure = 1) = 1 - pr(\varepsilon \leq -X\beta) = \frac{e^{X\beta}}{(1+e^{X\beta})}$ where *AnyExpenditure* is a binary variable equal to one if the employee's medical expenditures are greater than $0, and the errors, ε are distributed logistically. $X\beta$ is the matrix representation of the covariates in the model and their coefficients. The covariates in the model are as follows: health-related employer support (neither type of support, no physical support, no emotional support, reference category is both types of support); does not learn new things at work; does not have fun at work; does not have enough resources; job insecurity; unsatisfied; does not get to use strengths; not trusting and open environment; typical hours worked; Charlson Index score ≥ one; asthma; depression; high blood pressure; high cholesterol; smoking status; male; age; BMI; emotional health index; general health ladder; health insurance type (HMO – gatekeeper, HMO - POS or open access, indemnity, reference category is PPO); household monthly income ($3,000 to $3,999; $4,000 to $4,999; $5,000 to $7,499; $7,500 to $9,999; $10,000 and over; reference category is up to

$2,999/month); spouse/partner; number of children under 18 in the household; number of hospital beds per 1,000 people in state; active medical specialty physicians (excluding general internal medicine, pediatrics & psychiatry) per 10,000 people in state; active family, general, general internal medicine, and pediatric physicians per 10,000 people in state; active psychiatry specialty physicians per 10,000 people in state and census region.

The second part is a generalized linear model (GLM) with gamma distribution and log link function. A modified Park test was used to determine the appropriate family (regression of $\ln((y_i - \hat{y}_i)^2)$ on $\ln(\hat{y}_i)$ and a constant, where y_i is future medical expenditures). The GLM model used here has the form: $\ln(E[FutureMedicalExpenditures]) = X\theta$ where y follows a gamma distribution (variance is proportional to the square of the mean), X represents the other covariates in the model[20], and θ is their parameter vector. The log-OLS model could be more efficient, but, based on the error variance, was not in this case.

The results of each part of the model are discussed separately and then combined to form the unconditional margins as described earlier. Average marginal effects are calculated for each covariate for each part of the model. For categorical variables in the first part of the model, the change in the probability of having any expenditure as the variable changes from zero to one is calculated for each observation (the instantaneous rate of change is calculated for continuous variables). Then, the estimated effects are averaged to get the average marginal effect. For the second part of the model, the estimated effects are the differences in the conditional expected expenditure for each covariate. Again, the effects are

[20] The same covariates are entered for each part of the model.

calculated for each observation and then averaged to get the average marginal effect. The net overall effect (unconditional margin) for each covariate is also calculated as discussed previously. Confidence intervals are calculated using a Taylor Series expansion.

The hypotheses are tested by the size and sign of their average marginal effects on the covariate(s) of interest and their level of Type I error being below the 5% level. The most important is the net overall average marginal effect, but the average marginal effects for both parts of the model are also relevant because covariates may only have an impact in one part or the other or may have opposite effects that wash out the net overall effect. To test Hypothesis A-2, we look at the average marginal effects of the indicators of not having health-related employer support and see if the null hypothesis that they are zero can be rejected at the 5% level. The average marginal effects need to be positive to support the research hypothesis (less support → higher expenditures). Hypothesis B-3 is tested by whether any of the average marginal effects of pain on future medical expenditures is statistically significant at the 5% level and is positive (pain→higher expenditures). Hypothesis B-5 is tested by comparing the sign, magnitude and statistical significance of the average marginal effects of health-related employer support in the regression that controls for pain to the regression that did not control for pain (used to test Hypothesis A-2). For Hypothesis B-5 to be supported, the average marginal effects of health-related employer support must be significantly different from zero and positive after controlling for pain. Hypotheses B-3 and B-5 are part of the research question about whether pain mediates the effect of the

health-related employer support on future medical expenditures—the overall answer to this research question is discussed later in this chapter.

Hypothesis C-2 is tested by using the net overall effects since these are most closely aligned with the concepts expressed in the hypothesis. This hypothesis is tested by comparing the effect of pain on future medical expenditures when both types of support are present to the effects of pain on future medical expenditures when both or one type of support is lacking (three separate comparisons). According to the hypothesis, the effect of pain on future medical expenditures when both types of support are present should be greater than the effects of pain on future medical expenditures when both or one type of support is lacking.

With X representing the covariates not otherwise specified, the effect of pain on future medical expenditures when both types of support are present is given by the following:

E[FutureMedicalExpenditures | Pain=1, NoSupport=0, NoPhysicalSupport=0, NoEmotionalSupport=0, X] - E[FutureMedicalExpenditures | Pain=0, NoSupport=0, NoPhysicalSupport=0, NoEmotionalSupport=0, X]

The effect of pain on future medical expenditures when there is neither type of support is present is given by the following:

E[FutureMedicalExpenditures | Pain=1, NoSupport=1, NoPhysicalSupport=0, NoEmotionalSupport=0, X] - E[FutureMedicalExpenditures | Pain=0, NoSupport=1, NoPhysicalSupport=0, NoEmotionalSupport=0, X]

The effect of pain on future medical expenditures when there is no physical support is present is given by the following:

E[FutureMedicalExpenditures | Pain=1, NoSupport=0, NoPhysicalSupport=1, NoEmotionalSupport=0, X] - E[FutureMedicalExpenditures | Pain=0, NoSupport=0, NoPhysicalSupport=1, No EmotionalSupport=0, X]

The effect of pain on future medical expenditures when there is no emotional support is present is given by the following:

E[FutureMedicalExpenditures | Pain=1, NoSupport=0, NoPhysicalSupport=0, NoEmotionalSupport=1, X] - E[FutureMedicalExpenditures | Pain=0, NoSupport=0, NoPhysicalSupport=0, NoEmotionalSupport=1, X]

With X representing the covariates not otherwise specified, the moderation effect of not having either type of support is given by:

(E[FutureMedicalExpenditures | Pain=1, NoSupport=1, NoPhysicalSupport=0, NoEmotionalSupport=0, X] - E[FutureMedicalExpenditures | Pain=0, NoSupport=1, NoPhysicalSupport=0, NoEmotionalSupport=0, X]) - (E[FutureMedicalExpenditures | Pain=1, NoSupport=0, NoPhysicalSupport=0, NoEmotionalSupport=0, X] - E[FutureMedicalExpenditures | Pain=0, NoSupport=0, NoPhysicalSupport=0, NoEmotionalSupport=0, X])

According to the hypothesis, this difference should be negative and statistically significant—the difference between the effect of pain with neither type of support and the effect of pain with both types of support will be positive. Parallel equations and signs apply to not having physical support and not having emotional support.

As in the model of productivity at work, a singly imputed version of the data is used to estimate the differences in expectations given above with their 95% confidence intervals calculated using the bias-corrected accelerated bootstrap procedure and the test of the moderation effects are done in the same way as described in the section about moderation effects for the productivity at work outcome [138, 140].

Sensitivity Analyses for Future Medical Expenditures

There are a few sensitivity analyses that are conducted for the research questions that have future medical expenditures as an outcome. The sensitivity analyses address concerns about measurement and sample selection. As in the case of the productivity analyses the focus of the analyses are on the sign, magnitude and significance of the average marginal effects of health-related employer support and pain and whether they change substantially from the original analyses.

Measurement Issues: Preferences for Health Care

Preferences for healthcare are very difficult to measure. The limited measures used in the main analysis leave open concern about omitted variable bias. Using previous expenditures helps to proxy for preferences. To partially address this issue of omitted variable bias from not having good measures of preferences, the models of future medical expenditures are estimated controlling for previous expenditures. Previous expenditures are aggregated over the year before the WBA (and only individuals with continuous eligibility are included). For these analyses, previous expenditures are centered and added to the regression along with their square. However, recurring pain may have affected medical expenditures in the past as well as affect future expenditures so controlling for previous expenditures may dampen the association of pain with future medical expenditures.

Measurement Issues: Health-Related Employer Support

An additional analysis removes the indicator for not having a "trusting and open environment" from the regression because it is conceptually similar to health-related employer support.

Sample Selection: Expanded Sample

Some administrative claims information was available for employees in one additional employer, but the data are incomplete (not enough months after the WBA are available). To get a better idea of how the associations in the analyses of future medical expenditures might hold in a larger sample, a less restrictive sample definition is used for sensitivity analysis so that individuals from the other employer with claims data may be added. Under the less restrictive definition, employees with any months eligible for health insurance from the two employers with available claims information are included in the sample. Their expenditures are multiplied so that they approximate the employee's expenditures for the entire year. For example, if an employee was eligible for insurance for six months of the year, their claims from those six months were multiplied by two to approximate a year's worth of expenditures. In the regression model, the observations were weighted by the number of months of eligible months divided by 12 (in the example above, the weight would be 6/12, or ½) so that observations with less data would be weighted less heavily in the analysis[147]. Constructed this way, there were two employers, with 11,368 employees in the sample for the sensitivity analysis. A sample flow chart and descriptive statistics for the sample are available in Appendix 2, Figures 1 and 2.

Differential Effects of Pain by Gender

As in the analysis of productivity at work, an additional sensitivity analysis is conducted that stratifies the future medical expenditures analysis by gender when pain is included in the regression.

5.3 Methods for Research Question B-1: Is health-related employer support associated with pain?

The research question that has pain as its outcome is: (B-1) to what extent is health-related employer support associated with pain? As described in Chapter Four, pain is a dichotomous outcome. A logit model is used to estimate the association of health-related employer support with pain. The logit model has the same form as was described in earlier section. The covariates in the model are as follows: health-related employer support (neither type of support, no physical support, no emotional support, reference category is both types of support); unsatisfied; does not get to use strengths; not trusting and open environment; occupation (manager/executive/official, sales worker, clerical or office worker, manufacturing/production worker, business owner, service worker, construction/mining worker, transportation worker, installation/repair worker, farming/fishing/forestry worker, other worker, reference category is professional worker); number of children under 18; provides informal care; social help; spouse/partner; completed education (high school degree or diploma, technical/vocational school, some college, college graduate, post graduate work or degree, reference category is less than high school diploma); number of times exercised in the past week (one or two times, exercised three or more times, reference category is zero times); current smoker; AMI; asthma; cancer; depression; diabetes; high blood pressure; high cholesterol; age; BMI; emotional health index; health ladder and male.

The results are presented using average marginal effects as described earlier (changes in the probability of reporting pain for specified changes in the

covariates). The sign, significance, and magnitude of the average marginal effects of health-related employer support are assessed to determine the validity of the hypothesis that greater health-related employer support is associated with reduced chance of pain. To align with the hypothesis, the average marginal effects of not having health-related employer support must be statistically distinguishable from zero and positive (no support→ more pain). If all three indicators of a lack of health-related employer support are positive and statistically significant then that would be strong evidence in favor of the hypothesis. If fewer than three are positive and statistically significant, the support for the hypothesis is less strong.

Sensitivity Analyses for the Analysis of Pain

The sensitivity analyses for pain address concerns about omitted variable bias, sample selection, measurement, and reverse causality. Each category of sensitivity analysis is discussed in turn. As mentioned previously, the sensitivity analyses focus on whether the average marginal effects of health-related employer support change in terms of sign, magnitude or significance from the main analysis.

Omitted Variables Bias: Alcohol and Relaxing Drug Use

The use of drugs and alcohol to self-medicate for pain has been widely acknowledged. There are not measures of drug and alcohol use in the original analysis because they are not available for the entire sample—increasing the potential of omitted variable bias. To address this potential bias, use of drugs to relax and use of alcohol are added as covariates for the subsample of employees for whom these data are available (5 employers, N=32,603).

Omitted Variables Bias: Race/Ethnicity

Race/ethnicity has also been shown to be related to pain. However, the reason for this relationship is unclear; it may exist because of cultural factors, medical system bias or in underlying disease prevalence. Regardless of the source of the association, if race/ethnicity proxies for a concept that is not otherwise controlled in the original model leaving it out may lead to omitted variable bias. An additional sensitivity analysis controls for race/ethnicity for the subsample of employees with data (10 employers, N=17,975).

Sample Selection: Dependents

To partially address concerns about sample selection (as in the case of the productivity), sensitivity analyses compare the results of models using only working adult dependents to models that use the employees from the employer with data for both populations (as described in section 5.2.1).

Measurement: Health-Related Employer Support in the Analysis of Pain

Sensitivity analyses using variations of how the "don't know" answers to the questions about health-related employer are done in parallel to how these analyses were described in section 5.2.1. An additional analysis runs the model of pain in the sample used to estimate future medical expenditures as described in section 5.2.1. Another analysis removes the indicator for not having a "trusting and open environment" from the regression in case it is too similar to the idea of health-related employer support. In the case of health outcomes, such as pain, controlling for occupation may mask the role of poor psychosocial workplace factors since they are highly associated with certain occupations. An additional analysis removes the

dummy variables for different occupations in case they are resulting in over-controlling.

Measurement: Alternative Definitions of Pain

The research questions involving pain are also analyzed with alternative measures of "pain:" broken down by body area, and combined with a short-term pain question. In sensitivity analyses, neck/back and knee/leg conditions are analyzed separately to see if the estimated relationships vary with the body area affected by pain. Following the methodology of some pain researchers, under the definition of the alternative definition of pain employees are only counted as experiencing pain if they reported pain in the previous year and they reported experiencing physical pain during "a lot of the day" in the day before the survey.

Reverse Causality

There is reason to suspect that pain might influence an individual's perception of health-related employer support. For five of the employers, two years of survey data are available. This sample is used to look at the research questions where timing of the survey and the outcomes are a concern. This sensitivity analysis uses the two years of survey data to see whether health-related employer support measured at time one can predict pain measured at time two. An additional sensitivity analysis averages the values of the health-related employer support indicators within employers and states (employer-state combinations) in place of individual employee measures.

5.4 Testing Mediation

The hypotheses grouped under research question B should determine whether pain mediates the relationships between health-related employer support

and future medical expenditures and between health-related employer support and productivity at work (relationships described by research question A). Hypothesis B-1 tests whether there is a relationship between health-related employer support and pain, and hypotheses B-2 and B-3 evaluate mediation as discussed by Baron and Kenny by testing the relationships between pain and future medical expenditures and productivity at work respectively [143, 148]. Hypothesis B-4 and B-5 represent the "last step" of traditional mediation analysis as discussed by Baron and Kenny, seeing if the effect of health-related employer support is mediated by pain [143, 148]. This dissertation assesses simple mediation rather than multiple mediation [149, 150]. The methodology of testing multiple mediators is less advanced than testing for a single mediator [149].

Specifically, the first part of a mediation analysis as described by Baron and Kenny establishes that there is a relationship between the variable whose effect is to be mediated, health-related employer support, and the outcome variables, productivity at work and future medical expenditures [143, 148]. The second part of traditional mediation analysis assesses whether health-related employer support is associated with pain (the mediator) [143, 148]. The third step determines whether pain is related to the outcomes while controlling for health-related employer support [143, 148]. The fourth step assesses whether the effect of health-related employer support on the outcomes, productivity at work and future medical expenditures, are attenuated or eliminated after controlling for pain. In linear analysis (such as the analysis of self-rated relative productivity), the initial variable, health-related employer support, is said to be fully mediated if its coefficient is zero in the fourth step as long as steps two and three are met (if the

coefficient is attenuated but not zero then the variable is partially mediated) [143, 148]. As discussed in the literature, the simple tests of coefficients to assess mediation are not applicable in nonlinear models [143, 148, 150]. Because some of the models in the dissertation are nonlinear (such as the models of sick days and future medical expenditures), average marginal effects are used to determine the relationships between the variables, with large average marginal effects indicating a relationship. As discussed in the literature, statistical significance is not necessarily a good indicator of whether there is mediation [143, 148]. However, in the analyses used for this dissertation, the sample size is large, so if the estimated average marginal effects are large—they should be statistically significant. Therefore, in these analyses, statistical significance is used to inform the results because it's not clear how "large" the effect needs to be in this case[21].

Specifically, testing the mediation hypotheses involves assessing hypotheses B-1 (health-related employer support → pain), A-1 (health-related employer support → productivity at work, without controlling for pain), and A-2 (health-related employer support → future medical expenditures, without controlling for pain), as well as conducting the following tests:

- B-2: pain will be associated with lower productivity at work
    - Productivity measured as sick days: The null hypothesis of no average marginal effect of pain on productivity at work must be rejected at the 5% level and the average marginal effect should be positive (pain → more sick days).

[21] The literature notes that small effects can be significant in models with large sample size and large effects can be insignificant in small samples—I use statistical significant here when the effects are large.

    - Productivity measures as self-rated relative productivity: The null hypothesis of no average marginal effect of pain on productivity at work must be rejected at the 5% level and the average marginal effect should be negative (pain → lower self-rated relative productivity).
- B-3: pain will be associated with higher future medical expenditures
    - The null hypothesis of no average marginal effect of pain on future medical expenditures must be rejected at the 5% level and the average marginal effect should be positive.
- B-4: the association of health-related employer support with productivity at work will be smaller after controlling for pain.
    - Productivity measured as sick days: The null hypothesis of no average marginal effect of health-related employer support on productivity at work should be smaller than estimated in A-1 and must not be rejected at the 5% for complete mediation.
    - Productivity measures as self-rated relative productivity: The null hypothesis of no average marginal effect of health-related employer support on productivity at work should be smaller than estimated in A-1 and must not be rejected at the 5% for complete mediation.
- B-5: the association of health-related employer support with future medical expenditures will switch directions after controlling for pain.
    - The null hypothesis of no average marginal effect of health-related employer support on future medical expenditures must be rejected at the 5% level and the average marginal effect should be positive.

To determine if pain mediates the relationship of health-related employer support, the average marginal effects of the indicators of lack of health-related employer support when pain is controlled (B-4 and B-5) is compared to the average marginal effects of the indicators of lack of health-related employer support changes before pain is controlled in the regression (A-1 and A-2). If the magnitude of the average marginal effects of health-related employer support are smaller for productivity (B-4) differ, then mediation by pain is likely to have occurred. In the case of future medical expenditures, the sign of the average marginal effects should change for the hypothesis (B-5) to be supported.

Chapter 6. Results

This chapter describes the results of the analyses that were described in chapter five. The results are separated by research question and correspond to the order they were introduced. A summary of the results for each large research question (A, B, and C) is given after the results for all of the hypotheses under that question.

6.1 Is greater health-related employer support associated with greater productivity without controlling for pain?

The hypothesis is that greater health-related employer support is associated with greater productivity. Because having both physical and emotional support is coded as the reference category, the average marginal effects of the dummy variables indicate what happens when there is a lack of support in both or one dimensions.

6.1.1 Productivity Measured by Sick days

The regression adjusted associations (average marginal effects) of health-related employer support and sick days are given in Table 22. The second column of the Table gives the average marginal effect of the variables with respect to the probability of having at least one sick day[22] (the risk difference). The third column gives the average marginal effect for the second part of the model, the expected change in the number of sick days conditional on having at least one sick day. The fourth column gives the average marginal effects of the variables when both parts

[22] Sick days are measured in whole days.

of the model are combined, i.e., the net overall effect on the unconditional outcome of sick days (the unconditional margin). The regression estimates are given in Appendix 3, Table 1. For reference, about 20% of employees reported at least one sick day and the average number of days missed is 0.48 (SD 1.88). Conditional on having at least one missed day, the average number of days missed is 2.48 (SD 3.66).

As can be seen from Table 22, none of the indicators of health-related employer support are statistically significant at the 5% level in either part of the model or when both parts are combined, so the null hypothesis that all of the effects are zero cannot be rejected. The research hypothesis posited a positive relationship between not having support and sick days, and the estimates of the unconditional margins of not having health-related employer support are positive, but are not significant.

Only statistically significant average marginal effects are discussed individually. For example, if the average marginal effect of variable x is statistically significant only in the first part of the model (predicting any sick days) then it is discussed while the insignificant average marginal effects of x in the conditional part of the model and insignificant unconditional margin are not discussed. Not getting to use your strengths at work is associated with an increase in the probability of having any sick days of 0.02 (p-value 0.006). Having a supervisor who does not create a trusting and open environment is associated with an additional 0.25 sick days (p-value < 0.001) conditional on having at least one sick day, and with 0.06 (p-value 0.003) additional sick days overall (unconditional margin). Additional tenure on the job is negatively associated with the probability of

having any sick days (-0.001, p-value <0.001), fewer sick days conditional on having sick days (-0.01, p-value 0.003), and with fewer sick days when both parts are combined (-0.004, p-value <0.001).

Compared to being a professional worker, being a manager/executive/official is associated with decrease in the probability of having any sick days of three percentage points (p-value <0.001) and is associated with 0.09 fewer sick days overall (p-value <0.001). In contrast, being a clerical/office worker is associated with an increase in the probability of having any sick days of two percentage points (p-value 0.001) and is associated with fewer sick days overall, 0.04 fewer (p-value 0.02) compared to being a professional worker. The occupational category manufacturing/productions workers is associated with a reduced probability of taking sick days (-0.03, p-value 0.006) but with more days missed conditional on taking sick days, 0.64 more (p-value <0.001). The occupation category of business owner is associated with 0.23 (p-value 0.03) more sick days than the professional worker category overall, with an increase in the probability of taking sick days of 0.05 (p-value 0.049). With a smaller association, being a service worker compared to a professional worker is associated with 0.12 (p-value 0.01) more sick days, with an increase in sick days conditional on taking sick days of 0.36 (p-value 0.01). Likewise, being an installation/repair worker compared to a professional worker is associated with an additional 0.31 sick days (p-value 0.001) for the unconditional margin, and with an additional 0.85 sick days (p-value <0.001) conditional on taking sick days.

Moving to non-work factors, providing informal care is associated with an increase in the probability of taking sick days of 0.02 (p-value 0.008), and with an

increase of 0.05 sick days (p-value 0.003) overall (unconditional margin). Interestingly, having a spouse/partner is associated with fewer sick days, a 0.02 (p-value <0.001) reduced chance of taking sick days, and 0.03 (p-value 0.034) fewer sick days when both parts of the model are combined (unconditional margin). Compared to having less than a high school education level, having a high school diploma or some college is associated with a three percentage point increase in the chance of having any sick days (p-values 0.005 and 0.004 respectively). They are also associated with increases in sick days overall of 0.14 (p-value <0.001) and 0.13 (p-value <0.001) respectively. In contrast, having post-graduate work/degree is associated with less time missed, 0.07 days less (p-value 0.03), compared to having less than a high school education level.

Exercise in the previous week is associated with fewer sick days than not exercising in the previous week; 0.10 (p-value <0.001) fewer sick days overall for 1-2 times and 0.15 (p-value <0.001) fewer sick days overall for 3+ times. Each of the indicators for exercise are also statistically significant in the first part of the model, indicating less chance of taking any sick days, and in the second part of the model, indicating fewer sick days conditional on taking sick days. These changes in sick days are also economically significant, since exercising just 1-2 days a week is associated with about 20% fewer sick days compared to the average (but is just ~5% of SD). Current smokers are slightly more likely to have any sick days (0.03, p-value <0.001) but to have fewer sick days conditional on having any, -0.16 (p-value <0.001).

All of the indicators of health conditions have unconditional margins that are statistically significant at the 5% level, with virtually all the indicators of worse

health being associated with more sick days. Ever having an AMI is associated with 0.39 (p-value 0.03) more sick days in the conditional model and with 0.17 (p-value 0.03) more overall. Asthma is associated with a three (p-value <0.001) percentage point increase in the probability of having any sick days and with an additional 0.07 (p-value <0.001) sick days overall. Cancer is associated with a 0.06 (p-value <0.001) increase in the probability of sick days, an additional 0.92 (p-value <0.001) sick days in the conditional part of the model, and with an additional 0.38 (p-value <0.001) sick days overall. Similarly, depression is associated with a 0.09 (p-value <0.001) increase in the probability of sick days, an additional 0.25 (p-value <0.001) sick days in the conditional part of the model, and with an additional 0.29 (p-value <0.001) sick days overall (about a 60% increase in the number of sick days overall on average but only ~7% of SD). Diabetes is associated with an increase in the probability of having sick days of 0.04 (p-value <0.001) and with an increase in the unconditional margin of 0.10 (p-value <0.001) sick days. High blood pressure is associated with 0.36 (p-value <0.001) additional sick days in the conditional part of the model and an additional 0.09 (p-value <0.001) sick days overall. The unconditional margin of high cholesterol is significant at the 5% level, showing a reduction of -0.03 (p-value 0.047) sick days. Age and BMI are associated with increased sick days overall, of 0.004 (p-value <0.001) and 0.01 (p-value <0.001) respectively. Employees who scored higher on the index of emotional health (-0.01, p-value 0.005) and who reported having better general health (-0.05, p-value <0.001) have fewer sick days overall.

6.1.2 Productivity measured by Self-Rated Relative Productivity

The regression adjusted association of health-related employer support and employees' self-rated relative productivity are given in Table 23. As a reference, the range of self-rated relative productivity is [-10, 10] with an average of 0.98 (SD 5.49). Compared to having both physical and emotional support, not having either type of support is associated with an increase in self-rated relative productivity of 0.37 (p-value <0.001) after controlling for other factors. Not having physical support and not having emotional support are also associated with increases in self-rated relative productivity, of 0.15 (p-value 0.01) and 0.20 (p-value <0.001) respectively. The average marginal effects of not having health-related employer support are not statistically significant and were in the opposite of the hypothesized direction (although their sign does match the direction of the competing hypothesis).

Not using strengths at work is associated with a decrease in self-rated relative productivity of -0.17 (p-value <0.001), as is increased tenure on the job, -0.003 (p-value <0.001). Not working in a trusting and open environment is associated with an increase of 0.24 (p-value <0.001), holding all else equal. Being a clerical/office worker or a manufacturing/production worker, is associated with increased self-rated relative productivity compared to being a professional worker of 0.09 (p-value 0.03), 0.30 (p-value <0.001), respectively. Being a construction/mining worker or an installation/repair worker is associated with a 0.32 (p-value 0.04) or 0.19 (p-value 0.03) increase in self-rated relative productivity respectively.

Beginning with non-work factors, informal care giving is associated with a 0.05 (p-value 0.01) increase in self-rated relative productivity. The indicator for having a spouse/partner is associated with an increase in self-rated relative productivity, of 0.05 (p-value 0.02). Exercising one or two times a week compared to zero times a week is associated with a 0.05 (p-value 0.048) increase in self-rated relative productivity, and exercising three or more times per week is associated with a 0.07 (p-value 0.001) increase. Being a current smoker is associated with a 0.10 (p-value <0.001) increase in self-rated relative productivity compared to employees who did not report smoking. Of the indicators for health conditions, only depression is associated with a decrease in self-rated relative productivity of -0.13 (p-value <0.001) and is statistically significant at the 5% level. Greater age is associated with a small decrease in self-rated relative productivity of -0.004 (p-value <0.001). Better health on the general health ladder is associated with an increase in self-rated relative productivity of 0.03 (p-value <0.001).

6.1.3 Results of the Sensitivity Analyses of Productivity at Work

This section describes the results of the sensitivity analyses of productivity at work. The descriptions of the results focus on how the average marginal effects of the coefficients of interest (health-related employer support) are different than the original analysis. The results of these analyses are presented in Tables 24 (sick days) and 25 (self-rated relative productivity). The sensitivity analyses of sick days are presented first.

Omitted Variables Bias: Controlling for Drug and Alcohol in the Analysis of Sick Days

After controlling for drug and alcohol use (Table 24, column A), none of the indicators of lack of health-related employer support are statistically significant at the 5% level in either part of the model of sick days or overall. In results not shown in the table, reporting one to seven alcohol drinks per week compared to reporting none is associated with a 0.01 (p-value 0.008) lower risk of sick days, -0.36 (p-value<0.001) sick days conditional on having at least one, and -0.10 (p-value<0.001) sick days overall. Reporting eight or more drinks per week is also associated with less risk of having any sick days (-0.04, p-value<0.001), fewer sick days conditional on having any (-0.54, p-value<0.001), and fewer sick days combining both parts of the model (-0.18, p-value<0.001) compared to not drinking at all. Using drugs to relax "sometimes" compared to "rarely or never" is associated with an increase in the risk of sick days of 0.08 (p-value<0.001), an increase in the number of sick days in the conditional part of the model of 0.45 (p-value<0.001) and a 0.28 (p-value<0.001) increase in the number of sick days taking both parts of the model into account. The average marginal effects of using drugs to relax "almost every day" compared to "rarely or never" are 0.07 (p-value<0.001) increase in risk of sick days, 0.50 (p-value<0.001) more days conditional on having sick days, and 0.27 (p-value<0.001) more sick days overall.

Sample Selection: Dependents in the Analysis of Sick Days

The first sensitivity analysis contrasts employees and their dependents for the one employer with survey data for dependents (employer with dependents (EWD) sample). Using only the employees from the EWD sample, none of the

indicators of lack of health-related employer support are statistically significant at the 5% level in the regression with sick days as the dependent variable (Table 24, column B). With the exception of the conditional margin of not having physical support (4.83, p-value 0.005), the same is true of the dependents from the EWD sample (Table 24, column C).

Measurement: Health-related Employer Support in the Analysis of Sick Days

When "don't know" answers about health-related employer support are treated as "no" answers (Table 24, column D), the average marginal effects of the indicators of a lack of health-related employer support are nearly identical to the original results when the outcome is the number of sick days (column "original"). Both sets of average marginal effects are not statistically significant at the 5% level in either part of the model or combining both parts.

Another set of analyses treat "don't know" answers as "don't know" so the list of indicator variable expands to: neither, no physical, no emotional, physical/don't know emotional, no physical/don't know emotional, don't know physical/emotional, don't know physical/no emotional and both serves as the reference category. As in the original model of sick days, the indicators of not having either type of support and not having physical support are not statistically significant the 5% level (Table 24.1). Some of the other indicators are statistically significant in at least one part of the model. Not having emotional support is associated with a 0.02 (p-value 0.005) increase in the risk of having at least one sick day. Having physical/don't know emotional support is associated with a 0.01 (p-value 0.03) increase in the risk of having sick days and with 0.28 fewer (p-value<0.001) days missed conditional on having at least one (the unconditional

margin is not statistically significant). Not knowing physical support and not having emotional support is associated with an increase in the number of sick days overall (0.08, p-value 0.04) but the average marginal effects in the separate parts of the model are not statistically significant at the 5% level.

Another sensitivity analysis does not control for whether the supervisor creates a "trusting and open environment," in case that concept is too closely aligned with the concept of health-related employer support. Similarly to the original findings, none of the indicators of lack of health-related employer support have statistically significant average marginal effects on sick days in this sensitivity analysis (Table 24, column E).

Reverse Causality: Employer-State Averages of Health-Related Employer Support in the Analysis of Sick Days

To partially address the issue of reverse causality, sensitivity analyses used employer-state averages of health-related employer support in lieu of the employee health-related support. As would be expected, the results are qualitatively different because instead of being indicators, the measures of health-related employer support are percentages. Having 100% of employees reporting not having support in either dimension is associated with increased sick days overall (0.51, p-value 0.03) compared to having 100% of them report having both types of support (Table 24, column F). A more realistic change in the percentage of employees lacking both type of support, from the 25^{th} to the 75^{th} percentile (from 4.97% to 10.25% of employees), is associated with 0.03 more sick days overall (results not shown in table). Having 100% of employees, compared to 0%, report not having physical support is associated with an additional 9.78 (p-value 0.002) sick days conditional

on having at least one, and with an additional 1.89 (p-value 0.04) sick days overall (just more than one SD). Similarly, having 100% of employees report not having emotional support is associated with an increase in the number of sick days for the conditional margin (3.72, p-value<0.001) and for the unconditional margin (0.64, p-value 0.03). Moving from the 25th to the 75th percentile of the employer-state average (from 6.20% to 14.28% of employees) for not having emotional support is associated with an additional 0.04 sick days overall (results not shown in table).

Omitted Variables Bias: Controlling for Drug and Alcohol in the Analysis of Self-Rated Relative Productivity

Turning to the analysis of self-rated relative productivity (Table 25, column A), not having either type of support is associated with an increase of 0.38 (p-value <0.001) after controlling for drug and alcohol use, which is almost identical to the original estimate of 0.37 (p-value <0.001). Not having physical support has an almost identical effect to the original analysis after controlling for alcohol and relaxing drug use. Not having emotional support after controlling for drug and alcohol use is associated with a 0.21 (p-value <0.001) increase in self-rated relative productivity, nearly identical to the original model increase of 0.20 (p-value <0.001). In results not shown in the table, reporting zero to seven alcohol drinks per week compared to reporting none is not significantly associated with self-rated relative productivity, but reporting eight or more drinks per week is associated with higher self-rated productivity, an increase of 0.05 (p-value 0.04). Using drugs to relax "sometimes" or "almost every day" compared to "rarely or never" are not associated with self-rated relatively productivity at the 5% level of statistical significance.

Sample Selection: Dependents in the Analysis of Self-Rated Relative Productivity

With the self-rated relative productivity measure of productivity, the results of the sensitivity analysis using the employees-only EWD were similar to the original results, but with some differences (Table 25, column B). The average marginal effect of not having either type of support is slightly smaller in this sensitivity analysis, 0.35 (p-value <0.001) than in the original. The average marginal effect of not having physical support in this sensitivity analysis, 0.33 (p-value 0.04), is more than double the original estimate. For not having emotional support, the average marginal effect in this sensitivity analysis, 0.21 (p-value <0.001), is extremely close to the original average marginal effect.

Not having either type of support is associated with an increase in self-rated relative productivity of 0.37 (p-value 0.03) in the dependents EWD sample (Table 25, column C), compared to the increase of 0.35 (p-value < 0.001) in the employees only EWD sample. The average marginal effect of not having physical support is much smaller in the dependents EWD sample, 0.05 (0.84) than in the employees only EWD sample and is not statistically significant at the 5% level. Among the dependents EWD sample, not having emotional support is also not statistically significant unlike in the employees-only EWD sample.

Measurement: Health-related Employer Support in the Analysis of Self-Rated Relative Productivity

When self-rated relative productivity is used as the outcome and "don't know" answers are coded as "no" for health-related employer support (Table 25, column D), not having either type of support is associated with an increase of 0.37 (p-value <0.001)—identical to the results of the original model. Not having physical

support is not statistically significant when "don't know" is coded as "no," (p-value 0.057) whereas it is in the original analysis. In the original model, not having emotional support is associated with a 0.20 (p-value <0.001) increase in self-rated relative productivity—the same average marginal effect and significance level as in the sensitivity analysis.

In the original model of self-rated relative productivity, not having either type of support is associated with an increase of 0.37 (p-value <0.001). In this sensitivity analysis (Table 25.1), it is also associated with an increase in self-rated relative productivity of 0.37 (p-value <0.001). Not having physical support is not statistically significant, but the increase was statistically significant at the 5% level in the original analysis, 0.15 (p-value 0.01). Not having emotional support is also associated with an increase in self-rated relative productivity, of 0.17 (p-value <0.001) in the sensitivity analysis and 0.20 (p-value <0.001) in the original analysis. Only one of the other indicators, don't know physical/no emotional is associated with a statistically significant association with self-rated relative productivity, an increase of 0.25 (p-value <0.001).

When not being in a trusting and open environment is removed from the model of self-rated relative productivity, the coefficients on not having health-related employer support are larger (Table 25, column E). Not having either type of support is associated with an increase in self-rated relative productivity of 0.47 (p-value <0.001) in this sensitivity analysis, compared to only 0.37 in the original analysis. Not having physical support or not having emotional support are also associated with increases in self-rated relative productivity of 0.17 (p-value 0.006) and 0.24 (p-value <0.001) respectively. These values are slightly higher than those

estimated in the original model, 0.15 for no physical and 0.20 for no emotional, with essentially the same level of statistical significance.

Reverse Causality: Employer-State Averages of Health-Related Employer Support in the Analysis of Self-Rated Relative Productivity

The associations between health-related employer support and self-rated relative productivity are not statistically significant for two of the three measures (no physical support and no emotional support, Table 25, column F) when the employer-state averages, whereas all three indicators were statistically significant in the original analysis (Table 25, column "original"). Having 100% of employees report not having either type of support versus 0% is associated with an increase in self-rated relative productivity of 1.15 (p-value <0.001). Neither of the other measures is statistically significant at the 5% level. The percentages of employees reporting having both types of support, neither type of support, not having physical support, and not having emotional support range from 0% to 100%, but this feasible range is not uniform across employers. There are very few observations at the ends of the range. Not having either type of support has an average (of employer-state averages) of 23.30% with a standard deviation of 10.14%. Not having physical support has a mean of 3.46% (SD 2.08%). Not having emotional support has a mean of 19.24% (SD 5.06%). Finally, having both types of support has a mean of 53.87% (SD 13.95%).

6.2 Is greater health-related employer support associated with lower future medical expenditures without controlling for pain?

The hypothesis, A-2, is that greater health-related employer support is associated with lower future medical expenditures without controlling for pain. For reference, the average expenditures in the sample are $7,874 (SD $22,220). Conditional on having more than $0 of expenditures, the average expenditures is $8,719 (SD $30,111). Because having both physical and emotional support is coded as the reference category, the average marginal effects of the dummy variables indicate a lack of support in both or one dimensions. Under Hypothesis A-2, the average marginal effect of not having support (in both or either dimensions) should positive (less support → greater expenditures) and statistically significant. Under the competing hypothesis, the average marginal effect of not having support should be negative.

Regression-adjusted estimates of association of health-related employer support with expenditures (not controlling for pain) are presented in Table 26 (Appendix 4 contains the regression coefficients). The second column of the Table gives the average marginal effects for the first part of the model, the difference in the probability of having any expenditure. The third column gives the average marginal effects of the second part of the model, the difference in the level of expenditure conditional on having expenditure. The fourth column gives the unconditional margin, the difference in the level of expenditure accounting for the probability of having any expenditure. None of the indicators for lack of health-related employer support have statistically significant average marginal effects in either part of the model. Not having either type of support compared to having both

types of support is associated with an insignificantly increased chance of expenditure (p-value 0.97), with lower conditional expenditures, -$1,328 (p-value 0.55), and with a still insignificant unconditional margin of $1,227 (p-value 0.56). Not having physical support is also insignificant with a reduced chance of expenditure, six percentage points less (p-value 0.29), lower conditional expenditures of -$2,872 (p-value 0.29), and an average marginal effect combining both parts of the model of $2,850 (p-value 0.25), compared to having both types of support. Not having emotional support is associated with an insignificant increase chance of having any expenditure of an additional three (p-value 0.15) percentage points, lower conditional expenditures of -$2,910 (p-value 0.6), and an unconditional margin of -$2,613 (p-value 0.08).

Several of the variables measuring health status are statistically significant at the 5% level in the model. Having a score of at least one on the Charlson Comorbidity Index is associated with an eight percentage point increase in the chance of having expenditures (p-value <0.001), and with an additional $13,459 (p-value <0.001) expenditures in the conditional part of the model. When both parts of the model are combined, the estimated unconditional margin of having a score of at least one is associated with $13,454 (p-value <0.001) additional expenditures compared to having a score of zero. In the conditional part of the model, asthma is significantly associated with lower expenditures, -$3,913 (p-value 0.001) and with lower expenditures overall, -$3,615 (p-value 0.001). Depression is associated with an increased chance of expenditures, 0.05 (p-value 0.001) and with higher future medical expenditures $6,323 (p-value 0.01) in the conditional part of the model. Overall, depression is associated with $6,203 (p-value 0.01) additional

expenditures, all else equal. High blood pressure and high cholesterol are both associated with an increased chance of having expenditures, of 0.04 (p-values <0.001 and 0.003 respectively)[23]. Being male is associated with a significantly lower probability of having any expenditure, by nine percentage points (p-value <0.001), significantly lower expenditures, -$3,075 (p-value 0.01) in the conditional part of the model, and overall lower expenditures, -$3,231 (p-value 0.001). Higher age is associated with greater expenditures ($144, p-value 0.02) in the conditional model and overall ($137, p-value 0.02).

6.2.1 Results of Sensitivity Analyses for Future Medical Expenditures

This section discusses the results of the sensitivity analyses of the association between health-related employer support and future medical expenditures not controlling for pain. The estimates of the average marginal effects of health-related employer support are given in Table 27.

Measurement: Preferences

One sensitivity analysis controls for previous medical expenditures as a proxy for preferences even though it might be over-controlling (Table 27, column A). Most of the results are qualitatively similar to the original estimates. Not having either type of support is not significant in either part of the model or overall after controlling for previous expenditures and the estimates have the same signs as the original estimates. Not having physical support is also not statistically significant at the 5% level compared to having both types of support. Not having emotional support is associated with lower expenditures in the conditional part of the model

[23] The point estimates for high blood pressure and high cholesterol are slightly different but they round to the same values.

controlling for previous expenditures -$6,420 (p-value 0.048) as well as overall -$5,960 (p-value 0.49). These estimates are larger and more significant than those in the original model. Both of the expenditure variables, demeaned expenditures and demeaned and squared expenditures, are statistically significant at the 5% level in both parts of the model and with respect to the unconditional margin.

Measurement: Health-related Employer Support in the Analysis of Future Medical Expenditures

An additional sensitivity analysis leaves out the variable for not having a supervisor who creates a "trusting and open environment" (Table 27, column B). The average marginal effects of the indicators of lack of health-related employer support are very similar to the original estimates (column "original") and are not statistically significant at the 5% level.

Sample Selection: Expanded Sample

The results of the analysis using the expanded sample definition—all individuals with eligible claims in at least one month of the year after the WBA, are still not statistically significant in either part of the model or overall although the signs of the effects are different than in the original analysis (Table 27, column C).

6.3 Summary of Results of Reduced Form Analysis

Two hypotheses were tested in this section:

- Hypothesis A-1: Greater health-related employer support will be associated with greater productivity.
- Hypothesis A-2: Greater health-related employer support will be associated with lower future medical expenditures. (Competing

hypothesis: Greater health-related employer support will be associated with higher future medical expenditures.)

Two different measures of productivity were used to test the first hypothesis. With two exceptions, no statistically significant associations were found between the first measure, sick days, and health-related employer support in the original analysis and in most of the sensitivity analyses. There is some evidence that not having support is associated with more sick days when the employer-state average measures is used in place of individual measures. In addition, when "don't know" values are not treated as missing, not having emotional support was positively associated with sick days (not knowing emotional support has a slightly complicated effect with different directions in each part of the model). When using the second measure of productivity, self-rated relative productivity, hypothesis A-1 was rejected, as the signs of the average marginal effects were opposite from those hypothesized and were statistically significant at the 5% level for all three indicators of health-related employer support. The results of the sensitivity analyses largely confirmed these results but with some variation in statistical significance.

For the second hypothesis, A-2, only one measure of future medical expenditures was used. None of the indicators of health-related employer support had statistically significant average marginal effects in either part of the two-part model or when both parts were combined to form the unconditional margin. The same held true for two of the three sensitivity analyses. When previous medical expenditures were added to the model, not having emotional support was significantly related to lower expenditures conditional on having nonzero expenditures and overall. Taking all of the results together, no evidence was found

to support the research hypothesis and the qualitative nature of the results depended on the sample being used for analysis.

6.4 Is greater health-related employer support associated with reduced chance of pain?

The hypothesis is that greater health-related employer support is associated with less risk of pain (B-1). Because having both physical and emotional support is coded as the reference category, the average marginal effects of the dummy variables indicate what happens when there is a lack of support in both or one dimensions. The null hypothesis that there is no relationship between pain and health-related employer support will be rejected if the coefficients and average marginal effects are statistically significant at the 5% level (hypothesized average marginal effects are positive). For reference, 44% of sample reported having pain in the previous year.

The average marginal effects (risk differences) are given in Table 28. Having neither physical nor emotional support is associated with an increase in the risk of having pain of three percentage points (0.03, p-value 0.008) compared to having both types of support. Not having physical support compared to having both types of support is not significantly associated with having pain at the 5% level. Not having emotional support is associated with a three-percentage-point increase in the chance of pain and is statistically significant at the 5% level (0.03, p-value 0.001). Two of the three average marginal effects lend support to the hypothesis and while the remaining indicator is not statistically significant; its sign is in the hypothesized direction. Because the average marginal effects of lacking both type

of support and lacking emotional support have the same magnitude, it seems that only emotional support is important for pain.

The other workplace psychosocial variables are associated with pain with statistically significant average marginal effects. Being unsatisfied at work is associated with an increase in the risk of pain of four percentage points (p-value <0.001). Not getting to use strengths at work, and not having a trusting and open environment are associated with slightly smaller increases in the risk of pain, of two (p-value 0.01) and three (p-value <0.001) percentage points respectively. Education level, one of the proxies for physical load, does not have consistent statistically significant results, although going to technical/vocation school compared to having less than a high school degree is associated with a two-percentage-point increase in the risk of pain (p-value 0.04). Having more children under the age of 18, and having help when in need are both associated with decreases in the probability of pain—0.005 less (p-value 0.01) and 0.05 less (p-value <0.001) respectively. In contrast, providing informal care is associated with an increase in the risk of pain of two percentage points (p-value 0.01).

In terms of health behaviors, exercise is significantly associated with reduced chance of pain while being a smoker is associated with an increased chance of pain. Of course, individuals with pain are much less likely to be able to exercise so the threat of reverse causality is strong. Exercising one or two times a week compared to not exercising at all is associated with a reduced chance of pain of three percentage points (p-value 0.001). Exercising three or more times compared to not exercising at all is associated with a five percentage point reduction in the chance

of pain (p-value <0.001). Smoking is associated with an increase in the chance of pain of four percentage points (p-value <0.001).

Most of the proxies for health and mental health status are significantly related to pain. Asthma is associated with an increase in the risk of pain of seven percentage points (p-value <0.001). Cancer is associated with an increase in the risk of pain of four percentage points and is also statistically significant at the 5% level (p-value 0.001). As expected, depression is associated with a large increase in the chance of pain, of 10 percentage points (p-value < 0.001). High blood pressure and high cholesterol are each associated with three percentage point increases in the chance of pain and are statistically significant at the 5% level (p-values <0.001). In terms of age, the average marginal effect is 0.01 (p-value <0.001), a small but statistically significant increase. The average marginal effect of BMI on the probability of pain is 0.005 but is also statistically significant (p-value<0.001). The average marginal effect of the emotional health index is -0.01 (p-value of <0.001) (better emotional health→ lower risk of pain). Having a one unit higher score on the general health ladder is associated with a three-percentage-point lower risk of pain (p-value<0.001).

6.4.1 Results of Sensitivity Analyses

Omitted Variables Bias: Controlling for Use of Relaxing Drugs and Alcohol

The risk differences in the probability of pain (average marginal effects) of the indicators for lack of health-related employer support after controlling for drug and alcohol use (Table 29, column A) are almost identical to the original estimates. Not having either type of health-related employer support compared to having both types of support is associated with an increase in the risk of pain of three

percentage points (p-value 0.008) in the original model and after controlling for drug and alcohol use (p-value 0.014). Compared to having both types of support, not having physical support was not significantly associated with risk of pain in either the original analysis or after controlling for drug and alcohol use. Compared to having both types of support, not having emotional support is associated with an increase in the risk of pain of three percentage points in the original model (p-value 0.001) and after controlling for drug and alcohol use (p-value 0.001).

In results not shown in the table, reporting 0-7 alcohol drinks per week compared to reporting none is associated with higher risk of pain, 0.02 (p-value <0.001) and reporting eight or more drinks per week is also associated with higher risk of pain, 0.035 (p-value <0.001). Using drugs to relax "sometimes" compared to "rarely or never" is significantly associated with a ten-percentage-point higher risk of pain (p-value <0.001). Similarly, using drugs to relax "almost every day" compared to "rarely or never" is associated with a seven percentage point increase in the chance of pain (p-value <0.001). One issue with using "drugs to relax" as a confounder is that reverse causality is likely to affect the estimates (employees in pain may take pain-relieving medications).

Omitted Variables Bias: Controlling for Race/Ethnicity

The average marginal effects of the indicators of not having health-related employer support after controlling for race/ethnicity are very different than the original model of pain although the differences appear to be driven by the subsample used for analysis rather than controlling for race/ethnicity per se. In this sensitivity analysis, the indicators for not having either type of support and not having emotional support are not statistically significant at the 5% level, while they

are statistically significant in the original analysis (Table 29, column B). Not having physical support is insignificant in both the original and the sensitivity analysis. In results not shown in the table, when the original analysis (not controlling for race/ethnicity) is run using the smaller sample used for the sensitivity analysis controlling for race/ethnicity, the average marginal effects of the indicators of not having health-related employer support are not statistically significant and are almost identical to the results when race/ethnicity is included in the regression. The difference in the average marginal effects of not having health-related employer support after controlling for race/ethnicity seems to be due to the smaller sample. Caucasian/White is the reference category in the sensitivity analysis. In results not shown in the table, the average marginal effect of being African American/Black compared to being Caucasian/White is a lower chance of pain of five percentage points (p-value 0.001). Being Hispanic is associated with a six percentage point (p-value <0.001) lower risk of pain compared to being Caucasian/White. Additionally, being Asian is associated with a reduced chance of pain compared to being Caucasian/White, of five percentage points (p-value 0.004).

Sample Selection: Dependents

This sensitivity analysis compares the results using only working adult dependents vs. using only employees, in both cases deriving the sample from the employer with data for both populations (as described in section 5.2.1). The results of this sensitivity analyses are different in that none of the indicators of not having health-related employer support are statistically significant, although this attenuation of statistical significance could be due to the large decrease in sample size (Table 29, columns C and D).

Measurement: Health-related Employer Support in the Analysis of Pain

Sensitivity analyses using variations of how the "don't know" answers to the questions about health-related employer are done in parallel to how these analyses were described in section 5.2.1. The first sensitivity analysis sets the value of the indicators of health-related employer support equal to no support if the original values are "don't know.[24]" For both the indicators having neither type of support and not having emotional support, the estimated average marginal effects in this sensitivity analyses are identical to the original estimates (Table 29, column E). The estimated average marginal effect of not having physical support compared to having both types of support differs slightly from the original estimate but still is not statistically significant.

When the indicators of health-related employer support are expanded to include "don't know" as a distinct category, the results change slightly (Table 29, column G). In general, the indicators that include not having emotional support or not knowing about emotional support are associated with increases in the risk of pain compared to having both types of support. Not having either type of support is associated with a three percentage point increase in the risk of pain in the sensitivity analysis (p-value 0.004) and in the original analysis (p-value 0.008). Not having emotional support (but having physical support) is associated with a four percentage point (p-value < 0.001) increase in the risk of pain compared to a three percentage point (p-value 0.001) increase in the original model. Not knowing emotional support and having physical support is associated with a three percentage point (p-value <0.001) increase in this sensitivity analysis. Not having

[24] In the original analysis, these values were treated as missing.

emotional support and not knowing physical support is associated with a five percentage point increase in the risk of pain (p-value 0.002). The exception to the pattern of results with respect to emotional support is the average marginal effect of not knowing emotional support and not having physical support, which is not statistically significant. Not having physical support (but having emotional support), not knowing physical support and having emotional support are each not statistically significant in this sensitivity analysis.

To address concerns that the measure of working in an environment that is not trusting and open is too closely aligned with the measure of health-related employer support, the variable is left out in a sensitivity analysis (Table 29, column F). When not being in an open and trusting environment is not controlled for, not having either type of support is associated with a four percentage point increase in the risk of pain (p-value 0.002). This indicator was associated with a three percentage point increase in the original model (p-value 0.008). Not having physical support is not significant in this sensitivity analysis (p-value 0.169). Not having emotional support is associated with a three percentage point increase in the risk of pain in this sensitivity analysis (p-value <0.001) and the original model (p-value 0.001). Because controlling for occupation may also be over-controlling, another sensitivity analysis did not control for occupation. It yielded results that are very close to the original estimates (Table 29, column G).

Measurement: Alternative Definitions of Pain

The research questions involving pain are also analyzed with alternative measures of pain: the original measure combined with a short-term pain question and the original broken down by body area. In the first of these, the "new"

definition of pain requires that an individual report recurring pain over the past year and pain in the day before the survey to be coded as one (Table 29, column H). In this sensitivity analysis, not having either types of support is associated with a three percentage point (p-value <0.001) increase in the risk of pain compared to having both types of support—matching the original estimate (p-value 0.008). The average marginal effect of not having physical support is again insignificant. Not having emotional support is associated with a two percentage point (p-value 0.003) increase in the risk of pain in this sensitivity analysis compared to a three percentage point increase in the original analysis (p-value 0.001).

For the analyses stratified by body area, there are three separate regressions. The dependent variables are whether the individual had pain in neck/back (Table 29, column I), knee/leg (Table 29, column J), or in any other area (Table 29, column K). While all of the estimated average marginal effects of not having support were positive with respect to the risk of pain, only a few were statistically significant. Not having either type of support compared to having both types of support is associated with a four percentage point increase in the chance of neck/back pain (p-value 0.001). Not having emotional support is associated with a three percentage point increase in the risk of neck/back pain compared to having both types of support (p-value 0.001). Both of these associations are very close to the associations found in the original analysis. For pain in any other area, not having either type of support is associated with a two percentage point increase in the risk of pain (p-value 0.028).

Reverse Causality

There is reason to suspect that pain might influence an individual's perception of health-related employer support. One sensitivity analysis addresses this issue by using the employer-state average of health-related support in place of the individual measures (Table 29, column L). The employer-state averages of not having either type of support and not having physical support are not statistically significant at the 5% level. Having 100% percent of employees within the state report not having emotional support compared to having 100% report both types of support is associated with an increase in the risk of pain, of 0.30 (p-value 0.001). A more realistic example is for the percentage reporting not having emotional support to increase from the 25th percentile to the 75th percentile (from 6.20% to 14.28% of employees), which yields an increase in the risk of pain of 0.02 (results not shown in table).

The other sensitivity analysis that addresses this issue uses health-related employer support and other covariates from the first survey to predict pain in the second survey (column M). As can be seen from the table, the average marginal effects of not having support are no longer statistically significant. In results not shown in table, when the original specification is run on the panel data just using the first time point, only the average marginal effect of not having emotional support is statistically significant at the 5% level (0.04, p-value 0.005). When the original specification is run on data from the second time point only (comorbidities are only measured at time one and are included), the average marginal effect of not having either type of support is 0.03 (p-value 0.04) and the average marginal effect of not having physical support is associated with a 0.06 increase in the

probability of pain (p-value 0.04). The average marginal effect of not having emotional support is not statistically significant at the 5% level when only the second time point is used. These results, estimated using data from only time one or time two, are different from both the original analysis and from the analysis that uses time one covariates to predict pain at time two. Despite the differences, at least one of the indicators of not having health-related employer support is statistically significant in analyses using either cross-section but none of the indicators are statistically significant when time one is used to predict time two. This could imply that the relationship between health-related employer support and pain is not causal.

6.5 Results: Is pain associated with lower productivity at work? Does controlling separately for pain attenuate any positive associations of health-related employer support with productivity?

This section discusses the results of the analyses of productivity at work controlling for health-related employer support, pain, and other factors. The hypotheses are that pain is associated with less productivity, and that the effect of health-related employer support on productivity at work is attenuated after controlling for pain.

6.5.1 Productivity Measured as Sick Days

Pain is significantly related to the number of sick days in each part of the model and overall when both parts are combined (Table 30). Pain is associated with a five percentage point increase in the chance of having sick days (p-value<0.001). It is also associated with 0.38 more sick days conditional on having any (p-

value<0.001), and with 0.20 more sick days when both parts of the model are combined (p-value<0.001). These values support the research hypothesis that pain leads to reduced productivity (B-2)—in this case, more sick days.

None of the average marginal effects of the indicators of a lack of health-related employer support are statistically significant at the 5% level. There is no consistent pattern of difference between the average marginal effects of health-related employer support in the models that do and do not control for pain. Hypothesis B-4 (attenuation of the average marginal effects) is therefore not supported. The results for the remaining variables in the model are almost identical to those presented without controlling for pain.

6.5.2 Productivity Measured As Self-Rated Relative Productivity

Pain is not significantly related to productivity at work when productivity is measured as self-rated relative productivity (0.03, p-value 0.27)—not supporting Hypothesis B-2 (see Table 31). After controlling for pain, not having either type of support compared to having both types of support is associated with a 0.37 increase in self-rated relative productivity (p-value <0.001). Not having physical support compared to having both types of support is associated with a higher self-rated relative productivity of 0.15 (p-value 0.01), after controlling for pain. Not having emotional support is associated with a 0.19 increase in self-rated relative productivity (p-value<0.001) after controlling for pain. These results are virtually identical to the results of the analyses that did not control for pain (Hypothesis B-4 is not supported). Conceptually, because there is no relationship between pain and self-rated relative productivity, pain cannot be a mediator in the relationship between health-related employer support and self-rated relative productivity. The

coefficients for the other variables in the model are nearly identical to the original model, as can be seen in the Table, so they are not discussed separately here.

6.5.3 Results of Sensitivity Analyses

Omitted Variables Bias: Controlling for Alcohol and Relaxing Drug Use in the Analysis of Sick Days controlling for Pain

In the analysis of sick days controlling for alcohol and use of relaxing drugs, none of the indicators of lack of health-related employer support are significant when pain is included in the regression (see Table 32, column A). In results not shown in the table, reporting one to seven alcohol drinks per week compared to reporting none is associated with a 0.01 (p-value 0.01) lower risk of sick days, -0.36 (p-value<0.001) sick days conditional on having at least one, and -0.10 (p-value<0.001) sick days overall. Reporting eight or more drinks per week is also associated with less risk of having any sick days (-0.04, p-value<0.001), fewer sick days conditional on having any (-0.54, p-value<0.001), and fewer sick days combining both parts of the model (-0.10, p-value<0.001) compared to not drinking at all. Using drugs to relax "sometimes" compared to "rarely or never" is associated with an increase in the risk of sick days of 0.07 (p-value<0.001), an increase in the number of sick days in the conditional part of the model of 0.50 (p-value<0.001) and a 0.27 (p-value<0.001) increase in the number of sick day taking both parts of the model into account. The average marginal effects of using drugs to relax "almost every day" compared to "rarely or never" are 0.08 (p-value<0.001) increase in risk of sick days, 0.45 (p-value<0.001) more days conditional on having sick days, and 0.28 (p-value<0.001) more sick days overall.

Sample Selection: Dependents in the Analysis of Sick Days controlling for Pain

Using only employees from the employer with dependents (EWD) sample, none of the indicators of lack of health-related employer support are statistically significant at the 5% level when pain is controlled in the regression (Table 32, columns B and C). Pain, however, is associated with a five percentage point increase in the risk of having any sick days (p-value<0.001), 0.44 more sick days conditional on having any (p-value<0.001), and 0.21 additional sick days overall (p-value<0.001). Using just dependents of employees from the EWD sample, not having physical support is associated with 4.52 additional sick days (p-value 0.01) conditional on having at least one sick day but is not statistically significant at the 5% level in the first part of the model or when both parts are combined (slightly attenuated from the estimate without controlling for pain, 4.83). In this sensitivity analysis, pain is associated with a five percentage point (p-value 0.005) increase in the probability of having any days missing and with an additional 0.19 sick days overall (p-value 0.003).

Measurement: Health-Related Employer Support in the Analysis of Sick Days controlling for Pain

The first sensitivity analysis described in this section treats "don't know" answers about health-related employer support as "no" answers. As in the original analysis controlling for pain, and in the parallel sensitivity analysis not controlling for pain, none of the indicators of not having health-related employer support are statistically significant at the 5% level. The average marginal effects of pain on sick days are identical to those of the original analysis where "don't know" answers are imputed and the regression controls for pain (Table 32, column D).

Another set of analyses treat "don't know" answers as "don't know" so the list of indicator variable expands to: neither, no physical, no emotional, physical/don't know emotional, no physical/don't know emotional, don't know physical/emotional, don't know physical/no emotional, and the reference category is both (Table 32.1). The results of this sensitivity analysis on sick days are different than the results controlling for pain and different than the results of the parallel sensitivity analysis when the regression does not control for pain. Not having either type of support is associated with a decrease in the probability of having any sick days, 0.16 (p-value 0.031) conditional on having any days in this sensitivity analysis. The estimate without controlling for pain is similar, 0.15, but is not statistically significant at the 5% level. Not having emotional support is associated with a slight increase in the probability of having any sick days, 0.02 (p-value 0.01) conditional on having any days in this sensitivity analysis—this is less significant than the estimate without controlling for pain, 0.02 (p-value 0.005). Not having physical support/not knowing emotional support is not significantly related to the probability of having any sick days in this sensitivity analysis, whereas it is when pain is not a covariate (0.01, p-value 0.03). It is, however, still associated with fewer sick days conditional on having any, -0.29 (p-value<0.001) as in the model without controlling for pain, -0.28 (p-value<0.001). Not knowing physical support and not having emotional support has a statistically significant unconditional margin without controlling for pain (0.08, p-value 0.04) but does not once pain is controlled in the model. The average marginal effects of pain on sick days are virtually identical to those estimated when "don't know" values are treated as missing an imputed (original controlling for pain).

The final sensitivity analysis for this outcome that deals with the measurement of health-related employer support removes the indicator for not having a supervisor who creates a "trusting and open environment." As in the parallel sensitivity analysis of sick days that does not control for pain, and the original estimate that does control for pain, none of the indicators of lack of health-related employer support are statistically significant at the 5% level in this sensitivity analysis (Table 32, column E). The average marginal effects of pain on sick days are virtually identical to the (original) estimates that leave the indicator in the model and control for pain.

Reverse Causality in the Analysis of Sick Days controlling for Pain

To partially address the issue of reverse causality, sensitivity analyses used employer-state averages of health-related employer support in lieu of the employee health-related support. In this sensitivity analysis the average marginal effects of pain on sick days are close to the estimates of the average marginal effects when pain is not controlled in the regression (Table 32, column F). The unconditional margin of the percentage of employees within a state report not having either type of support is not statistically significant once pain is controlled for, whereas it is associated with an additional 0.51 sick days (p-value 0.03) when pain is not controlled in the regression (for moving from 0% to 100% of employees). Having a higher percentage of employee report not having physical support is associated with an increase in the number of sick days conditional on having any (10.15, p-value 0.001), and overall (1.96, p-value 0.03) when pain is included in the regression. These estimates are slightly higher than when pain is left out. With average marginal effects that are slightly smaller than when pain is not included in

the regression, having a higher percentage of employees report not having emotional support is associated with an additional 3.69 (p-value<0.001) sick days in the conditional part of the model, and with an additional 0.60 (p-value 0.04) sick days when both parts of the model are combined. The average marginal effects of pain on sick days with employer-state averages are virtually identical to the average marginal effects when individual measures of health-related employer are used.

Gender Differences in the Effect of Pain: Analysis of Sick Days controlling for Pain

In the sample using only men (column G), pain is associated with a four percentage point increase in the probability of having any sick days (p-value<0.001), with an additional 0.38 days conditional on having at least one sick day (p-value<0.001), and with an additional 0.14 additional sick days overall (p-value 0.001). In the sample using only women (column H), pain is associated with a seven percentage point increase in the probability of having any sick days (p-value<0.001), with an additional 0.41 days conditional on having at least one sick day (p-value<0.001), and with an additional 0.26 additional sick days overall (p-value 0.001). None of the indicators of not having health-related employer support are statistically significant in the gender-stratified analyses.

Omitted Variables Bias: Controlling for Alcohol and Relaxing Drug Use in the Analysis of Self-Rated Relative Productivity controlling for Pain

Switching productivity outcomes, not having either type of support is associated with a higher self-rated relative productivity of 0.38 (p-value <0.001) after controlling for alcohol and relaxing drug use (Table 33, column A), compared to a 0.37 increase in the original model (p-value <0.001). Not having physical

support is associated with a 0.15 (p-value 0.01) increase in self-rated relative productivity in this sensitivity analysis—very close to the original estimate. Not having emotional support is also associated with an increase in self-rated relative productivity after controlling for alcohol and relaxing drugs use, of 0.21 (p-value<0.001) which is slightly higher than the original estimate of 0.19 (p-value<0.01). Having eight or more drinks per week compared to none is associated with a slight increase (0.05, p-value 0.04) in self-rated relative productivity while none of the other indicators of drug or alcohol use are statistically significant at the 5% level.

Sample Selection: Dependents in the Analysis of Self-Rated Relative Productivity controlling for Pain

The results of the sensitivity analysis of self-rated relative productivity using employees and dependents from the employer with dependents (EWD) sample is virtually identical to the results of the same sensitivity analysis when pain is not included in the regression (Table 33, columns B and C).

Measurement: Health-related Employer Support in the Analysis of Self-Rated Relative Productivity controlling for Pain

When "don't know" answers about health-related employer support are treated as "no" answers, the results of the analysis of self-rated relative productivity after controlling for pain are virtually identical to the results when pain is not included in the regression (Table 33, column D). The coefficient on pain is not statistically significant at the 5% level (0.03, p-value 0.27).

The results of the sensitivity analysis of self-rated relative productivity when "don't know" answers are used as categories are virtually identical to the results of

the same sensitivity analysis without controlling for pain (Table 33.1). Additionally, pain is not statistically significant at the 5% level.

The results of this sensitivity analysis that removes the indicator of whether the supervisor creates a "trusting and open" environment are virtually identical to the results without controlling for pain (Table 33, column E). Additionally, pain is not statistically significant at the 5% level.

Reverse Causality in the Analysis of Self-Rated Relative Productivity controlling for Pain

The results of the sensitivity analysis of self-rated relative productivity that uses employer-state averages of health-related employer support in place of the individual measures are virtually identical to the results without controlling for pain (Table 33, column F). Once again, pain is not statistically significant at the 5% level.

Gender Differences in the Effect of Pain: Analysis of Self-Rated Relative Productivity controlling for Pain

As in other analyses, pain was not statistically significant in wither the men only or the women only samples (columns G and H). Not having either type of support is associated with an increase in self-rated relative productivity of 0.37 in each of the stratified analyses (p-values<0.001). Not having physical support was not statistically significant at the 5% level in either the men's or women's analysis. Not having emotional support is associated with a 0.17 (p-value<0.001) increase in self-rated relative productivity in the men's sample and with an increase of 0.23 (p-value 0.001) in the women's sample.

6.5.4 Summary of Results of the Productivity at Work Outcome controlling for Pain

Pain does not appear to be a mediator in the relationship between health-related employer support and productivity when productivity is measured as sick days. There is no quantitatively or statistically significant relationship between health-related employer support and sick days whether or not pain is included in the regression. There is evidence that pain affects the number of sick days, but it does not appear to be a mediating factor for health-related employer support. However, in some of the sensitivity analyses (of sick days; when "don't know" is coded as "don't know," in the dependents sample, and when employer-state averages are used in lieu of individual measures), there seems to be some relationship between health-related employer support and sick days (although the direction of the effects differs between analyses). Adding pain to the model also seems to make slight changes in these average marginal effects, although again not consistently.

Pain is not a mediator of health-related employer support in its relationship with self-rated relative productivity. Pain does not have a quantitatively or statistically significant relationship with self-rated productivity. The estimated effects of health-related employer support on self-rated relative productivity after controlling for pain are nearly identical to the estimates without controlling for pain. The estimated average marginal effects of not having health-related employer support in the sensitivity analyses are reasonably close to the original estimates (with or without controlling for pain). The exception is that using the employer-state averages instead of individual measures causes the estimated effects of two

of the three indicators of lack of support to become insignificant, although not having either type remains statistically significant and quantitatively large. Additionally, the association of pain with sick days is larger for women than for men. There is no difference in the association of pain with self-rated relative productivity when the sample is stratified by gender (both average marginal effects are insignificant).

6.6 Is pain associated with higher future medical expenditures after controlling for health-related employer support? Is greater health-related employer support associated with higher future medical expenditures after controlling for pain?

The results of the model of future medical expenditures controlling for pain are displayed in Table 34. None of the indicators of health-related employer support are statistically significant at the 5% level in either part of the model or when both parts are combined to form the unconditional margin. Not having either type of support and not having physical support have negative but insignificant associations with having any future expenditures, -0.003 (p-value 0.91) and -0.07 (p-value 0.24) respectively. In the conditional part of the model, these indicators are associated with reduced medical expenditures, -$1,474 (p-value 0.52) for neither type of support and -$2,862 (p-value 0.27) for no physical support, but are also not significant. They are also associated with negative unconditional margins, but as mentioned, they are not statistically significant at the 5% level. Not having emotional support is insignificantly associated with a three percentage point increase in the chance of having medical expenditures (p-value 0.23). Although

also not significant, not having emotional support is associated with -$3,153 (p-value 0.050) change in medical expenditures conditional on having expenditures and an unconditional margin of -$2,857 (p-value 0.06). Because none of the average marginal effects of health-related employer support are statistically significant and there is no overall pattern in how the results change when pain is added to the regression, Hypothesis B-5 is not supported.

Having pain is associated with a six percentage point increase in the chance of having future medical expenditures and is statistically significant (p-value <0.001). Having pain is also associated with increased expenditures of $2,535 in the conditional part of the model (p-value 0.03), and with increased expenditures for the unconditional margin of $2,618 (p-value 0.017). Hypothesis B-3 is supported in each part of the model and overall. Some of the measures of health status are also statistically significant in one or both parts of the model. Having a Charlson Comorbidity Index score of at least one is associated with an increase in the chance of having medical expenditures of eight percentage points (p-value <0.001). In the conditional part of the model, having a Charlson Comorbidity Index score of at least one is associated with additional $13,073 in expenditure (p-value< 0.001). The estimated unconditional margin is also statistically significant, $13,034 (p-value <0.001). Depression is significantly related to future medical expenditures in both parts of the model. In the first part of the model, depression is associated with a five percentage point increase in the chance of having any medical expenditure (p-value 0.002). Depression is also associated with an additional $5,991 (p-value 0.01) in expenditures conditional on having positive expenditures and with and additional $5,852 (p-value 0.01) combining both parts of the model.

High blood pressure and high cholesterol are each associated with a four percentage point increase in the risk of having any expenditure and are statistically significant (p-values 0.004 and 0.007 respectively). Neither condition is significantly associated with conditional expenditures or with unconditional expenditures. Asthma is not significantly associated with the chance of having any expenditures, but is associated with reduced expenditure, -$3,968 in the conditional part of the model (p-value 0.002) and overall, -$3,682 (p-value 0.002). Smoking status, BMI, the emotional health index, and the general health ladder are not statistically significant in either part of the model.

Being male is associated with a decrease in the chance of having expenditure of nine percentage points (p-value <0.001) and with reduced expenditures conditional on having positive expenditure, -$2,972 (p-value 0.01). The unconditional margin for male is statistically significant, -$3,126 (p-value 0.004). None of the other covariates are statistically significant in either part of the model or when both parts are combined.

6.6.1 Results of Sensitivity Analyses

Measurement: Preferences

The first sensitivity analysis discussed in this section controls for previous expenditures as a measure of preferences for health care (Table 35, column A). In this sensitivity analysis, the indicator of not having emotional support is no longer statistically significant in the conditional part of the model (-$6,401, p-value 0.58) or when both parts of the model are combined (-$5,954, p-value 0.59) when pain is included in the regression. These average marginal effects are statistically significant when pain was not included in the regression in the parallel sensitivity

analysis, -$6,420 (p-value 0.048) and -$5,960 (p-value 0.049) respectively. After controlling for previous expenditures, pain is associated with a five percentage point increase in the probability of having any future medical expenditure but its conditional and unconditional margins are not statistically significant as they are when previous expenditures are not included in the regression.

Measurement: Health-Related Employer Support in the Analysis of Future Medical Expenditures

The next sensitivity analysis does not control for being in an open and trusting environment (Table 35, column B). The results of this sensitivity analysis are extremely similar to the original results—none of the indicators of health-related employer support are statistically significant and the estimated magnitudes are very similar to the original analysis. The estimated average marginal effects of pain on future medical expenditures are also similar to the original estimates. In this sensitivity analysis pain is associated with a six percentage point increase in the probability of having any medical expenditures (p-value<0.001), an additional $2,549 (p-value 0.03) in the conditional part of the model, and an additional $2,625 (p-value 0.02) when both parts of the model are combined.

Sample Selection: Expanded Sample

This sensitivity analysis uses an expanded sample with less stringent eligibility criteria (Table 35, column C). None of the indicators of not having health-related employer support are statistically significant in either part of the model or when both parts are taken together. Pain is estimated to increase the risk of expenditure by eight percentage points in the expanded sample (p-value <0.001) while it is associated with a six percentage point increase in the original analysis.

The results for the conditional part of the model and for the unconditional margin of pain are more statistically significant in this sensitivity analysis though they are smaller in magnitude. Conditional on having non-zero expenditures, pain is associated with an additional $1,182 (p-value < 0.001) in spending in the expanded sample, compared to an additional $2,535 (p-value 0.03) in the original analysis. Overall, combining both parts of the model, pain is associated with an additional $2,618 (p-value 0.017) in the original analyses and with an additional $1,013 (p-value <0.001) in the expanded sample.

Differential Effects of Pain by Gender

As can be seen in the table (columns D and E), the association of pain with future medical expenditures differs by gender. For men (column D), pain is associated with an 11 percentage point increase (p-value<0.001) in the probability of having any expenditure. For women, pain is associated with a three percentage point increase (p-value 0.02) in the probability of having any expenditure. Neither the conditional margin nor the unconditional margin of pain was statistically significant for men. For women, pain is associated with an additional $4,311 (p-value 0.01) conditional on having expenditure and with an additional $4,339 (p-value 0.003) of future medical expenditures overall. Additionally, in the sample of only women, both the conditional margin and the unconditional margin of not having emotional support are statistically significant at the 5% level; -$4,090 (p-value 0.04) and -$3,950 (p-value 0.04), respectively. Under the hypothesis, these effects were supposed to positive instead of negative.

6.6.2 Summary of the Analyses of Future Medical Expenditures controlling for Pain

The hypothesis tested in this section was confirmed, i.e., pain does increase future medical expenditures. This result was confirmed by the sensitivity analyses but with smaller magnitudes in the expanded sample and reduced statistical significance when controlling for previous medical expenditures. None of the indicators of health-related employer support were statistically significant whether or not pain was included in the regression—ruling out mediation. In the sensitivity analyses controlling for previous medical expenditures, controlling for pain reduced the magnitude and significance of the average marginal effects of not having emotional support on future medical expenditures. The sensitivity analyses using the expanded sample still had average marginal effects of not having health-related employer support that could not be distinguished from zero but had opposite signs and much smaller magnitudes. In the gender-stratified analyses, pain had a larger effect on the conditional and unconditional margins of future medical expenditures for women than men (the average marginal effects for men are not statistically significant). The chance of having any expenditure for men with pain was greater than that for women only. Additionally, the conditional and unconditional margins of not having emotional support were statistically significant for women after controlling for pain but the direction was opposite of that hypothesized.

6.8 Is the negative association of pain with productivity at work larger for those with health-related employer support than for those without?

6.8.1 Productivity measured as Sick Days

Because the model of sick days is nonlinear, expectations are used to assess the potential moderation of hypothesis C-1: the negative association of pain with productivity will be larger for those with health-related employer support than those without. The estimated differences in expectations are displayed in Table 36.

Under hypothesis C-1, we are looking for the positive effect of pain on sick days with both types of support to be larger than the effect of pain on sick days with no support, no physical support, and no emotional support. According to the hypothesis, the estimated difference between the effect of pain on sick days with no support (or no physical support or no emotional support) and the effect of pain on sick days with both types of support should be negative and statistically significant. Each of the estimated moderation effects for the indicators of lack of health-related employer support are negative, but their 95% confidence intervals include zero. Hypothesis C-1 is not substantiated.

6.8.2 Productivity measured as Self-Rated Relative Productivity

In this linear model, moderation is assessed by testing the statistical significance of the coefficients on the interaction terms as discussed in the methods chapter. The coefficient on the interaction of pain and not having either type of support is positive, 0.12, and statistically significant (p-value 0.01). The coefficients of the interactions of pain with not having physical support (0.14) and not having

emotional support (0.09) are not statistically significant at the 5% level, with p-values of 0.22 and 0.18 respectively. An F-test of the joint significance of the coefficients on the interaction terms rejected the null hypothesis that all three coefficients are equal to zero (3.96, 0.01). Because the sign of the coefficient on health-related employer support is opposite what was expected (implying not having support → increased productivity) and the effect of pain on productivity is not statistically significant, it is not clear what the sign of the moderation terms should be to fit the hypothesis.

6.9 Is the positive association of pain with future medical expenditures greater for those with health-related employer support than for those without?

The model of future medical expenditures is nonlinear, so expectations are used to assess the potential moderation of hypothesis C-2: the positive association of pain with future medical expenditures will be larger for those with health-related employer support than those without. As with the analysis of sick days, each relevant expectation is estimated and reported with its 95% bias-corrected and accelerated confidence interval with the key differences in expectations also separately bootstrapped (reported in Table 37).

Under hypothesis C-2, we are looking for the effect of pain on future medical expenditures with both types of support to be larger than the effect of pain on future medical expenditures with no support, no physical support, and no emotional support. According to the hypothesis, the estimated difference between the effect of pain on future medical expenditures with no support (or no physical support or

no emotional support) and the effect of pain on future medical expenditures with both types of support should be negative and statistically significant. However, each of the estimated moderation effects is positive and has 95% confidence intervals that include zero. Hypothesis C-2 is not substantiated.

6.10 Summary of Results

This section summarizes the results organized by research questions.

Summary of Reduced Form Analyses

In the reduced form analyses that did not control for pain, the results for the effect of health-related employer support on productivity and expenditures were mixed but mostly not statistically significant. No relationship was found between health-related employer support and sick days, except in the sensitivity analysis that used employer-state averages in lieu of the individual measures (with a caveat that the effect may be outside of the feasible range at the employer level). Not having health-related employer support was found to increase self-rated relative productivity—the opposite of the hypothesis. Not having health-related employer support did not have a statistically significant relationship with future medical expenditures except in the sensitivity analysis that controlled for previous expenditures. In this sensitivity analysis, not having emotional support was associated with reduced future medical expenditures (matching the competing hypothesis).

Taken together, it does not appear that health-related employer support has a consistent relationship with sick days and future medical expenditures. The direction of the association between not having health-related employer support and self-rated relative productivity is unexpected. Turning to the other psychosocial

workplace factors in the analysis, not getting to use strengths at work was associated with a statistically significant decrease in self-rated relative productivity—as expected. Not working in a trusting and open environment is significantly associated with increased self-rated relative productivity. In the short-term, it may be that the health effects of not having support are outweighed by the effect of not having support on productivity—not maintaining productivity might be less acceptable in environments without support. Environments that lack health-related employer support are likely to make the employee feel that reductions in productivity for health reasons are not acceptable. This effect, which encourages the employee to maintain productivity, may dominate the reductions in productivity from lacking health-related employer support in the short-term because the health effects of lacking support may appear only over longer periods of time.

Results of Mediation Analyses

This analysis did find a statistically significant association between not having health-related employer support and pain. This relationship held up under most sensitivity analyses, including those that used a different definition of pain. When neck/pain and other pain were used as the dependent variable instead of any pain, not having health-related employer support increased the probability of pain just as it did when the dependent variable was any pain. The results using knee/leg pain as the dependent variable were not statistically significant—in part possibly because most of the employees in the sample work in office setting, where neck and back pain are much more common than knee and leg pain. Repeating this analysis with a larger population might shed further light on this issue. When the coding of health-related employer support "don't know" values was changed, not having and/or not

knowing about support, particularly emotional support, was still associated with increased probability of pain. The relationship also qualitatively held true (but with reduced statistical significance) when employer-state averages were used in place of individual measures. The relationship was not statistically significant in the sensitivity analyses that split up dependents and employees.

This analysis also found that pain did increase sick days and future medical expenditures, but did not change self-rated relative productivity. However, because the average marginal effects of not having health-related employer support on sick days and future medical expenditures were not statistically significant whether or not pain was included in the regressions, there does not appear to be mediation for either of these outcomes. Despite individual-level health-related employer support lacking statistical significance in the main results, when employer-state averages were used in the sick days analysis the estimated average marginal effects of not having health-related employer support changed dramatically—all three indicators of not having support were significantly associated with having more sick days overall, not having emotional support and not having physical support were also associated with greater sick days conditional on having at least one (these two remained significant after pain was controlled for in the model). From this sensitivity analysis, it seems that reverse causality might be dampening the effect of health-related employer support on sick days—but this is only a tentative explanation. However, because the sizes of the average marginal effects only decrease for two of the three indicators after controlling for pain, and the changes are very small (from 0.01 to 0.003 for neither, and from 0.06 to 0.05 for no physical support) we cannot say that this sensitivity analysis shows mediation

overall. Turning to the remaining outcome, self-rated relative productivity, the average marginal effects were exactly the same when pain was included, except for not having emotional support, which changed to 0.19 from 0.20 when pain was included in the regression.

Results of Moderation Analyses

Neither of the hypothesized moderation effects, of health-related employer support on the relationships between pain and sick days and between pain and future medical expenditures, was found in this analysis. The interaction terms in the linear model of self-rated relative productivity were jointly significant and did have the hypothesized sign but should be interpreted cautiously because pain had no effect on the outcome before the interaction terms were added and had a main effect (simple effect) that could not be distinguished from zero even after they were added (which could be interpreted as not having an effect for employees with both kinds of support). The other problem with interpreting this moderation is that the effect of not having health-related employer support was in the opposite of the hypothesized direction (less support → more productive).

Chapter 7. Discussion

This chapter is divided into several sections. The first section examines the principal results of the analyses and compares them to estimates from the literature. The second section covers the limitations of the dissertation and how they were addressed. The third section discusses the policy implications of the results and the final section discusses possibilities for future work.

7.1 Principal Results and Comparisons to the Literature

The following table summarizes the results of this dissertation:

Hypothesis	Supported by Main Analysis	Main Analysis Robust to Sensitivity Analyses
Greater health-related employer support will be associated with greater productivity without controlling for pain.	Inconclusive (sick days); Against (self-rated relative)	Mixed
Greater health-related employer support will be associated with lower future medical expenditures without controlling for pain.	Inconclusive	Yes
Greater health-related employer support will be associated with reduced chance of pain.	For	Mixed
Pain will be associated with lower productivity at work.	For (sick days); Against (self-rated relative)	Yes
Pain will be associated with higher future medical expenditures.	For	Yes
Controlling separately for pain will attenuate any positive associations of health-related employer support with productivity.	Inconclusive	Yes
Greater health-related employer support will be associated with	Inconclusive	Yes

higher future medical expenditures after controlling for pain.		
The negative association of pain with productivity at work will be larger for those with health-related employer support than for those without.	Inconclusive	NA
The positive association of pain with future medical expenditures will be greater for those with health-related employer support than for those without.	Inconclusive	NA

The results for the three main research questions posed in this dissertation were mixed.

- The first question was: To what extent is health-related employer support associated with productivity at work and future medical expenditures after controlling for additional factors other than pain? Following are the results.
    - Lack of health-related employer support was not significantly related to productivity at work when measured as sick days in the main and most of the sensitivity analyses. In two of the sensitivity analyses, indicators for not having support were significantly associated with net overall increases in sick days.
    - Lack of health-related employer support was not significantly related to future medical expenditures in any analysis (main or sensitivity).
    - Lack of health-related employer support was significantly associated with higher self-rated relative productivity in the main and sensitivity analyses.
- The second research question was: To what extent does pain mediate the relationships between health-related employer support and productivity at

work and between health-related employer support and future medical expenditures? Results follow.

  - Lack of emotional health-related employer support was significantly associated with increased chance of pain. While this result held true for most of the sensitivity analyses, the relationship was not statistically significant once race/ethnicity were controlled for, in the sample of dependents, and when two time points were used (although these samples were smaller than the one used for the main analysis and did not show much evidence of a relationship with the original specification). The lack of statistical significance is likely due to a lack of statistical power.
  - Pain was not significantly associated with self-rated relative productivity.
  - Pain was significantly associated with increased future medical expenditures.
  - Pain was significantly associated with increased sick days.
  - When pain was controlled for in the analyses of the association between not having health-related employer support and the outcomes (productivity at work and future medical expenditures), the results had the same pattern as when pain was not controlled for, so no mediation was shown.

- The third research question was: To what extent does health-related employer support moderate the relationship between pain and productivity at work and between pain and future medical expenditures? See results below.

- Lack of health-related support was not found to moderate either the relationship between pain and sick days or the relationship between pain and future medical expenditures.
- Although the moderation effects for the relationship between a lack of health-related employer support and self-rated relative productivity were statistically significant, the meaning of the effect is difficult to interpret. Pain was not significantly related to self-rated relative productivity and the effect of lacking health-related employer support was associated with higher self-rated relative productivity—the opposite of what was hypothesized.

Many of the estimates were not significant for most of the outcomes. There are several possible explanations. The simplest explanation is that the associations between the variables, for example between future medical expenditures and lack of health-related employer support, do not exist. Another possibility is that the sample size is too small or lacks enough variation to determine the nature of the relationship—more likely to be true for the case of future medical expenditures than for sick days. The lack of results in the analyses of the mediation of lack of health-related employer support by pain may simply imply that the effect cannot be observed over such a short time horizon.

In some of the sensitivity analyses, most notably the analyses using employer-state averages of health-related employer support in lieu of individual measures, some significant results were seen that did not appear in the main analyses. While these results are promising, the problem of multiple comparisons

(the more tests we perform on the data, the more likely we are to reject the null hypothesis—that the association is zero—when it is true) reduces their impact. They were also quantitatively small.

Because so few papers use employer support to predict productivity at work and future medical expenditures, it is difficult to compare these dissertation results to the literature. Some of the results can be compared to estimates from a paper by Shi and colleagues [40]. The measures used by Shi et al. differ from those used in this dissertation. Their measure of support was a general measure that asked employees to rank their employer's support for their well-being on a 0-10 scale (health-related employer support was the focus of this dissertation). For this dissertation's model estimating the number of sick days, only results from the first part estimating the probability of having any sick days can be compared because Shi et al. used a binary dependent variable equal to one if the employee had missed any days in the past 28. The estimates from Shi et al. did not find a relationship between overall organizational support and having any sick days, which parallels the results of this dissertation with its more narrowly defined measure of health-related employer support [40]. Shi et al. found that pain was associated with an increase in the odds of having sick days of 1.16 (the baseline odds of having any sick days was 0.24—0.19% of employees reported sick days) [40]. Using the baseline odds as an example, the estimated odds ratio implies that the probability of taking sick leave was 21% for employees with recurring pain compared to 19% for those without pain. This dissertation found that pain was associated with a five percentage point (0.05) increase in the probability of having any sick days holding all else equal. In results not shown, using the sample for this dissertation but with

self-rated productivity as the outcome to match the Shi et al. paper, the association of recurring pain with self-rated productivity was very similar, -0.034 (p-value<0.01), to the Shi et al. results, -0.033 (p-value<0.01) [40]. The key difference in the analysis of self-rated productivity was that the general well-being measure used by Shi et al. was significantly positively related to self-rated productivity while the measure of the health-related employer support used in this dissertation was not statistically significant.

Estimates from this dissertation of the impact of pain on productivity at work and future medical expenditures can be more readily compared to existing estimates. The estimate from this dissertation that employees with pain have an additional $2,618 in medical expenditures compared to individuals without pain is lower than the estimates of Gaskin and Richard, who estimated that individuals with pain had an additional $4,516 of expenditures compared to those without pain [1, 154]. However, Gaskin and Richard used a nationally representative sample—which is very different from the employee population used in this sample [1, 154]. While the prevalence of pain was smaller in the national sample (21% versus 44% in this dissertation) the survey questions asked to determine pain were different[25]. Individuals with severe functional limitations from pain were less likely to be in the employed sample than in the representative sample (because they may not be able to work). These individual are also more likely to have greater expenditures because of the severity of their pain.

Gaskin and Richard also estimated productivity loss using the number of days missed for health in the previous year [154]. The average number of days missed

[25] The SF-12 measures of pain were used by Gaskin and Richard.

in the sample used for this dissertation was higher, 0.48 in the last month (5.76 if scaled to a year), than the average in the Gaskin and Richard sample, 2.14 days missed over a year [154]. After controlling for other variables, Gaskin and Richard estimated that individuals with pain missed 2.1 additional days of work over a year than individuals without pain (average 0.18 days/month) [154]. This is actually fairly close to the estimate of an additional 0.20 days/month given in this dissertation, especially considering the difference in control variables and regression model[26].

7.2 Study Limitations

The major threats to the validity of the study are sample selection, reverse causality, measurement issues, and omitted variable bias. These threats and the attempts to minimize them are summarized in turn.

Sample selection is a threat because only employers who gave WBAs and employees who took WBAs are included in the sample, so, the results may not generalize to other populations. For the models of productivity at work and pain, sensitivity analyses using dependents of employees partially addressed this concern. These analyses differed slightly from the main results, most likely because the power was much lower. For the model of future medical expenditures, an expanded sample used a less restrictive definition of eligibility so that employees from an additional employer could be used for analysis. This sensitivity analysis confirmed the main result that lack of health-related employer support was not related to future medical expenditures. Given the limited previous work in this area

[26] Gaskin and Richard used a log-linear regression for the second part of the two-part model.

and the diversity of occupations and locations of worksites in the sample, the study still provides new information for the field despite the threat of selection bias.

Concerns about endogeneity between key concepts can only be partially addressed given the complicated nature of the relationships, the study design, and the lack of available instruments to use in instrumental variables methods. When employer-state averages (productivity and pain analyses) and two time points (pain analysis) were used to address this problem, the results either generally matched the main analyses or the association of health-related employer support with the outcomes became stronger—indicating that the direction of bias in the main analyses is towards the null. Of course, using two time points introduces its own bias, because only individuals who stayed at their employer were eligible (so individuals who left bad environments would no longer be in the sample).

Another limitation is the measurement of health-related employer support given the relatively large percentage of employees answering "don't know." If these answers contained information and should not have been treated as missing, then the main results might be biased. Two additional analyses tested the sensitivity of the results to the way "don't know" answers were handled. Generally, these results were the same as the main analysis. In addition, not knowing about emotional support was found to be related to increases in the probability of pain of about the same magnitude as not having emotional support. The measurement of pain was also tested by combining the existing measure with a measure of pain in the previous day. These results were very close to the main analyses.

Because not having physical and emotional health-related employer support were measured as binary variables, they have limited variation compared to

continuous variables. The measure of pain is also binary. This relative lack of variation may increase the likelihood of Type II error (failing to reject the null hypothesis when the alternative is true). In the analysis of the relationship between pain and not having health-related employer support, this conservative bias reinforces the importance of the result because it was statistically significant.

Additionally, in the analyses of productivity at work and medical expenditures, having both key exposure variables (not having health-related employer support and pain) be binary may also have led to increased probability of Type II error. The sensitivity analysis using employer-state averages of health-related employer support increases variation by allowing for a measure that varies from zero to one (but reduces variation in another sense because there is no longer individual variation). In the analysis of sick days, the indicators for lack of health-related employer support are associated with sick days when employer-state averages are used, but are not when individual measures are used—lending some support to the idea that the Type II error might be high in the original models. Pain was significantly related to sick days and future medical expenditures, despite the conservative bias from the lack of variation.

The presence of omitted variables could bias the results if these variables are correlated with both the dependent variables and with the predictors of interest (lack of health-related employer support and pain). In the future medical expenditures model, preferences could be considered an omitted factor despite the proxies used in the main analysis. When previous medical expenditures were included in the model, to proxy for preferences, not having health-related employer support was still not statistically significant. The use of drugs and alcohol are

potential omitted variables in the analyses of productivity at work and pain. The results of the sensitivity analyses that controlled for these factors using a subsample of employees were essentially the same as the main analyses. Race/ethnicity was another potentially omitted factor in the analysis of pain. The sensitivity analysis that used the subsample of employees with race/ethnicity data differed from the main results, but this was likely due to the specific subsample of employees rather than the addition of race/ethnicity to the model.

A few variables omitted from the main analyses could not be addressed with sensitivity analysis. Employee physical load and standard workplace metrics such as job strain and ERI could not be controlled for in any of the analyses (though physical load is only relevant for pain). In the case of estimating the impact of health-related employer support on pain, if physical load increases the risk of pain and tends to occur in workplaces without health-related employer support, then the estimated impacts are likely to be overestimated. However, the direction of the correlation between health-related employer support and physical load is not known and the analysis does use several proxies for physical load, which should reduce the bias. The bias of using non-standard measures of the psychosocial work environment cannot be assigned precisely because the sets of measures have not been compared.

7.3 Policy Implications

While most of the hypothesized effects were not statistically significant, health-related employer support was found to be related to pain and pain was found to be significantly related to future medical expenditures and sick days. These results have implications for employers and employees. They show that

health-related employer support is associated with pain, which in turn increases medical expenditures and reduces productivity by increasing sick days—two outcomes that are important to employers because they affect profitability. In other words, pain reduction would improve employers' bottom lines, all else equal, because it would likely lead to lower medical expenditures and decrease the number of sick days employees need to take. Health-related employer support is one potential mechanism employers can control and change that is associated with pain—other workplace psychosocial factors are also possible mechanisms. The association of health-related employer support with pain is likely to be more important to employees than the association of pain with future medical expenditures and sick days.

The implications of the results that not having health-related employer support increases self-rated relative productivity are less clear. In results not shown in the tables, lack of health-related employer support was *not* significantly related to self-rated productivity but was associated with reduced ratings of the usual worker. It seems that not having health-related employer support lowers employees' evaluations of others, but does not significantly alter self-evaluations. Pain was found to significantly decrease employees' ratings of their own productivity and of the productivity of others.

The previously documented relationship between negative affect and chronic pain may help to explain the result that not having health-related employer support increases self-rated relative productivity. Negative affect has been studied as both a state (temporary response to internal or external stimuli) and a trait (reflecting a pattern of response—foundation for personality characteristic) [151]. In general,

negative affect and pain are positively related [151-153]. State negative affect has been found to be associated with increased pain report, passive coping skills, and greater functional disability [151, 154, 155]. In a study of women with osteoarthritis and/or fibromyalgia, elevated pain and stress were found to predict increases in negative affect and both weekly increases and higher average levels of negative affect predicted pain—the relationship may be reciprocal [153]. This possibility has been noted in other studies as well [152].

Individuals with negative affect may be more likely to respond that they do not have health-related employer support, to view the usual worker's productivity more negatively, *and* to view their own productivity more negatively. In the estimated model, not having health related employer support was significantly related to increases self-rated relative productivity by reducing the employee's view of the productivity of the usual worker. However, not having health-related employer support was not significantly related to self-rated productivity. Given these results, negative affect may partially explain the direction of the finding that not having health-related employer support increased self-rated relative productivity, but is not a complete explanation.

Some of the ancillary results of this dissertation also have interesting policy implications. The association of physical activity with reduced sick days is interesting in the context of workplace wellness because physical activity is a modifiable factor commonly targeted by workplace wellness programs. While reverse causality is a threat to the direction of causation, the result that physical activity outside of work increases productivity at work has been shown before and

is one of the motivations for implementing worksite fitness programs, such as instant recess [155].

Given the lack of change in the sick days and medical expenditures associated with lack of health-related employer support in the reduced-form models, employers may want to focus on other workplace factors to impact these outcomes directly. The increase in the risk of pain associated with additional workplace psychosocial factors, such as job dissatisfaction, not getting to use strengths at work, and not working in a trusting and open environment, suggest additional mechanisms employers may use to reduce employee pain. Not working in a trusting and open environment was associated with increased sick days (~10% of the average), but with *increased* self-rated relative productivity (by lowering ratings of the usual worker). Not getting to use strengths at work was associated with a decrease in self-rated relative productivity. Despite not affecting medical expenditures and productivity at work in reduced-form models, health-related employer support does seem to affect pain, so it might be worthwhile for employers to continue using it as a way to improve employee health, even though the associations are quantitatively small (increase in pain is <10% of average of 44%, i.e. less than 4.4 percentage points). In other words, even though the reduced-form results do not provide support for a reduced-form relationship between health-related employer support and productivity at work and future medical expenditures, the mediation analyses provide at least some evidence that health-related may be affecting both outcomes when looking strictly at mediation through pain.

There have always been tensions between the concepts of "workplace wellness" and occupational health and safety which have been highlighted by the

passage of the ACA and its incentives for employers to provide wellness services and allow the use of substantial financial incentives for employees. Recent controversy surrounding wellness programs at the state level has also been fierce, with some states passing legislation to encourage the use of wellness programs while others have passed legislations restricting wellness programs. In California, Senate Bill 189: Health Care Coverage: Wellness Programs was recently analyzed by the California Health Benefits Review Program[27]. S.B. 189 sought to restrict the use of financial incentives, changes to premiums, and changes to cost-sharing based on wellness programs offered by plans/insurers regulated by the California Department of Insurance and the California Department of Managed Health Care for plans new after January 2014. This bill is an example of the controversy surrounding wellness programs as well as the complications that arise in the design of wellness programs since they may be offered directly by employers, by unions, or by insurers (among others).

Differences between the approach to health and the role of the workplace between the traditional occupational health and safety and the wellness approaches can be divided into three categories: conceptual, implementation, and impact measurement issues.

Conceptual issues that are a source of division stem from where the burden of poor health is placed. Workplace wellness programs place the primary responsibility for poor health on the employee, especially for modifiable risk factors that lead to chronic disease, while more traditional approaches to workplace health

[27] A copy of the report is available at http://chbrp.ucop.edu/index.php?action=read&bill_id=149&doc_type=3 .

and safety put a large portion of the burden on the employer. "Is it [reasonable] to expect a worker whose boss yells at her all day to quit smoking within 90 days?" [156] From the traditional occupational health standpoint, it is unreasonable to expect this employee to quit smoking because her psychosocial work environment creates undue amounts of stress. In contrast, a workplace wellness program might offer smoking cessation programs for free to the employee, or alternatively, she might be penalized for smoking by paying a higher share of her health insurance premiums because the behavior is one that she *chooses* to continue. However, the picture is more complicated than that because workplace wellness programs often recognize that environment matters. For example, cafeteria redesigns that promote healthy choices, instead of unhealthy ones, recognize the implicit impact of the environment on employees. In the academic literature, the extent to which external factors and individual choices affect health is still a matter of debate.

This dissertation controlled for both psychosocial workplace factors and individual health behaviors in the analysis of pain (which might be considered over-controlling from an occupational health standpoint). Both sets of factors had significant relationships with employee pain. Using an extended set of factors and additional outcomes may allow for a more nuanced argument about the role of employers and employees in determining health. Given that there is tacit acknowledgement that the environment does affect employee choices and health in the framework of workplace wellness, using workplace wellness as an entry point to discussions about working conditions more generally may have benefits for employees as well as for employers (who might not be spending money on programs that are unlikely to change employee health).

Implementation of wellness programs is another source of concern for employers, primarily with respect to litigation and turnover, and for employees, primarily because of fairness and privacy issues. There is also concern that some wellness efforts may turn social support among employees from a positive factor into a negative one [156]. Additionally, critiques of the NIOSH Total Worker Health Program, which promotes "integrating health protection and health promotion," [157] express concerns over whether the approach is applicable to small worksites, shows lack of collaboration with unions, and an "inadequate conceptual model of the causes of work-related diseases," among others [158]. These critiques stem from concerns over fairness with respect to individual employees in how programs are implemented, as well as fairness from a more global perspective—given the conceptual issues outlined previously. Rigorous research on the implementation of health, safety, and wellness programs is needed. This is particularly the case in small-employer settings, none of which were available for examination in this dissertation. Part of the difficulty in assessing implementation is that both "organizational culture" and individual behavior are very hard to change, so measuring the effect of change is often moot.

The third point of contention is how outcomes are defined and measured. Critiques of the NIOSH Total Worker Health initiative specifically target these areas [158]. Workplace wellness has generally had return-on-investment (ROI) as a primary outcome. This measure may use medical costs, productivity costs, and turnover costs to show whether wellness programs are a good investment for a given employer. Ostensibly, any cost improvement is due to the effect of the wellness programming on employee health. However, decreasing costs may not be

the result of better health, but rather be the result of poor psychosocial work environment factors that become barriers to seeking care (or encourage postponing needed care). Using the outcomes studied in this dissertation, decreased future medical costs may be the result of better employee health that has reduced the need for care or be the result of higher opportunity costs of getting care because of psychosocial workplace factors. Similarly, reduced sick days could be due to better employee health or could be due to workplace pressure on employees to work while ill. While this dissertation tried to address these issues of attribution through conducting mediation and moderation analyses, no conclusive results were found.

7.4 Future Work

Because health-related employer support was not significantly associated with the sick days and future medical expenditures, future analysis with different data could explore the relationships using validated workplace indices, such as the JCQ and the workplace psychosocial measures that were associated with sick days in this analysis. Future work might also include measures of physical activity as it is likely to be a confounder in the relationships between pain and productivity at work.

Given the counter-intuitive nature of the results using self-rated relative productivity, future analyses that examine each component of relative productivity seem warranted. Some factors, such as lack of health-related employer support and pain, affect self-ratings and ratings of others in the same direction, while other factors, such as exercise, only affect self-ratings. Conceptually, some of these measures should not impact employees' ratings of others, so controlling explicitly for psychological factors would increase the reliability of the attribution of the effects.

Since not having emotional support was associated with increased risk of pain, further exploration could look at the role of not having support for emotional health in other modifiable health conditions. Additionally, the relationships between psychosocial workplace factors, pain, productivity at work, and future medical expenditures could be studied over a longer time horizon since the short-term and long-term effects of not having health-related employer support might differ.

Table 1. Literature Review

Author & Year	Data Year/Study Sample	Design/ Methods	Outcome Variable(s)	Significant Predictor(s)	Insignificant Predictors	Other Predictor(s)	Brief Critique
Research Question A-1							
Alavenia 2009	2005-2006/Netherlands: N= 2,252, 24 companies	cross-section/logistic (control vars if their p-value<.05)	Productivity on last regular work day (10-point numerical rating scale w/ 0 = ‘‘nothing’’ & 10 = ‘‘normal quantity’’)	productivity: moderate & severely impaired by health problems (-), lack of job control (-), older age & being a smoker associated w/ less risk of loss	Job demands	age, job type, BMI category, physical activity	Data set confined to the Netherlands, covariates were included in the regression based on statistical significance-so most not included, and productivity question dichotomized with median as threshold.
Baltes, B.B., et al. 1999	1974-1997/PsycLIT, ABI/INFORM, Business Periodicals Index, Dissertation Abstracts; N=31	meta-analysis/(1985) categorical analyses, weighted multiple regression	productivity, job satisfaction, satisfaction w/ work schedule, absenteeism	Flexible work schedules (+) but decrease over time, too much flexibility seemed to have slightly (-) effects	employee type as moderator		Included studies are now over 15 years old.

Author & Year	Data Year/Study Sample	Design/ Methods	Outcome Variable(s)	Significant Predictor(s)	Insignificant Predictors	Other Predictor(s)	Brief Critique
Côté, P., et al. 2008	1980-early 2007/Studies w/ information on working adults & pain, N=109, >= 20 workers, pain in neck/shoulder area (excluded if pain as outcome of specific disease)	systematic review	annual prevalence of neck pain, % workers limited in their activities because of neck pain	age, previous musculoskeletal pain, high quantitative job demands, low social support at work, job insecurity, low physical capacity, poor computer workstation design, work posture, sedentary work, position, repetitive work, precision work	interventions on workstations & worker posture	women, occupation, headaches, emotional problems, smoking, poor job satisfaction, awkward postures, poor physical environment, ethnicity	Only one area of pain used, and small sample size.
Cotton 2003	Unclear	review/SEM	employee wellbeing, discretionary performance, withdrawal behavior intensions	Wellbeing: negative & positive experiences make separate contributions; All: personality characteristics, coping processes, organizational climate		positive affect (morale), negative affect (distress)	Review not systematic.

Author & Year	Data Year/Study Sample	Design/ Methods	Outcome Variable(s)	Significant Predictor(s)	Insignificant Predictors	Other Predictor(s)	Brief Critique
Gary, J. 2011	2009/Business School Graduates (4784 graduates contacted, n = 444)	cross-section, web-based/OLS, transformations of skewed dependent variables	Productivity Loss: SPS-6, WLQ; Presenteeism: # times gone to work while ill in past 6 months; Absenteeism: # days absent from work for any reason	PE (+ task significance, + task interdependence, + ease of replacement, + work to family conflict (w2f), - neuroticism, - equity, - job security, - internal health locus of control, - perceived absence legitimacy (pal)); AB (+ task significance, + pal, + f2w, - task interdependence, - w2f); PR (+neuroticism, + unconscientiousness, + job-insecurity, + pal, + w2f)	All the other variables in for each outcome		Data set confined to business school graduates of one business school.
Johns, G. 2010	2009/respondents of web-based survey of a Canadian business school (N=444, 9.3% response rate)	cross-section/OLS, negative binomial for count data outcomes	attending work while ill, productivity loss, presenteeism days, total days absent, sick days	WLQ, HPQ, SPS-6; pay(-), sick pay(+), attendance control	some: job security, adjustment latitude, ease of replacement, & teamwork (more - less absent)	few: downsizing, mixed evidence for job demands	Data set confined to business school graduates of one Canadian business school.

Author & Year	Data Year/Study Sample	Design/ Methods	Outcome Variable(s)	Significant Predictor(s)	Insignificant Predictors	Other Predictor(s)	Brief Critique
Melchior, M., et al. 2003	6-year follow-up/GAZEL; French, middle-age, N=13,226	log-linear Poisson, stratified by gender	sickness absence (per 100 person-years)	relatively low level of decision latitude & personal social support predicted increase in absence, low social support at work & low satisfaction w/ social relations predicted increased absence for men only	Interactions between workplace factors & social relations variables	age, marital status, education, occupation, smoking, alcohol consumption, BMI, overall health status, depressive symptoms	Data set confined to France, limited age range, sickness absence had to be verified by a physician
Moen, P., et al. 2011	2006/Two waves of survey data from 659 employees (Best Buy corporate headquarters)	corporate initiative Results Only Work Environment/ quasi-experimental nonequivalent control group design w/ both pretests & posttests; nested SEM	hours of sleep on work nights, well-being, exercise, not working while ill, "does not go to the doctor when busy"	ROWE (mediated through increasing schedule control & reducing work-family conflict) of hours of sleep, well-being		gender, age, live w/ child, household income, tenure in years, management level, organizational culture	Data set includes only employees from corporate headquarters, variable of interest was a specific intervention

Author & Year	Data Year/Study Sample	Design/ Methods	Outcome Variable(s)	Significant Predictor(s)	Insignificant Predictors	Other Predictor(s)	Brief Critique
Rael et. al. 1995	1985-1990/Whitehall II; civil servants (N= 10 308), age 35-55 @ baseline	prospective cohort study/Stratified by short/long absence; Poisson regression w/ adjustments to CIs for overdipersion	Duration of sickness absence	Small magnitudes; high levels of confiding/emotional support from "closest person" (+); increased level of negative aspects of social support (+), suggestive: health tastes may be mediator	household network size, isolation scale	age, employment grade, marital status, alcohol consumption, GHW, overall health status, recurrent health problems	absences over 7 days required doctor's certificate, used Poisson with overdispersion correction rather, data set confined to British civil servants
Siltaloppi, M., U. Kinnunen, & T. Feldt 2009	2007/Finland: N=527 employees	cross-section/hierarchical regression	need for recovery, job exhaustion, occupational well-being	"results of these studies are somewhat equivocal"	aspects of the psychosocial work environment, work engagement		Data set confined to Finland

Author & Year	Data Year/Study Sample	Design/ Methods	Outcome Variable(s)	Significant Predictor(s)	Insignificant Predictors	Other Predictor(s)	Brief Critique
Sverke, M., J. Hellgren, & K. Näswall 2002	1980-1999/ABI-Inform, ERIC, LIBRIS, Management Contents, MedLine, Mental Health Abstracts, NIOSHTIC, PsycINFO, Sociological Abstracts, Social SciSearch, Uncover	meta-analysis/Hunter & Schmidt 1990 method	job attitudes, organizational attitudes, health, behavioral relationship w/ the organization	job insecurity (-)	Moderator: may be underestimated in studies relying on single-item measures of job insecurity		

Author & Year	Data Year/Study Sample	Design/ Methods	Outcome Variable(s)	Significant Predictor(s)	Insignificant Predictors	Other Predictor(s)	Brief Critique
van den Heuvel 2010	2007/Netherlands Working Conditions Survey, N=22,759 employees (15 to 64 years)	cross-section/logistic regression using model selection procedure	sickness absence in last year, low performance at work	PR loss: general health, the number of longstanding health conditions, psychological complaints, musculoskeletal symptoms (weaker than w/ absence), less likely for physically demanding jobs (more likely to take sick leave), psychosocial factors strongest association w/ at work performance (weakly associated w/ absence), temporary contract, women (-) low performance but (+) absence, supervisor	the others not mentioned	other demographic factors	Data set confined to the Netherlands, regressors selected based on statistical significance, predictors unclear
Darr, W. & G. Johns 2008	275 effects from 153 studies	meta-analysis/SEM	absenteeism, work strain (not traditional), psychological illness, physical illness	small (+) between outcomes		connections might be mediated by psychological & physical symptoms	

Author & Year	Data Year/Study Sample	Design/ Methods	Outcome Variable(s)	Significant Predictor(s)	Insignificant Predictors	Other Predictor(s)	Brief Critique
Research Questions A-1, B-2							
Burton, W.N., et al. 2005	national financial services company, N=28375 employees	panel/repeated cross section/multiple logistic, negative binomial	WLQ	use of relaxation medication, life dissatisfaction, job dissatisfaction, poor health, stress	heavy alcohol use, high cholesterol	age, gender, year, smoking, physical activity, safety belt usage, high BP, BMI>=30, medical conditions	
Lenssinck, M. et al. 2012	through July 2012/PubMed, EMbase, PsycINFO and CINAHL databases; individuals with Inflammatory arthritis; N=44	systematic review	sick leave days	(two or more studies with 75% of them finding ss effect) pain, lower physical functioning (HAQ, SF-36), disease severity (DAS-28)	(one study with ss effect) heavier work, materials handling, time pressure, low control, older (less evidence)	(all other) supervisor, overhead work, (some showed no effect but at least one had effect: female, lower education)	Used all types of sick days (including doctor certified), mixed data from different countries, some participants were asked to attribute absence to arthritis

Author & Year	Data Year/Study Sample	Design/ Methods	Outcome Variable(s)	Significant Predictor(s)	Insignificant Predictors	Other Predictor(s)	Brief Critique
Research Question A-2							
Goetzel, R.Z., et al. 2012	2005-2009/MarketScan Health & Productivity Management database, seven employers who administered StayWell HRA (N=92,486)	multiple regression analysis (GLM), administrative claims & self-reported presenteeism	medical costs (employer + employee)	after controlling for CCI and similar psych measure, high blood pressure, obesity, physical inactivity, tobacco use, and depression	depression, high stress, high blood glucose (significant before controlling for baseline health)	age, sex, type of health plan, location, industry, hourly/salaried, number of months in data, employer	Does not address role of employers, does not include social factors, does not include income
Rothstein 2009	through 2009/Not systematic	literature review/reviewed proprietary HRA, literature review to determine the efficacy of HRRPs using HRAs, individualized employee interventions, & financial incentives for employee participation	employer health benefit costs, employee health	"some evidence that HRRPs in employer-sponsored programs improve measures of employee health, but the results of these studies are somewhat equivocal"			Not systematic.

Author & Year	Data Year/Study Sample	Design/ Methods	Outcome Variable(s)	Significant Predictor(s)	Insignificant Predictors	Other Predictor(s)	Brief Critique
Tamers 2011	N=1240 employees from 33 worksites from group randomized weight maintenance trial	short panel/GEE (negative binomial link, worksite clustering)	doctor's visits, ER visits, hospitalizations, absenteeism	outcomes. Consistent w/ the conceptual framework, the results indicate	co-worker social support for other outcomes	intervention status, gender, age, education, race/ethnicity, smoking, diet, physical activity, BMI	Data set limited to data collected to test a specific intervention.
Research Question B-1							
Christensen, J.O. & S. Knardahl 2010	2004-2006, 2006-2009/Norwegian employees, N=2419 for both time points, baseline (N=4569), follow-up (N=4122)	longitudinal, prospective/ordered logistic regressions (GLMs), cumulative odds ratios (above/below cutoff), did not adjust for all of the independent factors at once, included age & sex in "multivariate models"	reported intensity of neck pain during the 4 weeks prior to the questionnaire, ordinal	risk factors: role conflict, working w/ arms raised to or above shoulder level; protective factors: empowering leadership, decision control	baseline exposure as predictor- decision control, role conflict, empowering leadership, positive challenge	General Nordic questionnaire for psychological & social factors at work, perceived physical workload, age, sex, neck pain at T1	Data set limited to Norway. Did not include all control variables (see methods column)

Author & Year	Data Year/Study Sample	Design/ Methods	Outcome Variable(s)	Significant Predictor(s)	Insignificant Predictors	Other Predictor(s)	Brief Critique
Hammig, O., et al. 2011	2007/German speaking Zurich companies: insurance, banking, transportation, & healthcare (N=6091)	cross-section/stepwise linear regression w/ standardized coefficients, logistic regression	low back pain, neck/shoulder pain	Work-Life conflict (10-item scale): confounded by physical strain at work, workload & job autonomy, general stress perception (as mediating factor); For WLC, most association from work-to-life conflict		time pressure, workload, physical strain, job autonomy, age, sex, education, physical activity	data set confined to Zurich, survey response rates were not given, and used step-wise regression
Haukka, E., et al. 2011	2002-2005/385 kitchen workers	survey every 3 months for 2 years/w/ low MSP as reference, logit model, GEE: time-lagged by 3 months	MSP trajectories: low, descending, ascending, high; multiple sites: pain at least 3 of 7 sites	high MSP: poor coworker relationships, mental stress, hurry at baseline; MSP at baseline predicted ascending versus low of job control & mental stress, high ascending MSP: adverse change in psychosocial factors ; GEE: all psychosocial factors but 2 predicted MSP after controlling for MSP at baseline; MSP predicted low control, low supervisor support, & mental stress after adjusting for psych factors at baseline		age, BMI, smoking status, exercise, perceived physical workload at baseline, study arm, organizational reforms	part of a larger RCT testing a participatory ergonomics intervention, dichotomized trajectories as outcome variable

Author & Year	Data Year/Study Sample	Design/ Methods	Outcome Variable(s)	Significant Predictor(s)	Insignificant Predictors	Other Predictor(s)	Brief Critique
Hogg-Johnson, S., et al. 2009	1980-2006/general population, N=101	systematic review	neck pain	women, prevalence peaked in middle age; risk factors: genetics, poor psychological health, exposure to tobacco	disc degeneration		Only assessed one type of pain
Hoy, D., et al. 2010	1980-2009/Ovid Medline, Embase, Cinahl, CAB abstracts, WHOLIS & SIGLE databases	systematic review	low back pain	environmental & personal factors, low educational status, stress, anxiety, depression, job dissatisfaction, low levels of socials support in workplace, whole-body vibration			Only assessed one type of pain
Janwantanakul, P., et al. 2009	2006/Thailand office workers in Bangkok (convenience), N=1,185	cross-section/Chi-square tests, mostly descriptive statistics	Musculoskeletal symptoms in head/neck & upper back, lower back in previous 12 months. People were identified as "cases" if they reported MS symptoms & if they attributed the symptoms to work	frequent work in awkward positions (+ head/neck), frequent trunk movement (+ upper back), isolation (- upper back), working >8h (+ lower back) + more symptoms, - less symptoms	gender, age, height, weight, hand & leg dominance, chronic disease, education, marital status, # family members, income, leisure activities, exercise, health status, sleep quality, smoking, alcohol & caffeine, hrs. housework, hrs. commuting		Data set confined to Thailand, no regression analysis with cross-section data, employees had to report that the symptoms were due to work

Author & Year	Data Year/Study Sample	Design/ Methods	Outcome Variable(s)	Significant Predictor(s)	Insignificant Predictors	Other Predictor(s)	Brief Critique
Liu, C., P.E. Spector, & L. Shi 2007	2002/American (N=300) & Chinese (N=286) university workers, Chinese had much higher response rate	cross-section, quantitative & qualitative questionnaires/content analysis, mean comparison by t-test, correlations, hierarchical regression	job autonomy, interpersonal conflict, organizational constraints, frustration, depression, intent to quit, job satisfaction, physical strain	country as a moderating factor in relationships: job autonomy & job satisfaction, interpersonal constraints & job satisfaction, organizational constraints & frustration	country as a moderating factor in the other relationships	age, sex, faculty/staff indicator	
Nelson, N.A. & R.E. Hughes 2009	1966-2007/Medline & NIOSHtic-2 databases (N=15)	systematic review/direct observation, videotaping, instrumentation of participants, standard biomechanical methods	back injuries	Associations between back injuries & spinal compression, lifting, lifting ratios, pastures, combos			back injuries & other data came from workers' compensation claims, sickness/accident databases like OSHA log or company specific reports
Nixon, A.E., et al. 2011	through 2009/N=79 studies; PsycInfo, ABI/Inform, Medline, Dissertation Abstract International, abstracts by conference	meta-analysis	Backache, headache, eyestrain, sleep disturbance, dizziness, fatigue, appetite, & gastrointestinal problems	work hours, work load, role conflict, role ambiguity, organizational constraints, lack of control, interpersonal conflict			

Author & Year	Data Year/Study Sample	Design/ Methods	Outcome Variable(s)	Significant Predictor(s)	Insignificant Predictors	Other Predictor(s)	Brief Critique
Uchino, B. 2006	through 2005/Not systematic	literature review	changes in cardiovascular, neuroendocrine, & immune function	social support (more positive "biologic profile")			Not systematic
Woods, V. 2005	1985-2003/Published studies Medline OEM subset, Psychlit, Ergonomics Abstracts, CISDOC, HSELINE, MHIDAS, NIOSHTIC2 & RILOSH	literature review	social support, MS morbidity, MS sickness absence, return to work	social support: poor communication channels, unsatisfactory work relationships, unsupportive organizational culture; MS morbidity (some evidence): poor social support; (limited evidence) Poor Support: MS sickness absence, restricted activity, not returning to work after a MS episode	few studies: good support w/ decreased risk of MS ill-health & helping working cope w/ problems		Not systematic.

Author & Year	Data Year/Study Sample	Design/ Methods	Outcome Variable(s)	Significant Predictor(s)	Insignificant Predictors	Other Predictor(s)	Brief Critique
Research Questions B-1, B-2, B-3							
Institute of Medicine 2011	2008/MEPS	cross-section & literature review/Two-part model, logit, gamma w/ log-link;	medical expenditures, wages, annual work hours, days missed of missed work, incremental costs; pain in one model	pain as predictor: higher expenditures, 2-3 more days missed of work, fewer annual hours, lower wages. Outcome of pain: race/ethnicity, gender, income & education all significant predictors (Notably, one study did not find race/ethnicity predictive of pain after controlling for other SES elements)		age, race, gender, marital status, education, income, HI status, obesity status, smoking, exercising status, census urban/rural, health need	Pain: "those who reported that they experienced pain that limited their ability to work, that they were diagnosed w/ joint pain or arthritis, or that they had a disability that limited their ability to work," does not control for workplace psychosocial factors
Research Questions B-2, B-3							
Allen, H., D. Hubbard, & S. Sullivan 2005	2004/N=1039 employees of one firm	cross-section/OLS, stratified by pain severity, people with pain compared to "healthy" (report none of 24 diseases & above average health status)	PCS, MCS, limitations in work performance, presenteeism, absenteeism	Pain		demographics, medication use, condition management/ coping, health risk behaviors	Data set confined to one firm, response rate not given, comparison strategy likely to bias away from zero.

Author & Year	Data Year/Study Sample	Design/ Methods	Outcome Variable(s)	Significant Predictor(s)	Insignificant Predictors	Other Predictor(s)	Brief Critique
Dagenais, S., J. Caro, & S. Haldeman 2008	1997-2007/Inclusion: 1. Back pain/ LBP 2. Monetary estimate of direct or indirect costs 3. Societal or insurer perspective	literature review/studies methodologies varied greatly	medical costs of BP/ LBP, indirect costs of BP/LBP	direct: physical therapy (17%) & inpatient services (17%), pharmacy (13%), primary care (13%). indirect: lost work productivity were a majority of overall cost. 3 studies: estimates w/ friction period approach were lower than w/ the human capital approach.			Not systematic, only addresses one type of pain
Ganster, D.C., M.L. Fox, & D.J. Dwyer 2001	unclear (wave 1 pre-1993, 5 year follow-up)/full-time nurses, N=105	short panel (t=2)/polynomial regression, hierarchical model	5 year health care costs	elevations in salivary cortisol mediated the effects of job demands & control on costs	mental health: job demands, physiological reactivity	age, BMI, smoking, exercise, perceived physical workload, study arm, organizational reforms	

Author & Year	Data Year/Study Sample	Design/ Methods	Outcome Variable(s)	Significant Predictor(s)	Insignificant Predictors	Other Predictor(s)	Brief Critique
Goetzel, R.Z., et al. 2004	1997-1999/Medstat Market Scan Health & Productivity Management database, MIDUS, Employer health Coalition, American Productivity Audit	cross-section/different types of costs resulting from 10 different health conditions, administrative claims & self-reported presenteeism	Presenteeism (compared using average wages), medical costs	Presenteeism was higher than medical costs for most of the 10 conditions studied, MSD were one of 10 most expensive problems; medical costs were a greater share of costs for mental health issues			Study uses average wages to assign monetary values to productivity which does not acknowledge the possibility that condition prevalence may vary by job type.
Goetzel, R.Z., et al. 2003	1997-1999/Medstat MarketScan Health & Productivity Management database (N=374,799), studies of productivity loss, 6 employers	cost analysis/various: created standardized metrics to use productivity information from different surveys, used wage data	total cost of health, absence, short-term disability, productivity losses	health conditions (angina pectoris, chronic maintenance; essential hypertension; diabetes mellitus; mechanical low back pain; acute myocardial infarction; chronic obstructive pulmonary disease; back disorders not specified as low back; trauma to spine & spinal cord; sinusitis; diseases of the ear, nose & throat or mastoid process)			Only uses particular pain conditions

Author & Year	Data Year/Study Sample	Design/ Methods	Outcome Variable(s)	Significant Predictor(s)	Insignificant Predictors	Other Predictor(s)	Brief Critique
Kessler, R.C., et al. 2008	2006/N=4485 employees, 915 commercially insured	cross-section/HPQ, HAQ; logit; correlations; ols	probability of no longer working, effort to maintain work performance, sickness absence, non-RA pharmacy costs	rheumatoid arthritis (but not for outcomes hours worked, hourly wage)		sociodemographics, comorbidities	Only addressed one pain condition
Loeppke, R., et al. 2009	HPQ in 2005–2006 & in 2007–2008/combined response rate across companies, ~30% for 49,576 valid HPQ respondents, w/ 14,954 in phase 1 & 34,622 in phase 2	short panel/OLS stratified by: focal conditions (separate for each), none of focal conditions, other conditions but not focal. Compared coefficients for similar covariates samples	absenteeism (health days missed in past 28) & presenteeism (0-10 performance)	health conditions, medical/rx costs by condition--used 12 months prior to survey--amount paid by employer; people w/ back/neck pain had relatively higher $$ compared to absenteeism/presenteeism, relatively lower drug costs		gender, age, occupation	Use OLS which may not be the most efficient model for the data, do not control for supply-side factors and demand side factors such as income, insurance type, and workplace factors

Author & Year	Data Year/Study Sample	Design/ Methods	Outcome Variable(s)	Significant Predictor(s)	Insignificant Predictors	Other Predictor(s)	Brief Critique
Martin, B.I., et al. 2008	1997-2005/MEPS, 1997=23045, 2005=22258	cross-section/difference in mean adjusted overall expenditures ("incremental" method). Two-part model (logit, & log-link w/ gamma)	mean total expenditures	97: adj $ ppl w/ spine problems was $4695, $2731 those w/out. 05: adj $ ppl w/spine problems was $6096, $3516 those w/out. Proportion w/ back or neck problems w/ physical functioning limitations increased 97-05. Adjusted mental health, physical functioning, work or school limitations, & social limitations (w/ spine problems) were worse in 05 than in 97.		age, gender	Use of incremental method without controlling for comorbidities implies that non-spine conditions have the same prevalence in both populations.

Author & Year	Data Year/Study Sample	Design/ Methods	Outcome Variable(s)	Significant Predictor(s)	Insignificant Predictors	Other Predictor(s)	Brief Critique
Nimgade, A., et al. 2010	1999/random sample of 655 patients from a managed care company who had a new onset of back pain in 1999	cross-section/compared outcomes before & after onset broken into different categories; used t-test & paired t-tests	average monthly expenses per patient: 1) w/out radiology costs 2) w/out billings for non-LBP on days of LBP visits 3) excluded people w/ a baseline low utilization before LBP incident because "convenience may have been an especially important for them"	Largest association was between expenditures 1 & 3 months after compared to prior 1 month & 3-month costs, even under variation 1)			Data is confined to one type of pain (and to new onset only), only includes people with one type of health insurance plan, did not use regression analysis

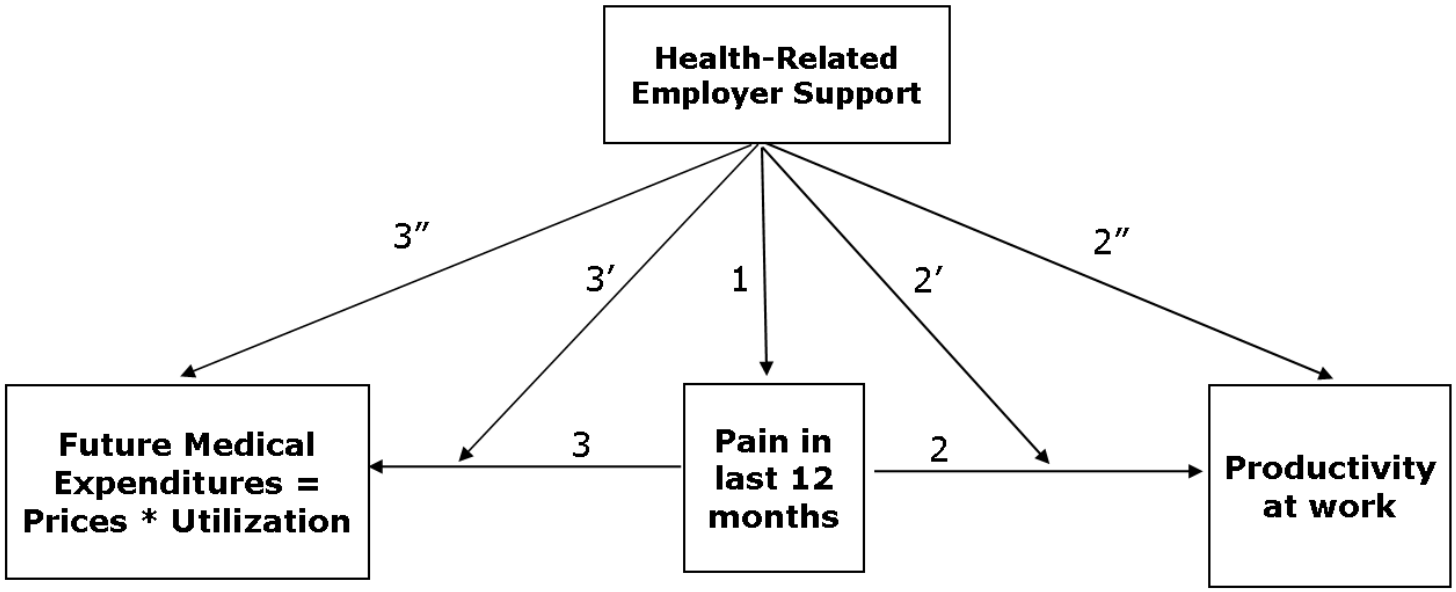
Author & Year	Data Year/Study Sample	Design/ Methods	Outcome Variable(s)	Significant Predictor(s)	Insignificant Predictors	Other Predictor(s)	Brief Critique
Rizzo, J.A., T.A. Abbott, 3rd, & M.L. Berger 1998	1987/National Medical Care Expenditure Survey: N=8,102 men & 9,775 women	cross-section/stratified by gender, multivariate, two-part model for disability days (logit first part), log transformed OLS second part	employment status, disability days	emp: (less chance) chronic backache (significant for some ages for men) arthritis, heart disease, prior heart attack, stroke, heavier smoking, black, older age, lower education; miss any days: whether respondents agreed that they could get well w/out help from a doctor, employer size, sick pay available, union status; # days missed: hardening of arteries	occupation, diabetes, hardening of the arteries, rheumatism, heart attack, hypertension, stroke, married, family size, education, backache interacted w/ age & education	gender (some differences)	Data is more than 25 years old and the measure of absenteeism is disability days

Author & Year	Data Year/Study Sample	Design/ Methods	Outcome Variable(s)	Significant Predictor(s)	Insignificant Predictors	Other Predictor(s)	Brief Critique
Shi, Yuyan, et al.	2010 & 2011/Employees who participated in WBA at 5 employers (N=19,121)	longitudinal (t=2)/multiple regression, individual fixed-effects (binary), first difference (continuous)	any sick days in past 28, WBA-P, self-rated productivity on [0, 10] scale	absence (recurring pain, lack of exercise, emotional health below 7 on 0-10 scale, cannot afford healthcare); WBA-P (high blood pressure, recurring pain, unhealthy diet, lack of exercise, alcohol use - more than 1 drink/day women or 2 drinks/day for men, wear seatbelt < 90% of time, emotional health below 7, social ties below average, job dissatisfaction, boss rather than partner, not getting to use strengths on job, environment not open and trusting, organizational care for well-being less than 7 on 0-10 scale, cannot afford food, cannot afford medical care); self-rated (recurring pain, unhealthy diet	cannot afford housing, smoking, high cholesterol not significant for any outcome; variables not mentioned as significant were not significant -- same variables in each regression	sex, age, marital status, education, manager, job tenure, employer indicators	Employers implemented multidimensional workplace wellness programs in between years, lacked conceptual framework for covariates, data not imputed, unclear what the supervisor relationship indicator is measuring, definition of social ties variable is unclear

Author & Year	Data Year/Study Sample	Design/ Methods	Outcome Variable(s)	Significant Predictor(s)	Insignificant Predictors	Other Predictor(s)	Brief Critique
Smith, Monica at al. 2012	2000-2007/MEPS (ppl with only ambulatory $) N=71,838	complex survey methods to assess difference in cost	treatments costs	time (increase in prevalence of back pain & chronic back pain); expenditures increased over time; both seem to be caused by aging of population			No regression so the estimates do not account for differences in conditions b/w groups
Van Eerd, D., et al. 2011	1997-1998/N=5761 w/ neck-pain lost-time claim Ontario Workplace Safety & Insurance Board	cohort study/Kaplan-Meier Survival Analysis	cumulative time on lost-time benefits	shorter for men, younger workers; median length of the 1st episode longer for claimants w/ multiple episodes (19–22 days) compared w/ those w/ 1 episode (11 days)		stratified by age, gender, & sector categories	Definition of pain excluded many causes (and used official lost time claims), data set confined to Ontario,
Research Questions C-1, C-2							
Böckerman, P. & E. Laukkanen 2010	2009/Finnish trade union members, N=884	cross-section/logistic regression	absenteeism, presenteeism (dichotomous)	match between desired & actual weekly work hours (-) for those in poor health; "efficiency" demos (+) presenteeism for those w/ good health	ones not mentioned <--	age groups, economy sector, establishment size, replaceability	Productivity measures are dichotomous, data set confined to Finland

Author & Year	Data Year/Study Sample	Design/ Methods	Outcome Variable(s)	Significant Predictor(s)	Insignificant Predictors	Other Predictor(s)	Brief Critique
Dollard, M.F. & A.B. Bakker 2010	unknown/Australian education workers (N =209–288) longitudinal, repeated measures (3) separated by 12 months, nested w/in 18 schools; about 80% women	longitudinal/Principal components analysis w/ varimax rotation; HLM; Mathieu & Taylor's (2007) rules of evidence for meso-mediation.	psychological distress, emotional exhaustion	workplace psychosocial safety climate "refers to policies, practices, & procedures for the protection of worker psychological health & safety": moderated the relationship between emotional demands & emotional exhaustion, predicted change in employee engagement, through its relationship w/ skill discretion.		work pressure, emotional demands	In between T2 and T3 a participatory stress intervention was implemented in half of the schools.
Schultz, A.B., C. Chin-Yu, & D.W. Edington 2009	through July 2008/Searches of MEDLINE, CINAHL & PubMed; 80 studies in final review	literature review	healthcare, pharmaceutical, absenteeism, presenteeism costs	employer-sponsored programs improved measures of employee health			Not systematic

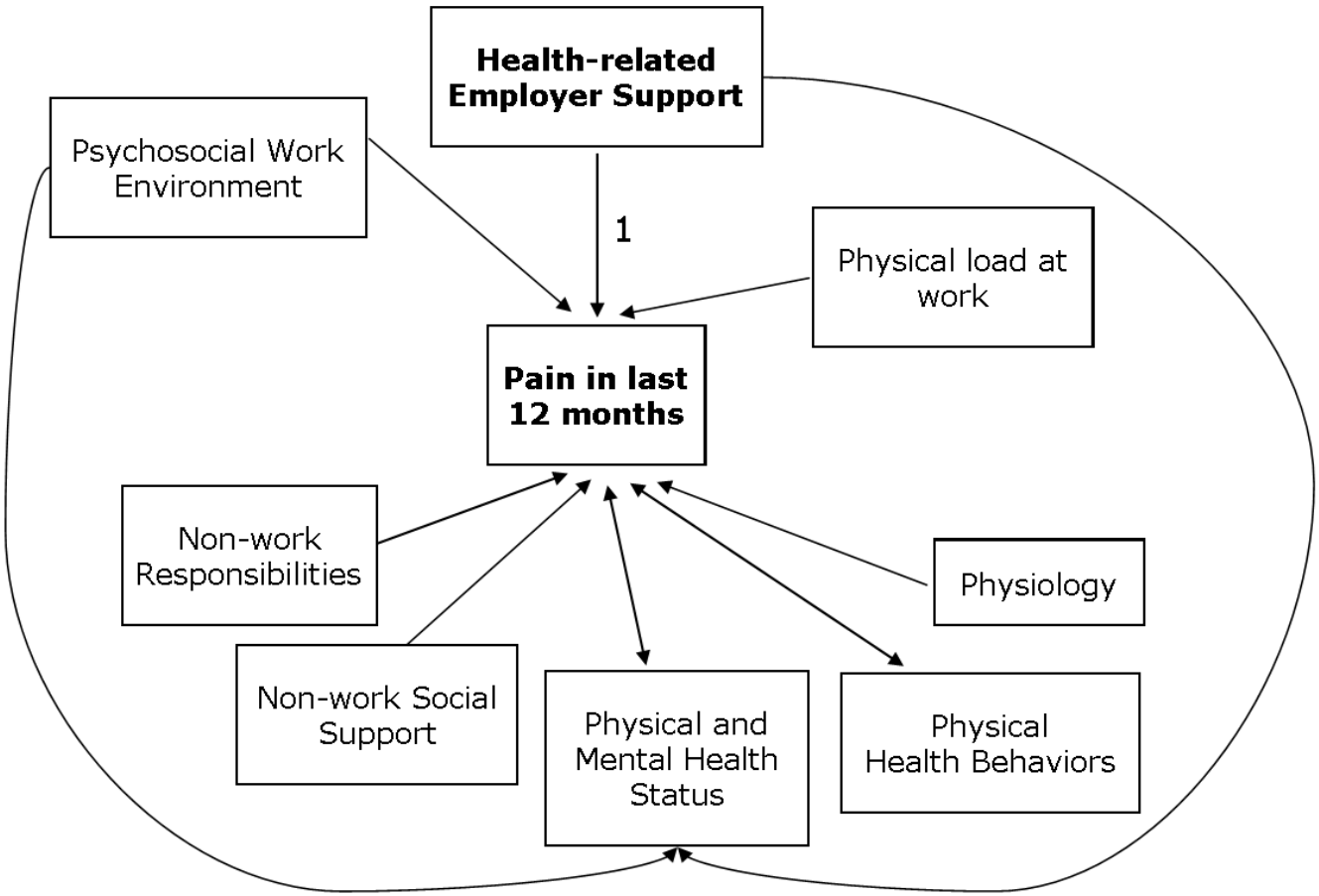
Figure 2. Conceptual Model Overview



Hypotheses Linked to Conceptual Model Labels

A-1) Greater health-related employer support will be associated with greater productivity without controlling for pain (1&2, 2″)
A-2) Greater health-related employer support will be associated with lower future medical expenditures without controlling for pain (1&3, 3″)
B-1) Greater health-related employer support will be associated with reduced chance of pain (1)
B-2) Pain will be associated with lower productivity at work (2)
B-3) Pain will be associated with higher future medical expenditures (3)
B-4) Controlling separately for pain will attenuate any positive associations of health-related employer support with productivity (2″)
B-5) Greater health-related employer support will be associated with higher future medical expenditures after controlling for pain (3″)
C-1) The negative association of pain with productivity at work will be larger for those with health-related employer support than for those without (2′)
C-2) The positive association of pain with future medical expenditures will be greater for those with health-related employer support than for those without (3′)

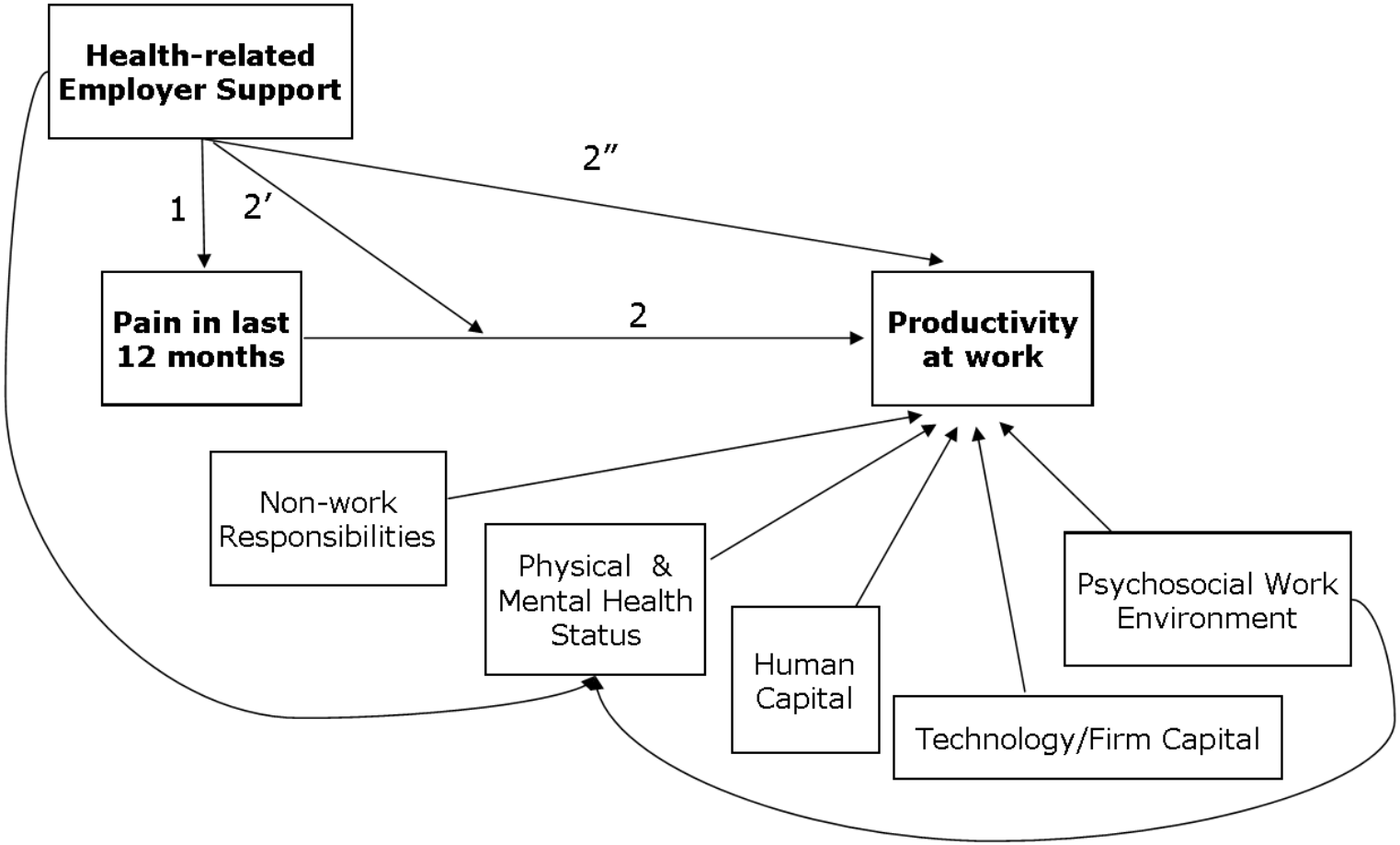
Figure 3. Conceptual Model—Pain



Hypothesis Linked to Conceptual Model Labels

B-1) Greater health-related employer support will be associated with reduced chance of pain (1)

Figure 4. Conceptual Model—Productivity at Work



Hypotheses Linked to Conceptual Model Labels

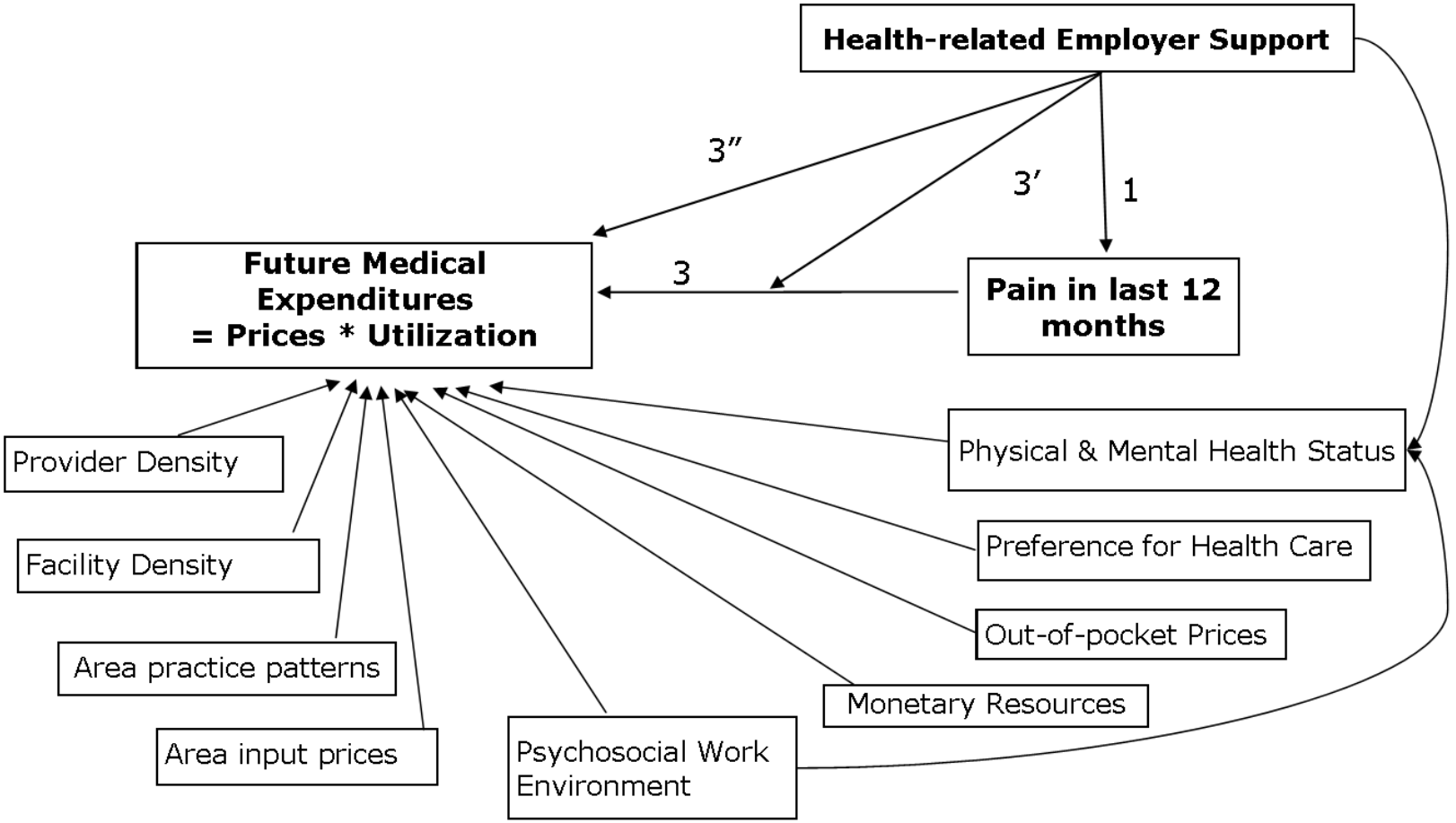
A-1) Greater health-related employer support will be associated with greater productivity without controlling for pain (1&2, 2″)

B-2) Pain will be associated with lower productivity at work (2)

B-4) Controlling separately for pain will attenuate any positive associations of health-related employer support with productivity (2″)

C-1) The negative association of pain with productivity at work will be larger for those with health-related employer support than for those without (2′)

Figure 5. Conceptual Model—Medical Expenditures



Hypotheses Linked to Conceptual Model Labels

A-2) Greater health-related employer support will be associated with lower future medical expenditures without controlling for pain (1&3, 3″)
B-3) Pain will be associated with higher future medical expenditures (3)
B-5) Greater health-related employer support will be associated with higher future medical expenditures after controlling for pain (3″)
C-2) The positive association of pain with future medical expenditures will be greater for those with health-related employer support than for those without (3′)

Figure 6. Geographic Distribution of Productivity Sample (N=34,359)

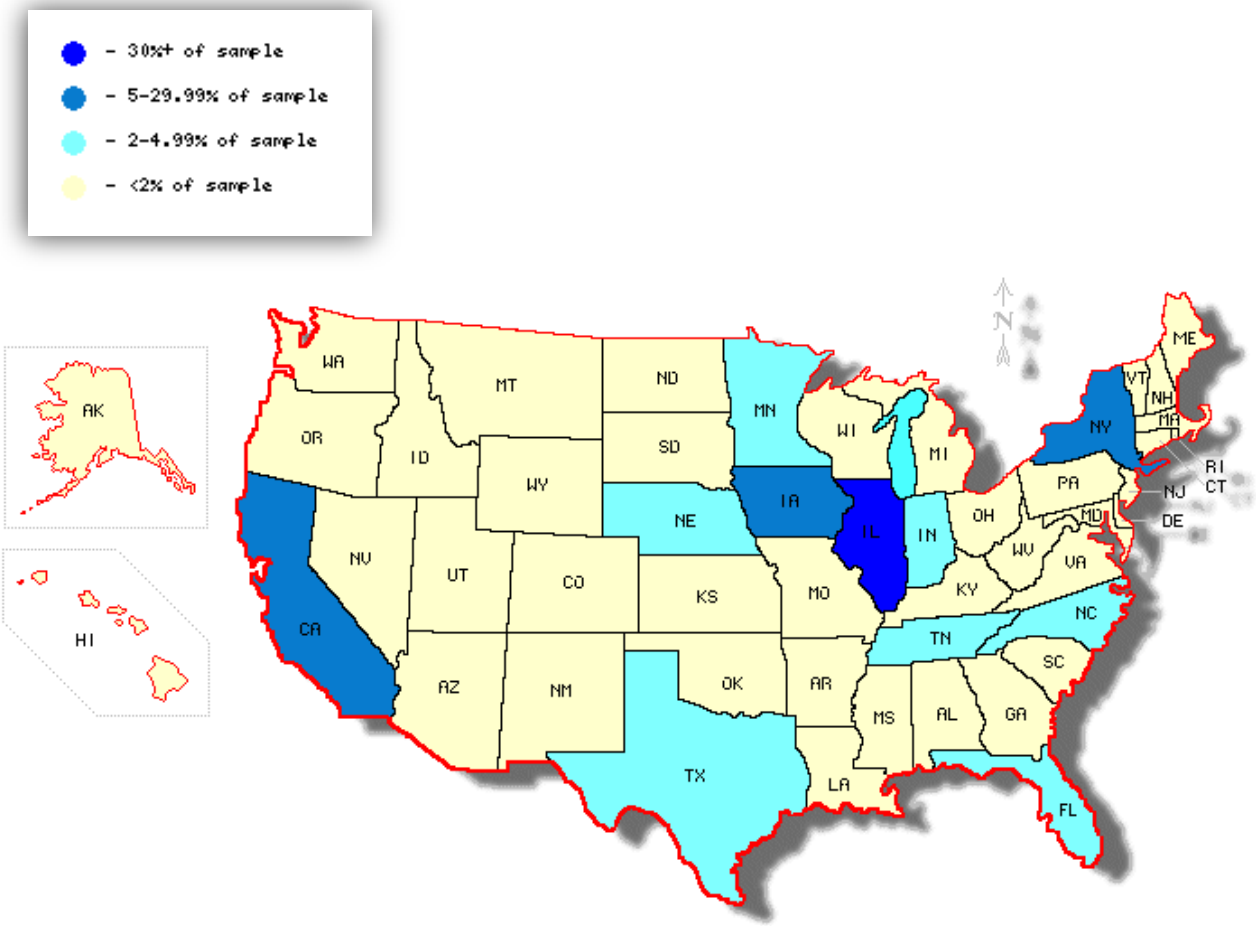


Figure 7. Sample Size Flowchart

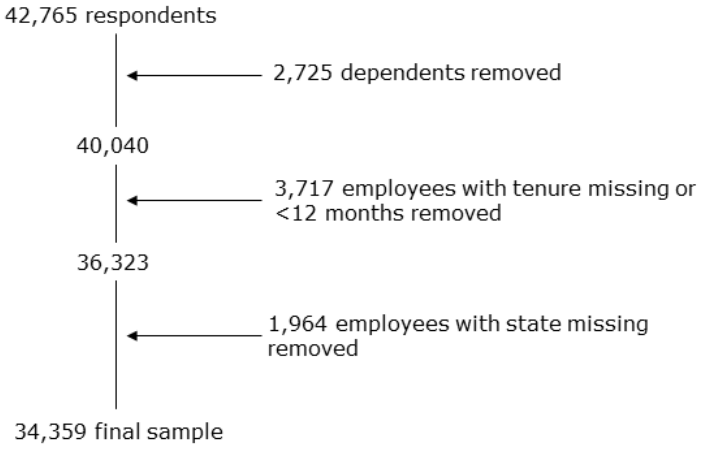


Figure 8. Sample Size Flowchart for Future Medical Expenditures Sample

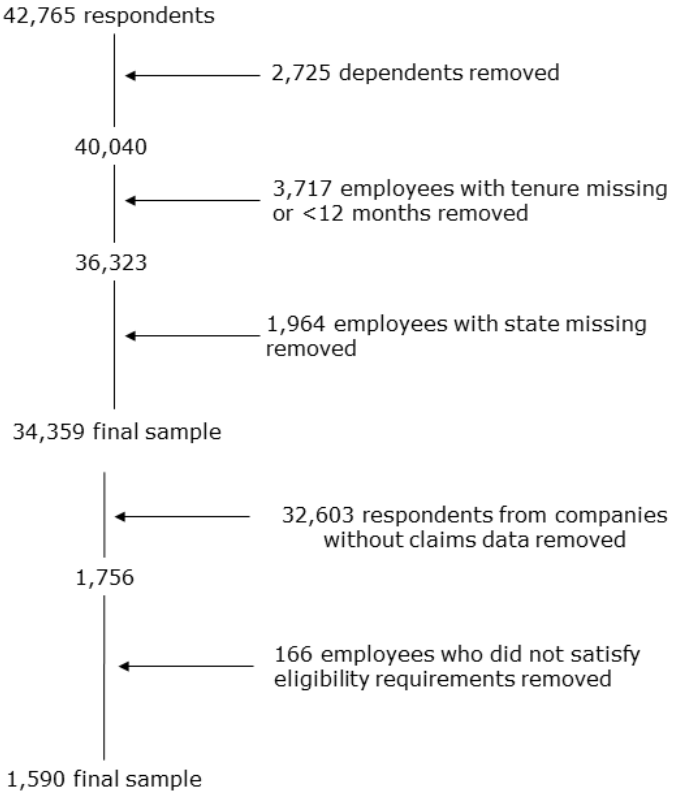


Table 9. Variable List by Research Question

A-1) Is health-related employer support associated with productivity at work after controlling for additional factors other than pain?
A-2) Is health-related employer support associated with future medical expenditures after controlling for additional factors other than pain?
B-1) To what extent is health-related employer support associated with pain?
B-2) To what extent is pain associated with productivity at work?
B-3) To what extent is pain associated with future medical expenditures?
B-4) Does controlling separately for pain will attenuate any positive associations of health-related employer support with productivity?
B-5) Does controlling separately for pain will attenuate any negative associations of health-related employer support with future medical expenditures?
C-1) To what extent does health-related employer support moderate the relationship between pain and productivity at work after controlling for additional factors?
C-2) To what extent does health-related employer support moderate the relationship between pain and future medical expenditures after controlling for additional factors?

	Research Questions						
	A-1	**A-2**	**B-1**	**B-2 & B-4**	**B-3 & B-5**	**C-1**	**C-2**
Dependent Variables							
Number of days missed from work for health reasons out of past 28 days (sick days)	X			X		X	
Self-rated Relative Productivity	X			X		X	
Future Medical Expenditures		X			X		X
Recurring pain in past 12 months			X				
Predictors							
Health-related Employer Support (Both is reference, Neither, No Physical Support, No Emotional Support)	X	X	X	X	X	X	X
Recurring pain in past 12 months	-	-	-	X	X	X	X
Recurring pain*health-related employer support	-	-	-	-	-	X	X
Unsatisfied at work	X	X	X	X	X	X	X
Does not get to use strengths at work	X	X	X	X	X	X	X
Work environment is not trusting and open	X	X	X	X	X	X	X
Does not have enough resources to do job well	u	X	u	u	X	u	X

Does not get to learn interesting things at work	u	X	u	u	X	u	X
Has Job Insecurity	u	X	u	u	X	u	X
Typical Hours Worked per week	u	X	u	u	X	u	X
Occupation Category (professional worker is references, manager/executive /official, sales worker, clerical/ office worker, manufacturing/ production worker, business owner, service worker, construction/mining worker, transportation worker, installation/repair worker, farming/fishing/forestry worker, other	X	-	X	X	-	X	-
Tenure on the job (years)	X	-	-	X	-	X	-
Number of Children under 18	X	X	X	X	X	X	X
Provides Informal Care	X	-	X	X	-	X	-
Has Spouse/Partner	X	X	X	X	X	X	X
Can count on family/friends for help if in trouble (social help)	-	-	X	-	-	-	-
Male	-	X	X	-	X	-	X
Current Smoker	X	X	X	X	X	X	X
Number of times exercised in past week (0 is reference, 1-2 times, 3 or more times)	X	-	X	X	-	X	-
Highest level of completed education (less than high school is reference, high school diploma or degree, technical/ vocational school, some college, college graduate, post graduate work or degree)	X	-	X	X	-	X	-
Age (years)	X	X	X	X	X	X	X
BMI	X	X	X	X	X	X	X
AMI	X	c	X	X	c	X	c
Asthma	X	X	X	X	X	X	X
Cancer	X	c	X	X	c	X	c
Depression	X	X	X	X	X	X	X
Diabetes	X	c	X	X	c	X	c
High Blood Pressure	X	X	X	X	X	X	X
High Cholesterol	X	X	X	X	X	X	X
Charlson Comorbidity Index ≥1	u	X	u	u	X	u	X
General Health Ladder	X	X	X	X	X	X	X
Emotional Health Index	X	X	X	X	X	X	X

Monthly Household Income (up to $2,999 is reference; $3,000 to $3,999; $4,000 to $4,999; $5,000 to $7,499; $7,500 to $9,999; $10,000 and over)	-	X	-	-	X	-	X
Health Insurance type	-	X	-	-	X	-	X
Number of hospital beds per 1,000 people in state	-	X	-	-	X	-	X
Active Medical Specialty Physicians (excluding GIM, Pediatrics & Psychiatry) per 10,000 people in state	-	X	-	-	X	-	X
Active Family, General, General Internal Medicine, and Pediatric physicians per 10,000 people in state	-	X	-	-	X	-	X
Active Psychiatry Specialty Physicians per 10,000 people in state	-	X	-	-	X	-	X
Census Region (East North Central is Reference, West North Central, West South Central, East South Central, South Atlantic, Middle Atlantic, New England, Mountain, Pacific)	X	X	X	X	X	X	X
Employer Indicator	X	-	X	X	-	X	-

NOTES: This table displays the dependent variables and predictors for each analysis organized by hypothesis. X: Variable is included in the analysis

u: Variable not included because it is unavailable for the relevant sample

-: Variable not included because it does not measure a concept in the relevant conceptual model

c: Variable not included because it is a component of the Charlson Index which is included

s: Variable not included because there are not enough observations to generate estimates for each category

Figure 10. Measurement Model—Pain

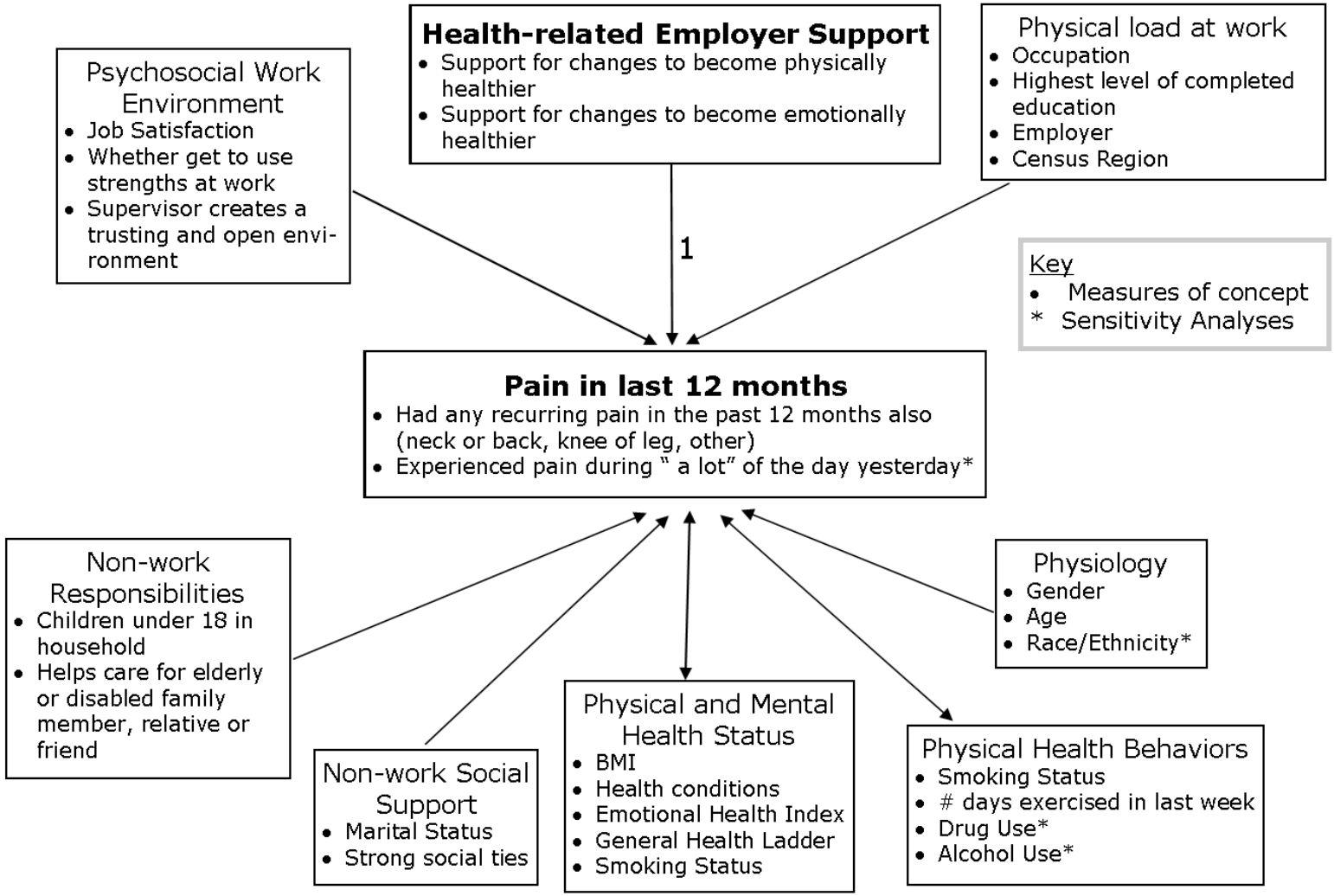
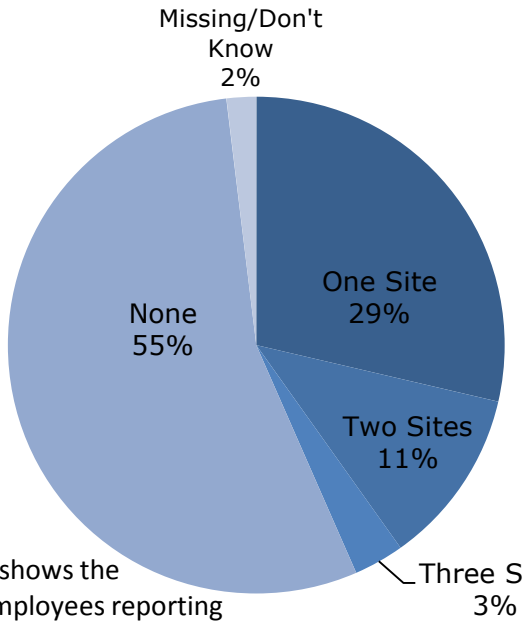


Figure 11. Percent of Employees Reporting Recurring Pain by Number of Sites (knee / arm, neck / back, other)



Note: This chart shows the percentage of employees reporting pain. The three "sites" are as follows: knee/leg, neck/back, and other.

Table 12. Sample Characteristics – Productivity Sample

Dependent Variables	Mean or Percent (Standard Deviation)	Percent Missing
Number of days missed for health reasons in the past 28 (Sick Days)	0.48 (1.88)	0.14%
Own Productivity Rating (0-10 scale)	8.36 (1.20)	1.50%
Rating of Usual Worker Productivity (0-10 scale)	7.36 (1.45)	7.92%
Self-rated Relative Productivity (Own – Usual)	0.98 (5.49)	see above
Recurring Pain in the last 12 months	44.43%	0.32%
Predictors		
Health-related Employer Support[1]		
Both Physical & Emotional	53.87%	26.15% missing emotional
Neither Physical or Emotional	6.39%	
Physical Only	6.85%	18.48% missing physical
Emotional Only	1.13%	
Unsatisfied with job	18.08%	7.45%
Do not use strengths every day	25.14%	5.25%
Supervisor does not create a trusting and open environment	19.47%	7.93%
Tenure on the Job (years)	11.72 (9.76)	0.00%
Number of Children under 18	0.87 (1.19)	0.02%
Provides informal care	16.17%	0.44%
Married/Partner	71.00%	1.27%
Current Smoker	8.54%	0.40%
Exercise in past week		1.67%
0 times	22.20%	
1 or 2 times	27.66%	
3 or more time	50.14%	
AMI (ever told)	0.77%	0.29%
Asthma (ever told)	9.67%	0.30%
Cancer (ever told)	3.71%	0.31%
Depression (ever told)	11.78%	0.63%
Diabetes (ever told)	5.29%	0.38%
High Blood Pressure (ever told)	22.34%	0.44%

[1] Totals do not sum to 100 because some individual reported values for only 1 question. 13.28% reported an answer for physical but not emotional, 5.61% did the reverse, and 12.88% did not report either answer.

High Cholesterol (ever told)	24.12%	0.71%
Age (years)	42.82 (10.86)	0.00%
BMI	28.31 (6.27)	0.23%
Emotional Health Index (out of 100)	74.47 (27.84)	0.03%
Health Ladder (0 to 10)	7.44 (1.78)	0.47%
Can count on family/friends if in trouble	95.51%	2.59%
Male	51.26%	0.00%
Highest level of completed education		0.04%
Less than high school diploma	5.43%	
High school degree or diploma	10.63%	
Technical/vocational school	5.46%	
Some college	21.85%	
College graduate	38.05%	
Post graduate work or degree	17.60%	
Employer Size		
0-999	8	NA
1,000-9,999	4	NA
10,000 & up	2	NA
Notes: This table gives the descriptive statistics for the sample used to estimated research questions that have productivity or pain as the dependent variable. (N=34,359, 14 employers)		

Table 13. Occupation Distribution of Productivity / Pain Sample

Occupation Category	*Percent of Sample*
Professional worker	40.4%
Manager, executive, or official	19.3%
Clerical or office worker	18.4%
Manufacturing or production worker	4.7%
Service worker	2.6%
Sales worker	2.1%
Business owner	0.8%
Installation or repair worker	0.7%
Transportation worker	0.4%
Construction or mining worker	0.3%
Farming, fishing, or forestry worker	0.3%
Other	7.8%
Prefer not\Don't Know\Missing	2.1%
Note: This table gives the percentage of employees in the sample by their self-reported occupations. (N=34359, Employers 14)	

Figure 14. Measurement Model—Productivity at Work

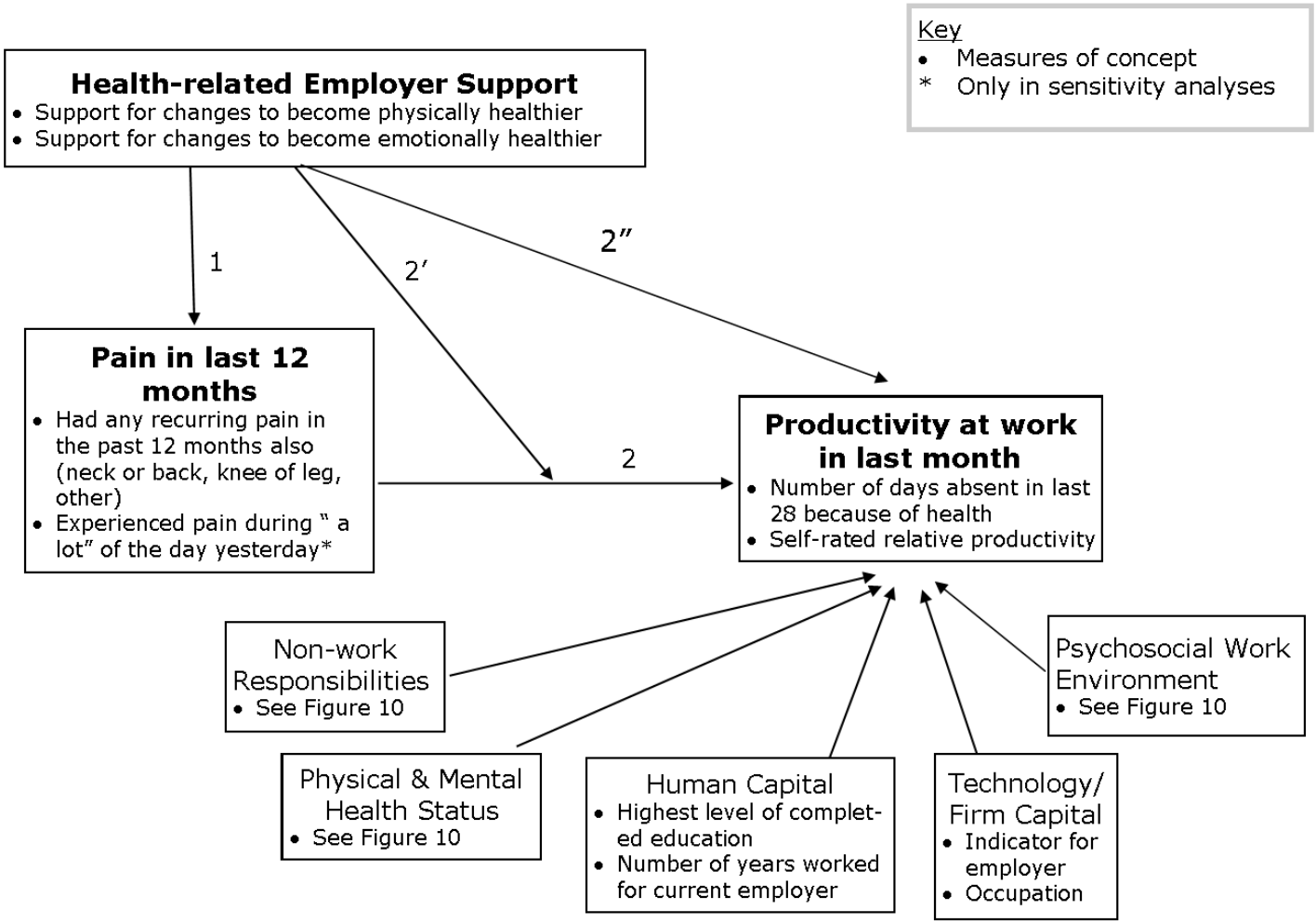


Figure 15. Number of Days Missed from Work for Own-Health in the past 28 days (sick days)

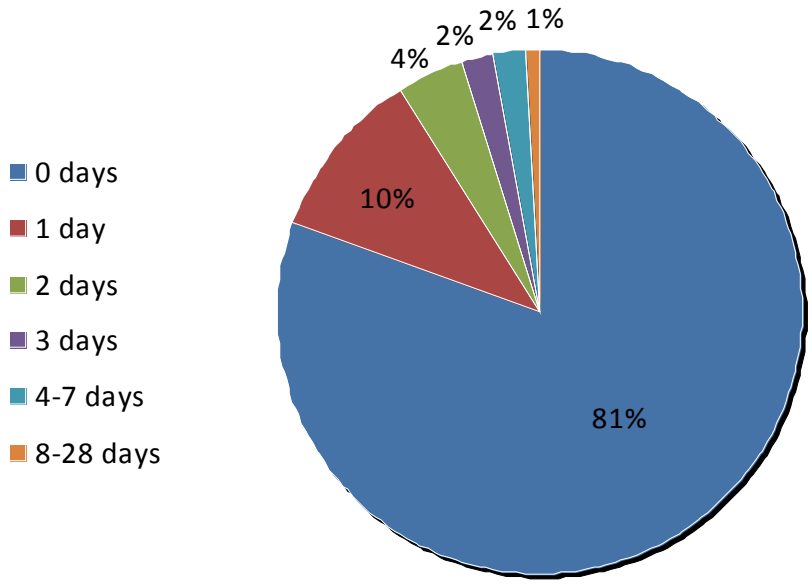
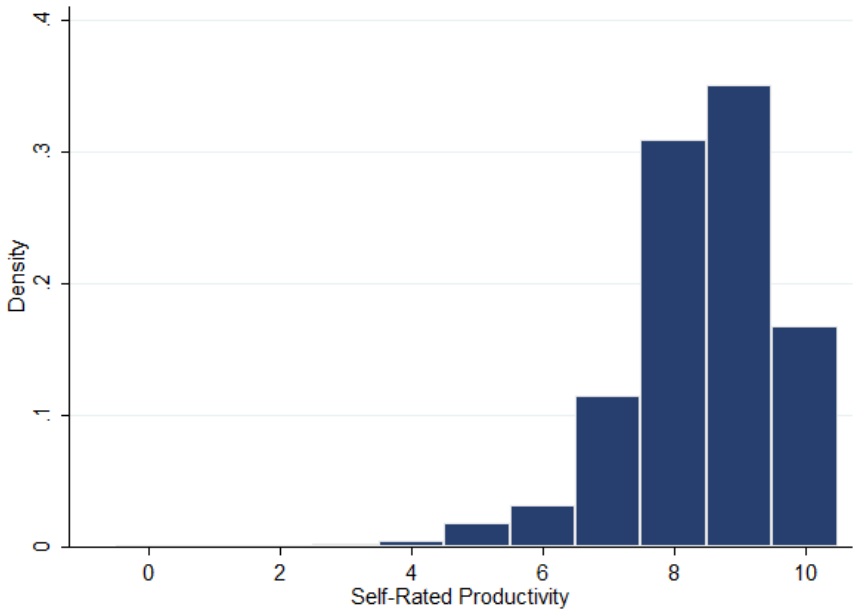
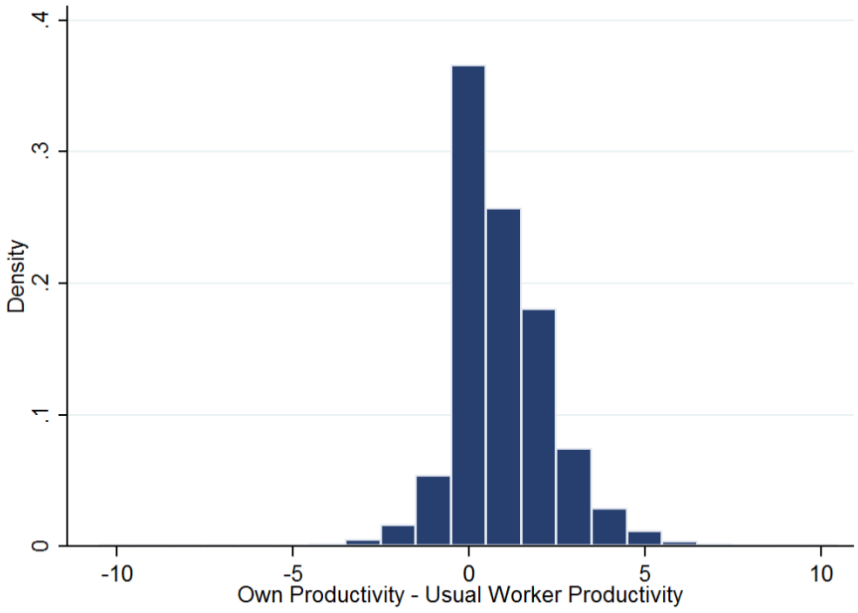


Figure 16. Histogram of Self-rated Productivity on a 0-10 scale



Note: 10 is the highest rating and 0 is the lowest rating

Figure 17. Histogram of the Self-rated Relative Productivity (Own Productivity – Usual Worker Productivity)



Note: 10 is the highest rating and 0 is the lowest rating for each of the variables.

Figure 18. Measurement Model—Medical Expenditures

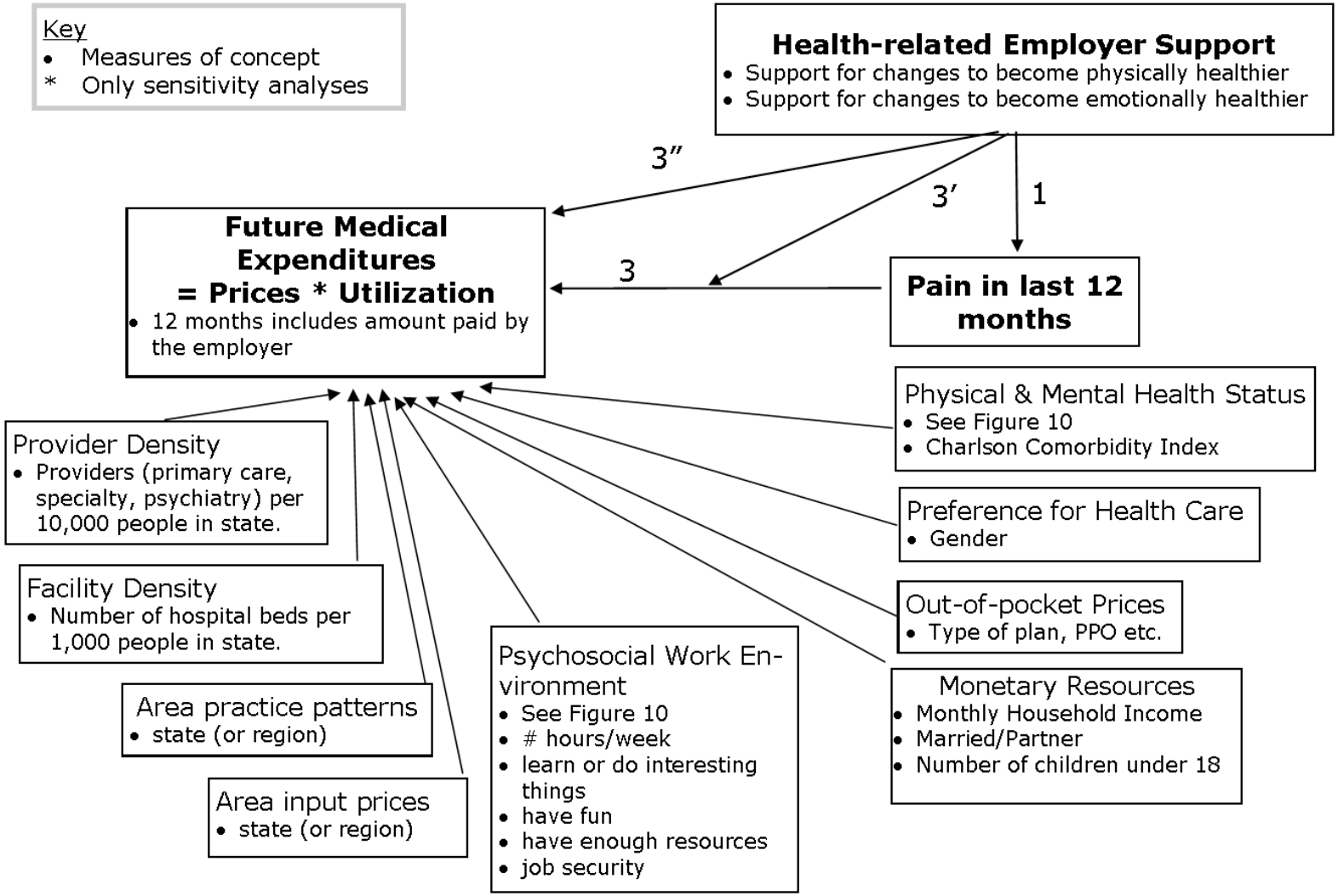
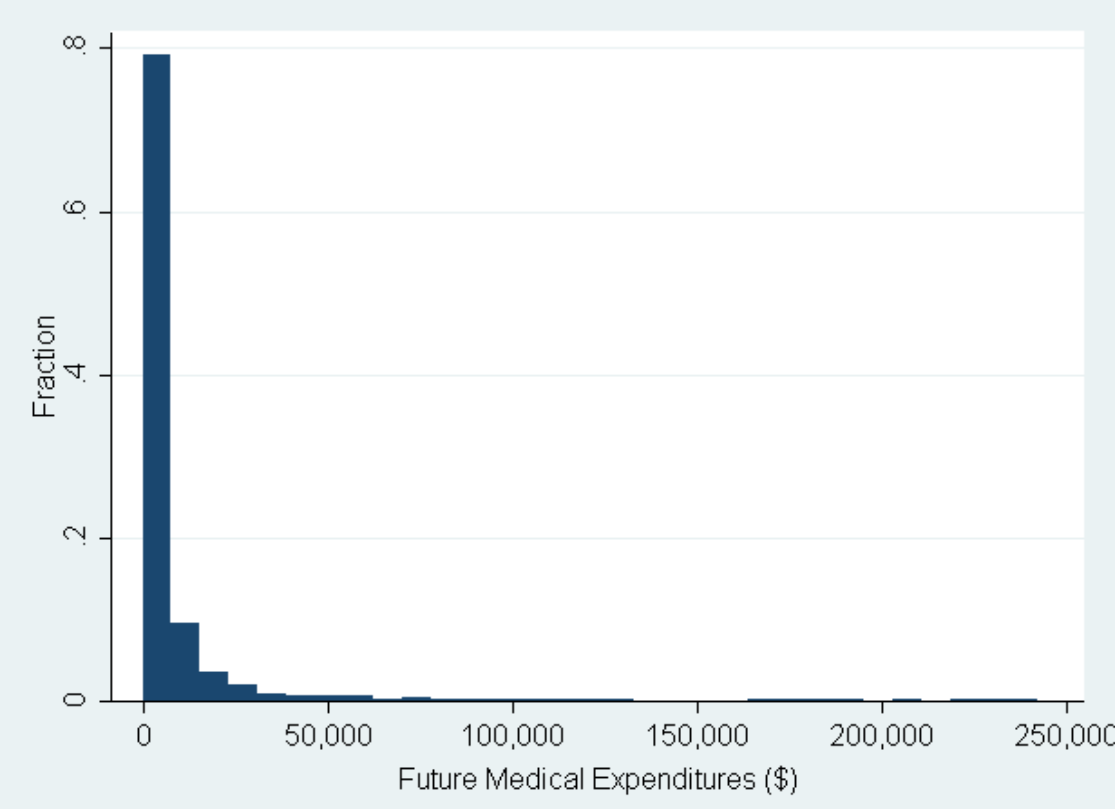


Figure 19. Distribution of Future Medical Expenditures



Note: This figure graphs the distribution of future medical expenditures for individuals who have greater than zero expenditure. (N=1584)

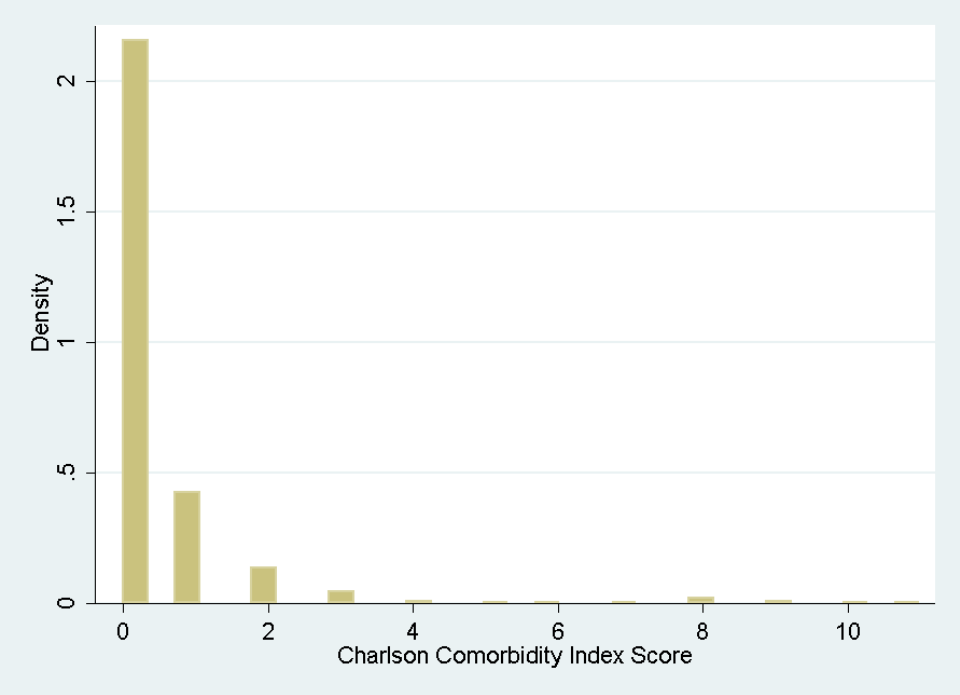
Table 20: Sample Characteristics of the Subsample used to Analyze Future Medical Expenditures

Characteristic	Mean (SD) or Percent	Percent Missing
Dependent Variable		
Aggregate Medical Expenditures (2008) $	$7,874 ($22,220)	0.00%
Predictors		
Health-related Employer Support[2]		
Physical & Emotional	80.43%	1.1% physical
Neither Physical nor Emotional	6.38%	1.8% emotional
Emotional Only	2.34%	
Physical Only	8.65%	
Typical Hours/week	40.82 (9.84)	1.96%
Do not learn or do interesting things at work	16.24%	0.06%
Do not have fun at work	25.14%	0.32%
Do not have resources to do job well	12.00%	0.51%
Unsatisfied with job	6.09%	0.51%
Do not use strengths every day	17.07%	0.13%
Supervisor does not create a trusting and open environment	19.70%	8.65%
Employer downsizing (Job Insecurity)	8.93%	2.46%
Men	41.35%	0.00%
Pain	46.09%	0.00%
Age (years)	45.76 (10.98)	0.00%
Current Smoker	12.69%	0.00%
BMI	28.28 (6.33)	3.35%
Charlson Comorbidity Index Score	0.43 (1.15)	0.00%
Asthma (ever told)	15.29%	0.06%
Depression (ever told)	16.87%	0.06%
High Blood Pressure (ever told)	24.95%	0.06%
High Cholesterol (ever told)	25.09%	0.13%
Emotional Health Index (out of 100)	84.53 (22.63)	0.57%
Health Ladder (0 to 10)	8.19 (1.58)	0.13%
Monthly Household Income		17.36%
$0 to $1,999	6.38%	
$2,000 to $2,999	9.03%	
$3,000 to $3,999	12.18%	
$4,000 to $4,999	12.25%	
$5,000 to $7,499	20.52%	

[2] Totals do not sum to 100 because some individual reported values for only 1 question. 0.38% reported an answer for physical but not emotional, 1.07% did the reverse, and 0.76% did not report either answer.

$7,500 to $9,999	9.22%	
$10,000 and over	13.07%	
Spouse or Partner	74.78%	0.63%
Number of Children under 18 in household	0.78 (1.07)	0.06%
Health Insurance Type		3.41%
PPO	64.97%	
HMO-Gate Keeper	18.82%	
HMO-Open Access or POS	12.68%	
Indemnity	3.53%	
Census Region		0.00%
Midwest	97.34%	
Northeast	0.5%	
South	1.20%	
West	0.95%	
Health System – state level		
Hospital Beds per 1,000 population	3.73 (0.66)	0.00%
Active Family, General, General Internal Medicine, and Pediatric physicians per 10,000 population	3.00 (0.68)	0.00%
Active Medical & Surgical Specialty Physicians per 10,000 population (excluding GIM, Pediatrics, & Psychiatry)	10.69 (1.16)	0.00%
Active Psychiatry Physicians per 10,000 population	0.68 (0.16)	0.00%
Notes: (N=1,584)		

Figure 21. Distribution of Charlson Score for employees in the subsample used to estimate future medical expenditures



Note: This histogram shows the Charlson Comorbidity Index scores for individuals in the subsample used to estimated medical expenditures. (N=1584)

Table 22. Two-Part Model Estimates of the Association Between Health-Related Employer Support and Sick Days, Not Controlling for Pain

Variable	Percentage Point Difference in Probability of Having Any Sick Days) [95% CI]	Change in Expected Number of Sick Days Conditional on Having > Zero [95% CI]	Unconditional Change in Expected Number of Sick Days [95% CI]
Health-related Employer Support (Both is reference)			
Neither	0.01	-0.03	0.01
	[-0.01, 0.02]	[-0.22, 0.17]	[-0.04, 0.06]
No Physical Support	-0.001	0.32	0.06
	[-0.03, 0.03]	[-0.28, 0.93]	[-0.09, 0.20]
No Emotional Support	0.01	0.08	0.04
	[-0.01, 0.03]	[-0.24, 0.39]	[-0.04, 0.13]
Unsatisfied	0.01	0.04	0.04
	[-0.001, 0.03]	[-0.14, 0.21]	[-0.01, 0.09]
Does not get to use strengths	***0.02***	-0.02	0.03
	[0.005, 0.03]	[-0.15, 0.10]	[-0.002, 0.07]
Not trusting and open environment	0.004	***0.25***	***0.06***
	[-0.01, 0.02]	***[0.12, 0.37]***	***[0.02, 0.10]***
Tenure on the Job (years)	***-0.001***	***-0.01***	***-0.004***
	[-0.001, -0.0004]	***[-0.01, -0.002]***	***[-0.01, -0.002]***
Occupation category (Professional worker is reference)			
Manager, executive, or official	***-0.03***	-0.05	***-0.09***
	[-0.05, -0.02]	[-0.18, 0.08]	***[-0.12, -0.05]***
Sales worker	-0.001	-0.01	-0.004
	[-0.03, 0.03]	[-0.41, 0.38]	[-0.11, 0.10]
Clerical or office worker	***0.02***	-0.03	*0.04*
	[0.01, 0.03]	[-0.14, 0.08]	*[0.01, 0.08]*
Manufacturing or production worker	***-0.03***	***0.64***	0.04
	[-0.05, -0.01]	***[0.38, 0.90]***	[-0.03, 0.11]
Business owner	**0.05**	0.46	**0.23**
	[0.0002, 0.10]	[-0.15, 1.07]	**[0.02, 0.44]**
Service worker	0.02	*0.36*	**0.12**
	[-0.01, 0.04]	*[0.08, 0.64]*	**[0.03, 0.21]**
Construction or mining worker	0.02	1.16	0.31
	[-0.05, 0.10]	[-0.30, 2.62]	[-0.07, 0.69]
Transportation worker	-0.01	0.68	0.10
	[-0.07, 0.05]	[-0.50, 1.87]	[-0.18, 0.38]
Installation or repair	0.05	***0.85***	***0.31***

worker	[-0.003, 0.10]	***[0.38, 1.32]***	***[0.12, 0.50]***
Farming, fishing, or forestry worker	0.04	0.08	0.12
	[-0.04, 0.13]	[-0.62, 0.78]	[-0.14, 0.38]
Other	0.01	0.14	0.04
	[-0.01, 0.02]	[-0.02, 0.30]	[-0.01, 0.09]
Number of Children under 18	0.002	-0.03	0.001
	[-0.001, 0.01]	[-0.06, 0.01]	[-0.01, 0.01]
Provides informal care	***0.02***	0.08	***0.05***
	[0.004, 0.03]	[-0.02, 0.18]	***[0.02, 0.09]***
Spouse/Partner	***-0.02***	0.06	**-0.03**
	[-0.03, -0.01]	[-0.03, 0.14]	**[-0.06, -0.002]**
Highest level of completed education (Less than high school diploma is reference)			
High school degree or diploma	***0.03***	**0.26**	***0.14***
	[0.01, 0.06]	**[0.03, 0.48]**	***[0.06, 0.21]***
Technical/vocational school	0.01	0.15	0.04
	[-0.02, 0.03]	[-0.11, 0.41]	[-0.03, 0.12]
Some college	***0.03***	**0.25**	***0.13***
	[0.01, 0.05]	**[0.04, 0.46]**	***[0.06, 0.19]***
College graduate	0.01	0.04	**0.03**
	[-0.01, 0.03]	[-0.16, 0.25]	**[-0.03, 0.09]**
Post graduate work or degree	-0.02	-0.18	**-0.07**
	[-0.04, 0.01]	[-0.40, 0.03]	**[-0.13, -0.01]**
Exercise in past week (0 times is reference)			
1 or 2 times	**-0.01**	***-0.33***	***-0.10***
	[-0.02, 0.00]	***[-0.43, -0.22]***	***[-0.14, -0.06]***
3 or more times	***-0.04***	***-0.29***	***-0.15***
	[-0.05, -0.03]	***[-0.39, -0.19]***	***[-0.18, -0.11]***
Current Smoker	***0.03***	***-0.16***	**0.05**
	[0.02, 0.05]	***[-0.27, -0.04]***	**[0.01, 0.09]**
AMI	0.04	**0.39**	***0.17***
	[-0.01, 0.08]	**[0.03, 0.76]**	***[0.02, 0.33]***
Asthma	***0.03***	0.03	***0.07***
	[0.01, 0.04]	[-0.09, 0.14]	***[0.03, 0.11]***
Cancer	***0.06***	***0.92***	***0.38***
	[0.04, 0.09]	***[0.73, 1.12]***	***[0.29, 0.48]***
Depression	***0.09***	***0.25***	***0.29***
	[0.08, 0.11]	***[0.15, 0.35]***	***[0.25, 0.34]***
Diabetes	***0.04***	0.001	***0.10***
	[0.02, 0.06]	[-0.14, 0.14]	***[0.04, 0.15]***

High Blood Pressure	0.01	***0.36***	***0.09***
	[-0.002, 0.02]	***[0.26, 0.46]***	***[0.06, 0.13]***
High Cholesterol	-0.01	-0.07	**-0.03**
	[-0.02, 0.003]	[-0.16, 0.03]	**[-0.06, 0.00]**
Age (years)	0.0001	***0.02***	***0.004***
	[-0.0004, 0.001]	***[0.01, 0.02]***	***[0.002, 0.01]***
BMI	***0.002***	0.0004	***0.01***
	[0.001, 0.003]	[-0.01, 0.01]	***[0.003, 0.01]***
Emotional Health Index (out of 10)	***-0.003***	0.002	***-0.01***
	[-0.01, -0.002]	[-0.01, 0.02]	***[-0.01, -0.002]***
Health Ladder (0 to 10)	***-0.01***	***-0.07***	***-0.05***
	[-0.02, -0.01]	***[-0.09, -0.04]***	***[-0.05, -0.04]***

Notes: This regression also controls for Census Region and Employer. The results are for a two-part model of sick days. The first part of the model uses a logit regression with the dependent variable equal to one if any sick days were reported (N=34312). The sample size is smaller than productivity analyses with self-rated relative productivity outcome because all missing sick days were dropped rather than imputed (because otherwise the imputed samples would have different Ns for the first and second parts of the model). The second part of the model is a GLM (Poisson and log-link) (N=6634). The third column presents the results of the combined model. Average Marginal Effects are reported in columns. Confidence Intervals were estimated using a first-order Taylor series expansion. Clustering by employer and state does not alter the significance levels of the results.
Statistically Significant at the 5% level, ***Statistically Significant at the 1% level***

Table 23. Multiple Linear Regression Estimates of the Association between Heath-Related Employer Support and Self-Rated Relative Productivity, Not Controlling for Pain

Variable	(Regression Coefficient) [95% CI]
Health-related Employer Support (Both is reference)	
Neither	***0.37***
	[0.31, 0.43]
No Physical Support	**0.15**
	[0.04, 0.27]
No Emotional Support	***0.20***
	[0.12, 0.27]
Unsatisfied	-0.003
	[-0.06, 0.05]
Does not get to use strengths	***-0.17***
	[-0.21, -0.12]
Not trusting and open environment	***0.24***
	[0.18, 0.29]
Tenure on the Job (years)	***-0.003***
	[-0.005, -0.002]
Occupation category (Professional worker is reference)	
Manager, executive, or official	0.02
	[-0.02, 0.07]
Sales worker	0.03
	[-0.08, 0.14]
Clerical or office worker	**0.09**
	[0.01, 0.17]
Manufacturing or production worker	***0.30***
	[0.23, 0.38]
Business owner	-0.01
	[-0.20, 0.17]
Service worker	-0.002
	[-0.11, 0.10]
Construction or mining worker	**0.32**
	[0.02, 0.62]
Transportation worker	0.25
	[-0.02, 0.51]
Installation or repair worker	*0.19*
	[0.02, 0.36]
Farming, fishing, or forestry worker	0.17
	[-0.07, 0.40]

Other	***0.13***
	[0.07, 0.19]
Number of Children under 18	-0.01
	[-0.02, 0.002]
Provides informal care	**0.05**
	[0.01, 0.09]
Spouse/Partner	**0.05**
	[0.01, 0.08]
Highest level of completed education (Less than high school diploma is reference)	
High school degree or diploma	0.07
	[-0.04, 0.19]
Technical/vocational school	0.06
	[-0.07, 0.19]
Some college	0.02
	[-0.09, 0.14]
College graduate	-0.07
	[-0.19, 0.04]
Post graduate work or degree	-0.04
	[-0.15, 0.08]
Exercise in past week (0 times is reference)	
1 or 2 times	**0.05**
	[0.0005, 0.09]
3 or more times	***0.07***
	[0.03, 0.12]
Current Smoker	***0.10***
	[0.04, 0.15]
AMI	0.07
	[-0.08, 0.21]
Asthma	-0.005
	[-0.05, 0.04]
Cancer	0.01
	[-0.09, 0.10]
Depression	***-0.13***
	[-0.18, -0.07]
Diabetes	-0.06
	[-0.14, 0.02]
High Blood Pressure	-0.01
	[-0.05, 0.02]
High Cholesterol	0.01
	[-0.02, 0.04]
Age (years)	***-0.004***
	[-0.01, -0.003]

BMI	-0.002
	[-0.004, 0.0003]
Emotional Health Index (out of 10)	0.004
	[-0.004, 0.01]
Health Ladder (0 to 10)	***0.03***
	[0.02, 0.04]
Notes: (N=34,359, 14 employers). This regression also controls for Census Region and Employer, Standard Errors are clustered by employer and state. **Statistically Significant at the 5% level, *Statistically Significant at the 1% level***	

Table 24. Sensitivity Analyses of the Association between Health-Related Employer Support and Sick Days, Not Controlling for Pain

		Original	(A)	(B)	(C)
Neither	Risk Difference	0.01 [-0.01, 0.02]	0.005 [-0.01, 0.02]	0.01 [-0.02, 0.04]	-0.002 [-0.06, 0.05]
	Conditional Margin	-0.03 [-0.22, 0.17]	-0.07 [-0.26, 0.12]	-0.23 [-0.62, 0.16]	0.70 [-0.72, 2.13]
	Unconditional Margin	0.01 [-0.04, 0.06]	-0.003 [-0.05, 0.05]	-0.01 [-0.12, 0.10]	0.09 [-0.16, 0.33]
No Physical Support	Risk Difference	-0.001 [-0.03, 0.03]	0.001 [-0.03, 0.04]	-0.004 [-0.08, 0.08]	0.04 [-0.10, 0.18]
	Conditional Margin	0.32 [-0.28, 0.93]	0.56 [-0.13, 1.24]	0.17 [-1.85, 2.19]	***4.83 [1.51, 8.15]***
	Unconditional Margin	0.06 [-0.09, 0.20]	0.11 [-0.05, 0.27]	0.03 [-0.47, 0.52]	0.94 [-0.13, 2.01]
No Emotional Support	Risk Difference	0.01 [-0.01, 0.03]	0.01 [-0.01, 0.03]	0.03 [-0.001, 0.06]	0.03 [-0.04, 0.10]
	Conditional Margin	0.08 [-0.24, 0.39]	0.07 [-0.26, 0.39]	0.14 [-0.37, 0.65]	-0.75 [-2.22, 0.71]
	Unconditional Margin	0.04 [-0.04, 0.13]	0.04 [-0.05, 0.13]	0.10 [-0.04, 0.25]	-0.03 [-0.35, 0.28]

Notes: Risk Difference = Percentage Point Change in the Probability of Having Any Sick Days; Conditional Margin = Change in Expected Number of Sick Days Conditional on Having > Zero; Unconditional Margin = Unconditional Change in Expected Number of Sick Days. This regression also controls for Census Region and Employer. The results are for a two-part model of sick days. The first part of the model uses a logit regression with the dependent variable equal to one if any sick days were reported. The second part of the model is a GLM (Poisson and log-link). The third column presents the results of the combined model. Average Marginal Effects are reported in columns. Confidence Intervals were estimated using a first-order Taylor series expansion. **Statistically Significant at the 5% level, *Statistically Significant at the 1% level***

(A) Controlling for use of "relaxing" drugs and alcohol (N=32574 1st part, N=6335 2nd part, 13 employers)

(B) Employer with Dependents Sample: Employees-Only (N=11358 1st part, N=2056 2nd part, 1 Employer)

(C) Employer with Dependents Sample: Dependents only (N=1818 1st part, N=251 2nd part, 1 Employer)

Table 24. Sensitivity Analyses of the Association between Health-Related Employer Support and Sick Days, Not Controlling for Pain (cont'd)

		Original	(D)	(E)	(F)
Neither	Risk Difference	0.01 [-0.01, 0.02]	0.01 [-0.01, 0.02]	0.01 [-0.01, 0.02]	0.14 [-0.01, 0.28]
	Conditional Margin	-0.03 [-0.22, 0.17]	-0.05 [-0.27, 0.18]	0.03 [-0.17, 0.22]	0.94 [-0.64, 2.52]
	Unconditional Margin	0.01 [-0.04, 0.06]	0.01 [-0.05, 0.06]	0.02 [-0.03, 0.08]	**0.51 [0.04, 0.99]**
No Physical Support	Risk Difference	-0.001 [-0.03, 0.03]	-0.001 [-0.04, 0.04]	-0.001 [-0.03, 0.03]	-0.002 [-0.49, 0.49]
	Conditional Margin	0.32 [-0.28, 0.93]	0.18 [-0.34, 0.70]	0.34 [-0.26, 0.95]	***9.78 [3.98, 15.58]***
	Unconditional Margin	0.06 [-0.09, 0.20]	0.03 [-0.08, 0.14]	0.06 [-0.08, 0.21]	**1.89 [0.06, 3.72]**
No Emotional Support	Risk Difference	0.01 [-0.01, 0.03]	0.01 [0.00, 0.03]	0.01 [-0.01, 0.03]	-0.03 [-0.20, 0.14]
	Conditional Margin	0.08 [-0.24, 0.39]	0.04 [-0.18, 0.26]	0.03 [-0.17, 0.22]	***3.72 [1.88, 5.56]***
	Unconditional Margin	0.04 [-0.04, 0.13]	0.04 [-0.02, 0.09]	0.06 [-0.03, 0.14]	**0.64 [0.08, 1.21]**

Notes: Risk Difference = Percentage Point Change in the Probability of Having Any Sick Days; Conditional Margin = Change in Expected Number of Sick Days Conditional on Having > Zero; Unconditional Margin = Unconditional Change in Expected Number of Sick Days. This regression also controls for Census Region and Employer. The results are for a two-part model of sick days. The first part of the model uses a logit regression with the dependent variable equal to one if any sick days were reported. The second part of the model is a GLM (Poisson and log-link). The third column presents the results of the combined model. Average Marginal Effects are reported in columns. Confidence Intervals were estimated using a first-order Taylor series expansion. **Statistically Significant at the 5% level, *Statistically Significant at the 1% level***

(D) Health-Related Employer Support: "Don't know" coded as "No" (N=34312 1st part, N=6634 2nd part, 14 Employers)

(E) Not controlling for "trusting and open environment" (N=34312 1st part, N=6634 2nd part, 14 Employers)

(F) Health-Related Employer Support: measured by employer-state averages (N=34312 1st part, N=6634 2nd part, 14 Employers)

Table 25. Sensitivity Analyses of the Association between Health-Related Employer Support and Self-Rated Relative Productivity, Not Controlling for Pain

	Original	(A)	(B)	(C)
Neither	***0.37 [0.31, 0.43]***	***0.38 [0.32, 0.44]***	***0.35 [0.21, 0.48]***	**0.37 [0.04, 0.69]**
No Physical Support	**0.15 [0.04, 0.27]**	**0.15 [0.03, 0.27]**	**0.33 [0.02, 0.65]**	0.05 [-0.47, 0.58]
No Emotional Support	***0.20 [0.12, 0.27]***	***0.21 [0.13, 0.29]***	***0.21 [0.09, 0.34]***	0.13 [-0.25, 0.51]

Notes: This multiple linear regression also controls for Census Region and Employer, Standard Errors are clustered by employer and state. **Statistically Significant at the 5% level, *Statistically Significant at the 1% level***
(A) Controlling for use of "relaxing" drugs and alcohol (N=32603, 13 employers)
(B) Employer with Dependents Sample: Employees-Only (N=11368, 1 Employer)
(C) Employer with Dependents Sample: Dependents Only (N=1826, 1 Employer)

Table 25. Sensitivity Analyses of the Association between Health-Related Employer Support and Self-Rated Relative Productivity, Not Controlling for Pain (cont'd)

	Original	(D)	(E)	(F)
Neither	***0.37 [0.31, 0.43]***	***0.37 [0.31, 0.43]***	***0.43 [0.37, 0.48]***	***1.15 [0.42, 1.88]***
No Physical Support	**0.15 [0.04, 0.27]**	0.16 [-0.005, 0.33]	**0.17 [0.05, 0.29]**	1.12 [-0.73, 2.97]
No Emotional Support	***0.20 [0.12, 0.27]***	***0.20 [0.13, 0.28]***	***0.24 [0.16, 0.31]***	-0.55 [-1.34, 0.24]

Notes: This multiple linear regression also controls for Census Region and Employer, Standard Errors are clustered by employer and state. **Statistically Significant at the 5% level, *Statistically Significant at the 1% level***
(D) Health-Related Employer Support: "Don't know" coded as "No" (N=34359, 14 Employers)
(E) Not controlling for "trusting and open environment" (N=34359, 14 Employers)
(F) Health-Related Employer Support: measured by employer-state averages (N=34359, 14 Employers)

Table 25.1 Sensitivity Analyses of the Association between Health-Related Employer Support and Self-Rated Relative Productivity, Not Controlling for Pain (cont'd)

	Original	Health-Related Employer Support: "don't know" coded as "don't know"
Neither	***0.37 [0.31, 0.43]***	***0.37 [0.30, 0.43]***
No Physical Support	**0.15 [0.04, 0.27]**	0.11 [-0.05, 0.27]
No Emotional Support	***0.20 [0.12, 0.27]***	***0.17 [0.09, 0.25]***
Physical, Don't Know Emotional	NA	0.03 [-0.01, 0.07]
No Physical, Don't Know Emotional	NA	0.14 [-0.01, 0.28]
Don't Know Physical, Emotional	NA	-0.02 [-0.11, 0.07]
Don't Know Physical, No Emotional	NA	***0.25 [0.17, 0.33]***

Notes: This regression also controls for Census Region and Employer, Standard Errors are clustered by employer and state. **Statistically Significant at the 5% level, *Statistically Significant at the 1% level*** (N=34359, 14 employers)

Table 26. Results of the Two-Part Model of the Association between Heath-related Employer Support and Future Medical Expenditures, Not Controlling for Pain (N=1584, N=1469 in 2nd part)

Variable	Percentage Point Difference in the Probability of Having Any Expenditure [95% CI]	Change in Expected Expenditures Conditional on Having > Zero [95% CI]	Unconditional Change in Expected Expenditures [95% CI]
Health-related Employer Support (Both is reference)			
Neither	0.001	-$1,328	-$1,227
	[-0.06, 0.06]	[-$5,720, $3,064]	[-$5,304, $2,850]
No Physical Support	-0.06	-$2,872	-$2,850
	[-0.18, 0.05]	[-$8,230, $2,487]	[-$7,678, $1,978]
No Emotional Support	0.03	-$2,910	-$2,613
	[-0.01, 0.07]	[-$5,989, $169]	[-$5,503, $277]
Does not learn new things	-0.01	-$177	-$186
	[-0.04, 0.03]	[-$3,386, $3,033]	[-$3,163, $2,791]
Does not have fun	0.01	-$758	-$681
	[-0.03, 0.04]	[-$3,720, $2,205]	[-$3,436, $2,074]
Does not have enough resources	-0.01	-$1,402	-$1,332
	[-0.06, 0.04]	[-$4,767, $1,964]	[-$4,449, $1,785]
Job Insecurity	0.02	-$699	-$571
	[-0.02, 0.06]	[-$4,468, $3,070]	[-$4,103, $2,961]
Unsatisfied	0.03	-$1,268	-$1,072
	[-0.02, 0.08]	[-$5,652, $3,115]	[-$5,193, $3,048]
Does not get to use strengths	-0.03	$3,711	$3,268
	[-0.08, 0.01]	[-$722, $8,143]	[-$798, $7,334]
Not trusting and open environment	-0.02	-$699	$1,092
	[-0.06, 0.02]	[-$4,468, $3,070]	[-$1,920, $4,104]
Typical Hours Worked	-0.0003	$14	$12
	[-0.002, 0.001]	[-$108, $136]	[-$102, $125]
Charlson Index Score ≥1	***0.08***	***$13,459***	***$13,454***
	[0.06, 0.10]	***[$8,751, $18,166]***	***[$8,848, $18,061]***
Asthma	0.005	***-$3,913***	***-$3,615***
	[-0.04, 0.05]	***[-$6,292, -$1,534]***	***[-$5,826, -$1,404]***
Depression	***0.05***	***$6,323***	***$6,203***
	[0.02, 0.08]	***[$1,749, $10,896]***	***[$1,855, $10,551]***
High Blood Pressure	***0.04***	-$363	-$174
	[0.01, 0.07]	[-$3,005, $2,278]	[-$2,657, $2,309]
High Cholesterol	***0.04***	$5	$176
	[0.01, 0.07]	[-$2,673, $2,682]	[-$2,340, $2,693]
Smoking Status	-0.03	-$1,597	-$1,598
	[-0.08, 0.01]	[-$4,598, $1,404]	[-$4,355, $1,159]
Male	***-0.09***	***-$3,075***	***-$3,231***
	[-0.12, -0.06]	***[-$5,244, -$907]***	***[-$5,246, -$1,217]***
Age (years)	0.001	**$144**	**$137**

	[-0.0004, 0.002]	**[$25, $263]**	**[$26, $248]**
BMI	0.002	$79	$81
	[-0.001, 0.004]	[-$110, $268]	[-$95, $256]
Emotional Health Index (0-10)	0.001	-$351	-$321
	[-0.01, 0.01]	[-$935, $232]	[-$863, $221]
Health Ladder (0-10)	-0.002	-$6	-$14
	[-0.01, 0.01]	[-$782, $770]	[-$735, $706]
Health Insurance Type (PPO is reference)			
HMO - gatekeeper	-0.02	-$524	-$560
	[-0.07, 0.03]	[-$3,324, $2,277]	[-$3,151, $2,031]
HMO - POS or Open Access	-0.01	$1,035	$920
	[-0.06, 0.04]	[-$2,527, $4,598]	[-$2,391, $4,230]
Indemnity/HAS	-0.04	$7,589	$6,788
	[-0.13, 0.05]	[-$3,498, $18,676]	[-$3,366, $16,943]
Monthly Income (Up to $2,999 is reference)			
$3,000 to $3,999	-0.03	$527	$368
	[-0.08, 0.02]	[-$3,516, $4,571]	[-$3,382, $4,117]
$4,000 to $4,999	-0.04	-$1,191	-$1,236
	[-0.08, 0.01]	[-$4,962, $2,579]	[-$4,743, $2,270]
$5,000 to $7,499	-0.03	$1,960	$1,703
	[-0.07, 0.01]	[-$2,128, $6,048]	[-$2,108, $5,514]
$7,500 to $9,999	-0.01	-$1,860	-$1,785
	[-0.07, 0.03]	[-$5,707, $1,988]	[-$5,380, $1,810]
$10,000 and over	-0.02	$659	$528
	[-0.06, 0.04]	[-$3,574, $4,893]	[-$3,429, $4,485]
Spouse/Partner	0.01	$1,373	$1,301
	[-0.03, 0.04]	[-$1,431, $4,176]	[-$1,304, $3,907]
Number of Children under 18	0.01	-$765	-$681
	[-0.01, 0.02]	[-$1,927, $397]	[-$1,759, $398]

Note: This regression also controlled for the number of hospital beds per 1,000 pop; Active Medical Specialty Physicians (excluding GIM, Pediatrics & Psychiatry) per 10,000 pop; Active Family, General, General Internal Medicine, and Pediatric physicians per 10,000 pop; Active Psychiatry Specialty Physicians per 10,000 pop; and Census Region. The results are for a two-part model of future medical expenditures. The first part of the model uses a logit regression with the dependent variable equal to one if there were any expenditures. The second part of the model is a GLM (Gamma and log-link). The third column presents the results of the combined model. Average Marginal Effects are reported in columns. Confidence Intervals were estimated using a first-order Taylor series expansion. **Statistically Significant at the 5% level, *Statistically Significant at the 1% level***

Table 27. Sensitivity Analyses of the Two-Part Model Estimates of the Association between Health-Related Employer Support and Future Medical Expenditures, Not Controlling for Pain

		Original	(A)	(B)
Neither	Risk Difference	0.001 [-0.06, 0.06]	0.001 [-0.06, 0.06]	0.001 [-0.06, 0.06]
	Conditional Margin	-$1,328 [-$5,720, $3,064]	-$4,077 [-$11,218, $3,064]	-$1,328 [-$5,720, $3,064]
	Unconditional Margin	$1,227 [-$5,304, $2,850]	-$3,797 [-$10,454, $2,859]	-$1,227 [-$5,304, $2,850]
No Physical Support	Risk Difference	-0.06 [-0.18, 0.05]	-0.06 [-0.17, 0.05]	-0.06 [-0.18, 0.05]
	Conditional Margin	-$2,872 [-$8,230, $2,487]	-$5,614 [-$15,240, $4,012]	-$2,872 [-$8,230, $2,487]
	Unconditional Margin	-$2850 [-$7,678, $1,978]	*-$4,879 [-$13,791, $4,034]*	-$2,850 [-$7,678, $1,978]
No Emotional Support	Risk Difference	0.03 [-0.01, 0.07]	0.01 [-0.04, 0.06]	0.03 [-0.01, 0.07]
	Conditional Margin	-$2910 [-$5,989, $169]	-$6,420 [-$12,773, -$67]	-$2,910 [-$5,989, $169]
	Unconditional Margin	-$2613 [-$5,503, $277]	*-$5,960 [-$11,889, -$30]*	-$2,613 [-$5,503, $277]

Note: Risk Difference = Percentage Point Change in the Probability of Having Any Expenditure; Conditional Margin = Change in Expected Expenditures Conditional on Having > Zero; Unconditional Margin = Unconditional Change in Expected Expenditures. The results are for a two-part model of future medical expenditures. The first part of the model uses a logit regression with the dependent variable equal to one if there were any expenditures. The second part of the model is a GLM (Gamma and log-link). Confidence Intervals were estimated using a first-order Taylor series expansion. ***Statistically Significant at the 1% level*. Statistically Significant at the 5% level.**

(A) Controlling for previous medical expenditures (N=1371 1st part, N=1289 2nd part, 1 employer)

(B) Not controlling for "open and trusting environment" (N=1584 1st part, N=1469 2nd part, 1 employer)

Table 27. Sensitivity Analyses of the Two-Part Model Estimates of the Association between Health-Related Employer Support and Future Medical Expenditures, Not Controlling for Pain (cont'd)

		(C)
Neither	Risk Difference	0.001 [-0.05, 0.05]
	Conditional Margin	$115 [-$864, $1,095]
	Unconditional Margin	$78 [-$573, $729]
No Physical Support	Risk Difference	-0.03 [-0.15, 0.09]
	Conditional Margin	$99 [-$1,813, $2,012]
	Unconditional Margin	-$34 [-$1,265, $1,198]
No Emotional Support	Risk Difference	-0.0002 [-0.06, 0.06]
	Conditional Margin	$60 [-$1,132, $1,251]
	Unconditional Margin	$38 [-$738, $815]
Note: Risk Difference = Percentage Point Change in the Probability of Having Any Expenditure; Conditional Margin = Change in Expected Expenditures Conditional on Having > Zero; Unconditional Margin = Unconditional Change in Expected Expenditures. The results are for a two-part model of future medical expenditures. The first part of the model uses a logit regression with the dependent variable equal to one if there were any expenditures. The second part of the model is a GLM (Gamma and log-link). Confidence Intervals were estimated using a first-order Taylor series expansion. ***Statistically Significant at the 1% level*. Statistically Significant at the 5% level.**		
(C) Expanded Sample with less strict eligibility requirements (N=9767 1st part, N=6176 2nd part, 2 employers)		

Table 28 Results of the Logit Model of the Association between Heath-related Employer Support and Pain

Variable	Percentage Point Change in the Probability of Having Pain [95% CI]
Health-related Employer Support (Both is reference)	
Neither	***0.03 [0.01, 0.05]***
No Physical Support	0.03 [-0.02, 0.09]
No Emotional Support	***0.03 [0.01, 0.05]***
Unsatisfied	***0.04 [0.02, 0.06]***
Does not get to use strengths	***0.02 [0.01, 0.03]***
Not trusting and open environment	***0.03 [0.01, 0.04]***
Occupation category (Professional worker is reference)	
Manager, executive, or official	0.01 [-0.01, 0.02]
Sales worker	0.02 [-0.02, 0.05]
Clerical or office worker	0.01 [-0.01, 0.03]
Manufacturing or production worker	-0.01 [-0.03, 0.02]
Business owner	-0.02 [-0.08, 0.03]
Service worker	-0.01 [-0.04, 0.02]
Construction or mining worker	-0.02 [-0.11, 0.07]
Transportation worker	0.02 [-0.06, 0.10]
Installation or repair worker	0.02 [-0.04, 0.08]
Farming, fishing, or forestry worker	-0.02 [-0.12, 0.08]
Other	-0.02 [-0.04, 0.004]
Number of Children under 18	**-0.005 [-0.01, -0.0002]**
Provides informal care	***0.02 [0.005, 0.03]***
Social Help	***-0.05 [-0.07, -0.02]***
Spouse/Partner	0.004 [-0.01, 0.02]

Highest level of completed education (Less than high school diploma is reference)	
High school degree or diploma	-0.001 [-0.03, 0.03]
Technical/vocational school	**0.03** **[0.002, 0.07]**
Some college	0.02 [-0.01, 0.04]
College graduate	0.01 [-0.02, 0.03]
Post graduate work or degree	-0.0002 [-0.03, 0.03]
Exercise in past week (0 times is reference)	
1 or 2 times	***-0.03*** ***[-0.04, -0.01]***
3 or more times	***-0.05*** ***[-0.07, -0.04]***
Current Smoker	***0.04*** ***[0.02, 0.05]***
AMI	0.06 [0.00, 0.12]
Asthma	***0.07*** ***[0.06, 0.09]***
Cancer	***0.04*** ***[0.02, 0.07]***
Depression	***0.1*** ***[0.08, 0.12]***
Diabetes	0.01 [-0.02, 0.03]
High Blood Pressure	***0.03*** ***[0.01, 0.04]***
High Cholesterol	***0.03*** ***[0.02, 0.05]***
Age (years)	***0.01*** ***[0.005, 0.01]***
BMI	***0.005*** ***[0.004, 0.01]***
Emotional Health Index (out of 10)	***-0.01*** ***[-0.01, 0.00]***
Health Ladder (0 to 10)	***-0.03*** ***[-0.03, -0.02]***
Male	-0.001 [-0.01, 0.01]
Notes: This regression also controls for Census Region and Employer. Average Marginal Effects are reported. Clustering by employer and state does not alter the statistical significance of the results. **Statistically Significant at the 5% level**, ***Statistically Significant at the 1% level***	

Table 29. Sensitivity Analyses of the Logit Model Estimates of the Association between Health-Related Employer Support and Pain

	Original	(A)	(B)	(C)
Neither	***0.03*** ***[0.01, 0.05]***	**0.03** **[0.01, 0.05]**	0.01 [-0.02, 0.05]	0.01 [-0.03, 0.05]
No Physical Support	0.03 [-0.02, 0.09]	0.03 [-0.02, 0.09]	0.004 [-0.10, 0.11]	-0.02 [-0.15, 0.10]
No Emotional Support	***0.03*** ***[0.01, 0.05]***	***0.03*** ***[0.01, 0.05]***	0.02 [-0.003, 0.05]	0.03 [-0.01, 0.06]

Notes: This regression also controls for Census Region and Employer. **Statistically Significant at the 5% level, *Statistically Significant at the 1% level***

(A) Controlling for use of "relaxing" drugs and alcohol (N=32603, 13 Employers)
(B) Controlling for Race/Ethnicity (N=17975, 10 Employers)
(C) Employer with Dependents Sample: Employees-Only (N=11368, 1 Employer)

Table 29. Sensitivity Analyses of the Logit Model Estimates of the Association between Health-Related Employer Support and Pain (cont'd)

	(D)	(E)	(F)	(G)
Neither	0.003 [-0.08, 0.09]	***0.03*** ***[0.01, 0.05]***	***0.04*** ***[0.01, 0.06]***	***0.03*** ***[0.01, 0.05]***
No Physical Support	0.11 [-0.07, 0.30]	0.04 [-0.01, 0.10]	0.04 [-0.02, 0.09]	0.03 [-0.02, 0.09]
No Emotional Support	0.03 [-0.08, 0.13]	***0.03*** ***[0.01, 0.05]***	***0.03*** ***[0.02, 0.05]***	***0.03*** ***[0.01, 0.05]***

Notes: This regression also controls for Census Region and Employer. **Statistically Significant at the 5% level, *Statistically Significant at the 1% level***

(D) Employer with Dependents Sample: Dependents Only (N=1826, 1 Employer)
(E) Health-Related Employer Support: "Don't know" coded as "No" (N=34359, 14 Employers)
(F) Not controlling for "open and trusting environment" (N=34359, 14 Employers)
(G) Not controlling for occupation (N=34359, 14 Employers)

Table 29. Sensitivity Analyses of the Logit Model Estimates of the Association between Health-Related Employer Support and Pain (cont'd)

	Original	(H)	(I)	(J)
Neither	***0.03*** ***[0.01, 0.05]***	***0.03*** ***[0.01, 0.04]***	***0.04*** ***[0.01, 0.06]***	0.004 [-0.01, 0.02]
No Physical Support	0.03 [-0.02, 0.09]	0.02 [-0.02, 0.05]	0.02 [-0.03, 0.07]	0.01 [-0.03, 0.05]
No Emotional Support	***0.03*** ***[0.01, 0.05]***	***0.02*** ***[0.01, 0.03]***	***0.03*** ***[0.01, 0.04]***	0.01 [-0.01, 0.02]

Notes: This regression also controls for Census Region and Employer. **Statistically Significant at the 5% level, *Statistically Significant at the 1% level***

(H) With dependent variable =1 if recurring pain last 12 months AND pain yesterday (N=34052, 14 Employers)
(I) With dependent variable = 1 if neck/back pain (N=34052, 14 Employers)
(J) With dependent variable = 1 if knee/leg pain (N=34131, 14 Employers)

Table 29. Sensitivity Analyses of the Logit Model Estimates of the Association between Health-Related Employer Support and Pain (cont'd)

	(K)	(L)	(M)
Neither	**0.02** **[0.002, 0.03]**	0.17 [-0.01, 0.34]	0.02 [-0.01, 0.05]
No Physical Support	0.02 [-0.01, 0.05]	0.06 [-0.45, 0.57]	0.03 [-0.03, 0.09]
No Emotional Support	0.01 [-0.001, 0.03]	***0.30*** ***[0.13, 0.48]***	0.02 [-0.004, 0.05]

Notes: This regression also controls for Census Region and Employer. **Statistically Significant at the 5% level, *Statistically Significant at the 1% level***

(K) With dependent variable = 1 if other pain (N=33925, 14 Employers

(L) Health-Related Employer Support: measured by employer-state averages (N=34359, 14 Employers)
(M) Using employees with two surveys with Pain in Time 2 as the outcome (N=18140, 5 Employers)

Table 29.1 Sensitivity Analyses of the Logit Model Estimates of the Association between Health-Related Employer Support and Pain

	Original	Health-Related Employer Support: "don't know" coded as "don't know"
Neither	***0.03 [0.01, 0.05]***	***0.03 [0.01, 0.06]***
No Physical Support	0.03 [-0.02, 0.09]	0.05 [-0.001, 0.10]
No Emotional Support	***0.03 [0.01, 0.05]***	***0.04 [0.02, 0.06]***
Physical, Don't Know Emotional	NA	***0.03 [0.02, 0.05]***
No Physical, Don't Know Emotional	NA	0.05 [-0.01, 0.10]
Don't Know Physical, Emotional	NA	0.02 [-0.02, 0.05]
Don't Know Physical, No Emotional	NA	***0.05 [0.02, 0.08]***
Notes: This regression also controls for Census Region and Employer. **Statistically Significant at the 5% level, *Statistically Significant at the 1% level*** (N=34359, 14 Employers)		

Table 30 Results of the Two-part Model of the Association between Heath-related Employer Support and Sick Days, Controlling for Pain (N=34312 1st, N=6634 2nd, 14 employers)

Variable	Percentage Point Difference in Probability of Having Any Sick Days) [95% CI]	Change in Expected Number of Sick Days Conditional on Having > Zero [95% CI]	Unconditional Change in Expected Number of Sick Days [95% CI]
Pain	***0.05***	***0.38***	***0.20***
	[0.05, 0.06]	***[0.30, 0.47]***	***[0.18, 0.23]***
Health-related Employer Support (Both is reference)			
Neither	0.01	-0.04	0.003
	[-0.01, 0.02]	[-0.24, 0.15]	[-0.05, 0.06]
No Physical Support	-0.003	0.32	0.05
	[-0.04, 0.03]	[-0.28, 0.93]	[-0.09, 0.20]
No Emotional Support	0.01	0.07	0.04
	[-0.01, 0.03]	[-0.24, 0.37]	[-0.05, 0.12]
Unsatisfied	0.01	0.01	0.03
	[-0.003, 0.02]	[-0.16, 0.18]	[-0.02, 0.07]
Does not get to use strengths	0.01	-0.02	0.03
	[0.004, 0.03]	[-0.15, 0.11]	[-0.003, 0.07]
Not trusting and open environment	0.003	***0.23***	***0.05***
	[-0.01, 0.01]	***[0.11, 0.36]***	***[0.01, 0.09]***
Tenure on the Job (years)	***-0.001***	***-0.01***	***-0.004***
	[-0.001, -0.0004]	***[-0.01, 0.00]***	***[-0.01, -0.002]***
Occupation category (Professional worker is reference)			
Manager, executive, or official	***-0.03***	-0.04	***-0.09***
	[-0.05, -0.02]	[-0.18, 0.09]	***[-0.12, -0.05]***
Sales worker	-0.002	-0.01	-0.01
	[-0.03, 0.03]	[-0.41, 0.38]	[-0.11, 0.10]
Clerical or office worker	***0.02***	-0.03	**0.04**
	[0.01, 0.03]	[-0.14, 0.08]	**[0.005, 0.08]**
Manufacturing or production worker	***-0.03***	***0.65***	0.05
	[-0.05, -0.01]	***[0.40, 0.91]***	[-0.02, 0.12]
Business owner	*0.05*	0.45	**0.23**
	[0.0002, 0.10]	[-0.16, 1.05]	**[0.02, 0.44]**
Service worker	0.02	**0.34**	**0.11**
	[-0.01, 0.04]	**[0.07, 0.62]**	**[0.02, 0.21]**
Construction or mining worker	0.03	1.23	0.33
	[-0.05, 0.10]	[-0.28, 2.74]	[-0.07, 0.72]
Transportation worker	-0.01	0.64	0.09
	[-0.07, 0.05]	[-0.55, 1.83]	[-0.19, 0.36]
Installation or repair worker	0.05	***0.85***	***0.31***
	[-0.004, 0.10]	***[0.38, 1.32]***	***[0.12, 0.50]***
Farming, fishing, or forestry worker	0.05	0.08	0.12
	[-0.04, 0.13]	[-0.61, 0.77]	[-0.13, 0.38]
Other	0.01	0.15	0.04
	[-0.01, 0.02]	[-0.01, 0.31]	[-0.01, 0.10]
Number of Children under 18	0.003	-0.03	0.002
	[-0.001, 0.01]	[-0.06, 0.01]	[-0.01, 0.01]

Provides informal care	**0.01**	0.06	***0.05***
	[0.003, 0.03]	[-0.04, 0.15]	***[0.01, 0.08]***
Spouse/Partner	***-0.02***	0.05	**-0.03**
	[-0.03, -0.01]	[-0.04, 0.14]	**[-0.06, -0.003]**
Highest level of completed education (Less than high school diploma is reference)			
High school degree or diploma	***0.03***	**0.28**	***0.14***
	[0.01, 0.06]	**[0.05, 0.50]**	***[0.07, 0.21]***
Technical/vocational school	0.005	0.17	0.04
	[-0.02, 0.03]	[-0.09, 0.42]	[-0.04, 0.12]
Some college	***0.03***	**0.24**	***0.12***
	[0.01, 0.05]	**[0.03, 0.45]**	***[0.06, 0.19]***
College graduate	0.01	0.06	0.03
	[-0.01, 0.03]	[-0.14, 0.27]	[-0.03, 0.09]
Post graduate work or degree	-0.02	-0.16	**-0.06**
	[-0.04, 0.01]	[-0.37, 0.06]	**[-0.13, -0.002]**
Exercise in past week (0 times is reference)			
1 or 2 times	-0.01	***-0.31***	***-0.09***
	[-0.02, 0.0004]	***[-0.42, -0.21]***	***[-0.13, -0.06]***
3 or more times	***-0.03***	***-0.27***	***-0.14***
	[-0.04, -0.02]	***[-0.37, -0.17]***	***[-0.17, -0.10]***
Current Smoker	***0.03***	***-0.16***	0.04
	[0.02, 0.05]	***[-0.28, -0.04]***	[0.0001, 0.09]
AMI	0.03	**0.38**	**0.16**
	[-0.02, 0.08]	**[0.02, 0.74]**	**[0.01, 0.32]**
Asthma	***0.02***	0.01	**0.05**
	[0.01, 0.04]	[-0.11, 0.12]	**[0.01, 0.10]**
Cancer	***0.06***	***0.88***	***0.36***
	[0.04, 0.08]	***[0.69, 1.07]***	***[0.27, 0.45]***
Depression	***0.09***	***0.23***	***0.27***
	[0.07, 0.10]	***[0.13, 0.33]***	***[0.22, 0.31]***
Diabetes	***0.04***	0.00	***0.09***
	[0.02, 0.06]	[-0.15, 0.14]	***[0.04, 0.15]***
High Blood Pressure	0.01	***0.34***	***0.08***
	[-0.004, 0.02]	***[0.24, 0.44]***	***[0.05, 0.12]***
High Cholesterol	-0.01	-0.07	**-0.04**
	[-0.02, 0.001]	[-0.17, 0.02]	**[-0.07, -0.01]**
Age (years)	-0.0002	***0.02***	***0.003***
	[-0.001, 0.0003]	***[0.01, 0.02]***	***[0.001, 0.004]***
BMI	***0.002***	-0.001	***0.004***
	[0.001, 0.002]	[-0.01, 0.005]	***[0.002, 0.01]***
Emotional Health Index (out of 10)	***-0.003***	0.004	**-0.01**
	[-0.005, -0.001]	[-0.01, 0.02]	**[-0.01, -0.001]**
Health Ladder (0-10)	***-0.01***	***-0.06***	***-0.04***
	[-0.15, -0.009]	***[-0.08, -0.03]***	***[-0.05, -0.03]***

Notes: This regression also controls for Census Region and Employer. The results are for a two-part model of sick days. The first part of the model uses a logit regression with the dependent variable equal to one if any sick days were reported. The second part of the model is a GLM (Poisson and log-link). The third column presents the results of the combined model. Average Marginal Effects are reported in columns. Confidence Intervals were estimated using a first-order Taylor series expansion. **Statistically Significant at the 5% level, Statistically Significant at the 1% level**

Table 31 Results of the Multiple Linear Regression Analysis of the Association between Heath-related Employer Support and Self-rated Relative Productivity, Controlling for Pain (N=34,359, 14 employers)

Variable	Regression Coefficient [95% CI]
Pain	0.03
	[-0.02, 0.07]
Health-related Employer Support (Both is reference)	
Neither	***0.37***
	[0.31, 0.43]
No Physical Support	**0.15**
	[0.04, 0.27]
No Emotional Support	***0.19***
	[0.11, 0.27]
Unsatisfied	-0.004
	[-0.06, 0.05]
Does not get to use strengths	***-0.17***
	[-0.21, -0.12]
Not trusting and open environment	***0.24***
	[0.18, 0.29]
Tenure on the Job (years)	***-0.003***
	[-0.005, -0.002]
Occupation category (Professional worker is reference)	
Manager, executive, or official	0.02
	[-0.02, 0.07]
Sales worker	0.03
	[-0.08, 0.14]
Clerical or office worker	**0.09**
	[0.01, 0.17]
Manufacturing or production worker	***0.31***
	[0.23, 0.38]
Business owner	-0.01
	[-0.20, 0.17]
Service worker	-0.002
	[-0.11, 0.10]
Construction or mining worker	**0.32**
	[0.02, 0.62]
Transportation worker	0.25
	[-0.02, 0.51]
Installation or repair worker	*0.19*
	[0.02, 0.36]
Farming, fishing, or forestry worker	0.17
	[-0.07, 0.40]
Other	***0.13***
	[0.07, 0.19]
Number of Children under 18	-0.01
	[-0.02, 0.002]
Provides informal care	**0.05**
	[0.01, 0.09]
Spouse/Partner	**0.05**

	[0.01, 0.08]
Highest level of completed education (Less than high school diploma is reference)	
High school degree or diploma	0.07
	[-0.04, 0.19]
Technical/vocational school	0.06
	[-0.07, 0.19]
Some college	0.02
	[-0.09, 0.14]
College graduate	-0.07
	[-0.19, 0.04]
Post graduate work or degree	-0.04
	[-0.15, 0.08]
Exercise in past week (0 times is reference)	
1 or 2 times	**0.05**
	[0.001, 0.09]
3 or more times	***0.08***
	[0.03, 0.12]
Current Smoker	***0.10***
	[0.04, 0.15]
AMI	0.07
	[-0.08, 0.21]
Asthma	-0.01
	[-0.05, 0.04]
Cancer	0.01
	[-0.09, 0.10]
Depression	***-0.13***
	[-0.19, -0.07]
Diabetes	-0.06
	[-0.14, 0.02]
High Blood Pressure	-0.01
	[-0.05, 0.02]
High Cholesterol	0.01
	[-0.02, 0.04]
Age (years)	***-0.004***
	[-0.01, -0.003]
BMI	-0.002
	[-0.004, 0.0003]
Emotional Health Index (out of 10)	0.004
	[-0.004, 0.01]
Health Ladder (0 to 10)	***0.03***
	[0.02, 0.05]
Notes: This regression also controls for Census Region and Employer, Standard Errors are clustered by employer and state. **Statistically Significant at the 5% level, *Statistically Significant at the 1% level***	

Table 32. Sensitivity Analyses of the Two-Part Model Estimates of the Association between Health-related Employer Support and Sick Days, Controlling for Pain

		Original	(A)	(B)	(C)
Pain in the last 12 months	Risk Difference	***0.05 [0.05, 0.06]***	***0.05 [0.04, 0.06]***	***0.05 [0.03, 0.06]***	***0.05 [0.01, 0.08]***
	Conditional Margin	***0.38 [0.30, 0.47]***	***0.34 [0.26, 0.42]***	***0.44 [0.28, 0.60]***	0.37 [-0.19, 0.94]
	Unconditional Margin	***0.20 [0.18, 0.23]***	***0.18 [0.15, 0.21]***	***0.21 [0.16, 0.26]***	**0.19 [0.06, 0.31]**
Neither	Risk Difference	-0.003 [-0.04, 0.03]	0.003 [-0.01, 0.02]	0.01 [-0.02, 0.04]	-0.002 [-0.06, 0.05]
	Conditional Margin	0.32 [-0.28, 0.93]	-0.08 [-0.27, 0.11]	-0.23 [-0.62, 0.16]	0.74 [-0.69, 2.17]
	Unconditional Margin	0.05 [-0.09, 0.20]	-0.01 [-0.06, 0.04]	-0.01 [-0.12, 0.09]	0.09 [-0.16, 0.34]
No Physical Support	Risk Difference	0.01 [-0.01, 0.03]	-0.001 [-0.04, 0.03]	-0.004 [-0.08, 0.08]	0.04 [-0.10, 0.17]
	Conditional Margin	0.07 [-0.34, 0.27]	0.55 [-0.13, 1.24]	0.15 [-1.84, 2.14]	***4.52 [1.25, 7.79]***
	Unconditional Margin	0.04 [-0.05, 0.12]	0.10 [-0.05, 0.26]	0.02 [-0.46, 0.51]	0.84 [-0.15, 1.84]
No Emotional Support	Risk Difference	0.01 [-0.01, 0.02]	0.01 [-0.01, 0.03]	0.03 [-0.002, 0.05]	0.03 [-0.04, 0.10]
	Conditional Margin	-0.04 [-0.24, 0.15]	0.06 [-0.26, 0.37]	0.14 [-0.36, 0.65]	-0.77 [-2.22, 0.68]
	Unconditional Margin	0.003 [-0.05, 0.06]	0.03 [-0.05, 0.12]	0.10 [-0.04, 0.24]	-0.04 [-0.35, 0.26]

Notes: Risk Difference = Percentage Point Change in the Probability of Having Any Sick Days; Conditional Margin = Change in Expected Number of Sick Days Conditional on Having > Zero; Unconditional Margin = Unconditional Change in Expected Number of Sick Days. This regression also controls for Census Region and Employer. The results are for a two-part model of sick days. The first part of the model uses a logit regression with the dependent variable equal to one if any sick days were reported. The second part of the model is a GLM (Poisson and log-link). The third column presents the results of the combined model. Confidence Intervals were estimated using a first-order Taylor series expansion. **Statistically Significant at the 5% level, *Statistically Significant at the 1% level***

(A) Controlling for use of "relaxing" drugs and alcohol (N=32574 1st part, N=6335 2nd part, 13 employers)

(B) Employer with Dependents Sample: Employees-Only (N=11358 1st part, N=2056 2nd part, 1 Employer)

(C) Employer with Dependents Sample: Dependents only (N=1818 1st part, N=251 2nd part, 1 Employer)

Table 32. Sensitivity Analyses of the Two-Part Model Estimates of the Association between Health-related Employer Support and Sick Days, Controlling for Pain (cont'd)

		Original	(D)	(E)	(F)
Pain in the last 12 months	Risk Difference	***0.05 [0.05, 0.06]***	***0.05 [0.05, 0.06]***	***0.05 [0.03, 0.06]***	***0.05 [0.05, 0.06]***
	Conditional Margin	***0.38 [0.30, 0.47]***	***0.38 [0.30, 0.47]***	***0.39 [0.31, 0.47]***	***0.38 [0.30, 0.46]***
	Unconditional Margin	***0.20 [0.18, 0.23]***	***0.20 [0.18, 0.23]***	***0.21 [0.18, 0.23]***	***0.20 [0.18, 0.23]***
Neither	Risk Difference	-0.003 [-0.04, 0.03]	0.005 [-0.01, 0.02]	0.01 [-0.01, 0.02]	0.13 [-0.02, 0.27]
	Conditional Margin	0.32 [-0.28, 0.93]	-0.06 [-0.28, 0.16]	0.01 [-0.19, 0.21]	0.86 [-0.73, 2.44]
	Unconditional Margin	0.05 [-0.09, 0.20]	-0.0005 [-0.05, 0.05]	0.02 [-0.04, 0.07]	0.47 [-0.01, 0.95]
No Physical Support	Risk Difference	0.01 [-0.01, 0.03]	-0.004 [-0.04, 0.03]	-0.003 [-0.04, 0.03]	0.00001 [-0.48, 0.48]
	Conditional Margin	0.07 [-0.34, 0.27]	0.17 [-0.35, 0.70]	0.34 [-0.26, 0.95]	***10.15 [4.39, 15.92]***
	Unconditional Margin	0.04 [-0.05, 0.12]	0.02 [-0.09, 0.13]	0.06 [-0.08, 0.20]	**1.96 [0.17, 3.76]**
No Emotional Support	Risk Difference	0.01 [-0.01, 0.02]	0.01 [-0.004, 0.02]	0.01 [-0.01, 0.03]	-0.05 [-0.22, 0.12]
	Conditional Margin	-0.04 [-0.24, 0.15]	0.04 [-0.18, 0.26]	0.11 [-0.19, 0.42]	***3.69 [1.79, 5.58]***
	Unconditional Margin	0.003 [-0.05, 0.06]	0.03 [-0.02, 0.09]	0.05 [-0.04, 0.13]	**0.60 [0.04, 1.17]**

Notes: Risk Difference = Percentage Point Change in the Probability of Having Any Sick Days; Conditional Margin = Change in Expected Number of Sick Days Conditional on Having > Zero; Unconditional Margin = Unconditional Change in Expected Number of Sick Days. This regression also controls for Census Region and Employer. The results are for a two-part model of sick days. The first part of the model uses a logit regression with the dependent variable equal to one if any sick days were reported. The second part of the model is a GLM (Poisson and log-link). The third column presents the results of the combined model. Confidence Intervals were estimated using a first-order Taylor series expansion. **Statistically Significant at the 5% level, *Statistically Significant at the 1% level***

(D) Health-Related Employer Support: "Don't know" coded as "No" (N=34312 1st part, N=6634 2nd part, 14 Employers)

(E) Not controlling for "trusting and open environment" (N=34312 1st part, N=6634 2nd part, 14 Employers)

(F) Health-Related Employer Support: measured by employer-state averages (N=34312 1st part, N=6634 2nd part, 14 Employers)

Table 32. Sensitivity Analyses of the Two-Part Model Estimates of the Association between Health-related Employer Support and Sick Days, Controlling for Pain (cont'd)

		Original	(G)	(H)
Pain in the last 12 months	Risk Difference	***0.05 [0.05, 0.06]***	***0.04 [0.03, 0.05]***	***0.07 [0.05, 0.08]***
	Conditional Margin	***0.38 [0.30, 0.47]***	***0.38 [0.26, 0.50]***	***0.41 [0.29, 0.52]***
	Unconditional Margin	***0.20 [0.18, 0.23]***	***0.16 [0.13, 0.19]***	***0.26 [0.22, 0.30]***
Neither	Risk Difference	-0.003 [-0.04, 0.03]	0.005 [-0.02, 0.02]	0.008 [-0.02, 0.04]
	Conditional Margin	0.32 [-0.28, 0.93]	-0.15 [-0.40, 0.09]	0.10 [-0.19, 0.39]
	Unconditional Margin	0.05 [-0.09, 0.20]	-0.01 [-0.07, 0.04]	0.04 [-0.05, 0.13]
No Physical Support	Risk Difference	0.01 [-0.01, 0.03]	0.01 [-0.03, 0.05]	-0.02 [-0.07, 0.03]
	Conditional Margin	0.07 [-0.34, 0.27]	0.28 [-0.48, 1.05]	0.32 [-0.69, 1.32]
	Unconditional Margin	0.04 [-0.05, 0.12]	0.07 [-0.09, 0.23]	0.01 [-0.25, 0.28]
No Emotional Support	Risk Difference	0.01 [-0.01, 0.02]	-0.01 [-0.01, 0.03]	-0.01 [-0.02, 0.04]
	Conditional Margin	-0.04 [-0.24, 0.15]	0.17 [-0.19, 0.52]	-0.07 [-0.51, 0.36]
	Unconditional Margin	0.003 [-0.05, 0.06]	0.05 [-0.03, 0.14]	0.01 [-0.11, 0.13]

Notes: Risk Difference = Percentage Point Change in the Probability of Having Any Sick Days; Conditional Margin = Change in Expected Number of Sick Days Conditional on Having > Zero; Unconditional Margin = Unconditional Change in Expected Number of Sick Days. This regression also controls for Census Region and Employer. The results are for a two-part model of sick days. The first part of the model uses a logit regression with the dependent variable equal to one if any sick days were reported. The second part of the model is a GLM (Poisson and log-link). The third column presents the results of the combined model. Confidence Intervals were estimated using a first-order Taylor series expansion. **Statistically Significant at the 5% level, *Statistically Significant at the 1% level***
(G) Men Only (N=17593 1st part, N=2919 2nd part)
(H) Women Only (N=16719 1st part, N=3715 2nd part)

Table 32.1 Sensitivity Analyses of the Two-Part Model Estimates of the Association between Health-related Employer Support and Sick Days, Controlling for Pain (cont'd)

		Original	Health-Related Employer Support: "Don't know" coded as "Don't know"
Pain in the last 12 months	Risk Difference	***0.05 [0.05, 0.06]***	***0.05 [0.04, 0.06]***
	Conditional Margin	***0.38 [0.30, 0.47]***	***0.39 [0.31, 0.47]***
	Unconditional Margin	***0.20 [0.18, 0.23]***	***0.20 [0.18, 0.23]***
Neither	Risk Difference	-0.003 [-0.04, 0.03]	0.01 [-0.01, 0.02]
	Conditional Margin	0.32 [-0.28, 0.93]	**-0.16 [-0.31, -0.01]**
	Unconditional Margin	0.05 [-0.09, 0.20]	-0.01 [-0.06, 0.04]
No Physical Support	Risk Difference	0.01 [-0.01, 0.03]	0.001 [-0.04, 0.04]
	Conditional Margin	0.07 [-0.34, 0.27]	0.16 [-0.23, 0.55]
	Unconditional Margin	0.04 [-0.05, 0.12]	0.03 [-0.06, 0.01]
No Emotional Support	Risk Difference	0.01 [-0.01, 0.02]	**0.02 [0.005, 0.04]**
	Conditional Margin	-0.04 [-0.24, 0.15]	-0.05 [-0.20, 0.09]
	Unconditional Margin	0.003 [-0.05, 0.06]	0.04 [-0.01, 0.09]
Physical, Don't Know Emotional	Risk Difference	NA	0.01 [-0.0003, 0.02]
	Conditional Margin	NA	***-0.29 [-0.40, -0.18]***
	Unconditional Margin	NA	-0.03 [-0.06, 0.01]
No Physical, Don't Know Emotional	Risk Difference	NA	0.02 [-0.02, 0.06]
	Conditional Margin	NA	-0.09 [-0.50, 0.32]
	Unconditional Margin	NA	0.03 [-0.10, 0.17]
Don't Know Physical, Emotional	Risk Difference	NA	0.004 [-0.02, 0.03]
	Conditional Margin	NA	-0.16 [-0.43, 0.10]
	Unconditional Margin	NA	-0.02 [-0.10, 0.06]
Don't Know Physical, No Emotional	Risk Difference	NA	0.01 [-0.01, 0.04]
	Conditional Margin	NA	0.17 [-0.04, 0.38]
	Unconditional Margin	NA	0.07 [-0.003, 0.14]

Notes: Risk Difference = Percentage Point Change in the Probability of Having Any Sick Days; Conditional Margin = Change in Expected Number of Sick Days Conditional on Having > Zero; Unconditional Margin = Unconditional Change in Expected Number of Sick Days. This regression also controls for Census Region and Employer. The results are for a two-part model of sick days. The first part of the model uses a logit regression with the dependent variable equal to one if any sick days were reported. The second part of the model is a GLM (Poisson and log-link).Confidence Intervals were estimated using a first-order Taylor series expansion. **Statistically Significant at the 5% level**, ***Statistically Significant at the 1% level*** (N=34312 1st part, N=6634 2nd part, 14 Employers)

Table 33. Sensitivity Analyses of the Association between Health-Related Employer Support and Self-Rated Relative Productivity, Controlling for Pain

	Original	(A)	(B)	(C)
Pain in the last 12 months	0.03 [-0.02, 0.07]	0.02 [-0.004, 0.05]	0.04 [-0.01, 0.09]	0.05 [-0.09, 0.19]
Neither	***0.37 [0.31, 0.43]***	***0.38 [0.32, 0.44]***	***0.35 [0.21, 0.48]***	**0.37 [0.04, 0.69]**
No Physical Support	**0.15 [0.04, 0.27]**	***0.15 [0.03, 0.27]***	**0.33 [0.02, 0.65]**	0.05 [-0.48, 0.57]
No Emotional Support	***0.19 [0.11, 0.27]***	***0.21 [0.13, 0.28]***	***0.21 [0.09, 0.34]***	0.13 [-0.25, 0.51]

Notes: This multiple linear regression also controls for Census Region and Employer, Standard Errors are clustered by employer and state. **Statistically Significant at the 5% level, *Statistically Significant at the 1% level***
(A) Controlling for use of "relaxing" drugs and alcohol (N=32603, 13 Employers)
(B) Employer with Dependents Sample: Employees-Only (N=11368, 1 Employer)
(C) Employer with Dependents Sample: Dependents Only (N=1826, 1 Employer)

Table 33. Sensitivity Analyses of the Association between Health-Related Employer Support and Self-Rated Relative Productivity, Controlling for Pain (cont'd)

	Original	(D)	(E)	(F)
Pain in the last 12 months	0.03 [-0.02, 0.07]	0.03 [-0.02, 0.07]	0.03 [-0.02, 0.08]	0.03 [-0.02, 0.07]
Neither	***0.37 [0.31, 0.43]***	***0.37 [0.31, 0.43]***	***0.42 [0.36, 0.48]***	***1.15 [0.41, 1.89]***
No Physical Support	**0.15 [0.04, 0.27]**	0.16 [-0.005, 0.33]	**0.17 [0.05, 0.29]**	1.12 [-0.72, 3.00]
No Emotional Support	***0.19 [0.11, 0.27]***	***0.20 [0.12, 0.28]***	***0.24 [0.16, 0.31]***	-0.56 [-1.35, 0.24]

Notes: This multiple linear regression also controls for Census Region and Employer, Standard Errors are clustered by employer and state. **Statistically Significant at the 5% level, *Statistically Significant at the 1% level***
(D) Health-Related Employer Support: "Don't know" coded as "No" (N=34359, 14 Employers)
(E) Not controlling for "trusting and open environment" (N=34359, 14 Employers)
(F) Health-Related Employer Support: measured by employer-state averages (N=34359, 14 Employers)

Table 33. Sensitivity Analyses of the Association between Health-Related Employer Support and Self-Rated Relative Productivity, Controlling for Pain (cont'd)

	Original	(G)	(H)
Pain in the last 12 months	0.03 [-0.02, 0.07]	0.02 [-0.06, 0.09]	0.03 [-0.02, 0.08]
Neither	***0.37 [0.31, 0.43]***	***0.37 [0.30, 0.44]***	***0.37 [0.25, 0.49]***
No Physical Support	**0.15 [0.04, 0.27]**	0.09 [-0.05, 0.24]	0.26 [-0.03, 0.55]
No Emotional Support	***0.19 [0.11, 0.27]***	***0.17 [0.10, 0.25]***	***0.23 [0.11, 0.35]***

Notes: This multiple linear regression also controls for Census Region and Employer, Standard Errors are clustered by employer and state. **Statistically Significant at the 5% level, *Statistically Significant at the 1% level***
(G) Men only (N=17614, 14 Employers)
(H) Women only (N=16745, 14 Employers)

Table 33.1 Sensitivity Analyses of the Association between Health-Related Employer Support and Self-Rated Relative Productivity, Controlling for Pain (cont'd).

	Original	Health-Related Employer Support: "don't know" coded as "don't know"
Pain in the last 12 months	0.03 [-0.02, 0.07]	0.03 [-0.02, 0.07]
Neither	***0.37 [0.31, 0.43]***	***0.37 [0.30, 0.43]***
No Physical Support	**0.15 [0.04, 0.27]**	0.11 [-0.05, 0.27]
No Emotional Support	***0.19 [0.11, 0.27]***	***0.17 [0.09, 0.23]***
Physical, Don't Know Emotional	NA	0.03 [-0.02, 0.07]
No Physical, Don't Know Emotional	NA	0.13 [-0.006, 0.28]
Don't Know Physical, Emotional	NA	-0.02 [-0.11, 0.07]
Don't Know Physical, No Emotional	NA	***0.25 [0.16, 0.33]***

Notes: This regression also controls for Census Region and Employer, Standard Errors are clustered by employer and state. **Statistically Significant at the 5% level, Statistically Significant at the 1% level** (N=34359, 14 employers)

Table 34. Results of the Analysis of the Association between Heath-related Employer Support and Future Medical Expenditures, Controlling for Pain (N=1584, N=1469 in 2nd part)

Variable	Percentage Point Difference in the Probability of Having Any Expenditure [95% CI]	Change in Expected Expenditures Conditional on Having > Zero [95% CI]	Unconditional Change in Expected Expenditures [95% CI]
Pain	***0.06***	**$2,535**	**$2,618**
	[0.04, 0.09]	**[$233, $4,837]**	**[$460, $4,777]**
Health-related Employer Support (Both is reference)			
Neither	-0.003	-$1,474	-$1,378
	[-0.06, 0.05]	[-$6,012, $3,064]	[-$5,582, $2,825]
No Physical Support	-0.07	-$2,862	-$2,857
	[-0.19, 0.05]	[-$8,485, $2,761]	[-$7,911, $2,197]
No Emotional Support	0.03	-$3,153	-$2,855
	[-0.02, 0.07]	[-$6,312, $5]	[-$5,814, $104]
Does not learn new things	-0.01	-$381	-$382
	[-0.05, 0.03]	[-$3,694, $2,931]	[-$3,451, $2,686]
Does not have fun	0.004	-$888	-$809
	[-0.03, 0.04]	[-$3,982, $2,206]	[-$3,683, $2,064]
Does not have enough resources	-0.02	-$1,795	-$1,737
	[-0.07, 0.03]	[-$5,210, $1,620]	[-$4,883, $1,410]
Job Insecurity	0.03	-$710	-$553
	[-0.01, 0.07]	[-$4,579, $3,160]	[-$4,185, $3,079]
Unsatisfied	0.02	-$1,264	-$1,103
	[-0.04, 0.08]	[-$5,844, $3,316]	[-$5,390, $3,184]
Does not get to use strengths	-0.03	$3,981	$3,529
	[-0.07, 0.01]	[-$759, $8,721]	[-$821, $7,879]
Not trusting and open environment	-0.02	$1,266	$1,076
	[-0.06, 0.02]	[-$2,151, $4,682]	[-$2,061, $4,212]
Typical Hours Worked	-0.00004	$20	$18
	[-0.001, 0.001]	[-$107, $147]	[-$100, $136]
Charlson Index Score ≥1	***0.08***	***$13,073***	***$13,034***
	[0.06, 0.10]	***[$8,213, $17,932]***	***[$8,291, $17,777]***
Asthma	-0.001	***-$3,968***	***-$3,682***
	[-0.04, 0.04]	***[-$6,468, -$1,468]***	***[-$6,000, -$1,363]***
Depression	***0.05***	***$5,991***	**$5,852**
	[0.02, 0.08]	***[$1,286, $10,696]***	**[$1,392, $10,311]**
High Blood Pressure	***0.04***	-$186	-$11
	[0.01, 0.07]	[-$2,970, $2,599]	[-$2,627, $2,604]
High Cholesterol	***0.04***	-$144	$17
	[0.01, 0.07]	[-$2,936, $2,648]	[-$2,602, $2,636]
Smoking Status	-0.04	-$1,845	-$1,844
	[-0.09, 0.01]	[-$4,933, $1,244]	[-$4,674, $985]
Male	***-0.09***	**-$2,972**	***-$3,126***
	[-0.12, -0.06]	**[-$5,241, -$703]**	***[-$5,231, -$1,020]***
Age (years)	0.0005	$117	$110

	[-0.001, 0.002]	[-$9, $242]	[-$7, $227]
BMI	0.001	$54	$54
	[-0.001, 0.004]	[-$142, $249]	[-$127, $235]
Emotional Health Index 10 point scale	0.002	-$346	-$312
	[-0.004, 0.01]	[-$956, $265]	[-$878, $254]
Health Status 10pt scale	0.001	$19	$21
	[-0.01, 0.01]	[-$794, $833]	[-$734, $776]
Health Insurance Type (PPO is reference)			
HMO - gatekeeper	-0.02	-$424	-$451
	[-0.06, 0.03]	[-$3,377, $2,530]	[-$3,185, $2,284]
HMO - POS or Open Access	-0.01	$883	$781
	[-0.06, 0.04]	[-$2,767, $4,533]	[-$2,608, $4,170]
Indemnity/HAS	-0.04	$7,686	$6,843
	[-0.13, 0.05]	[-$4,002, $19,375]	[-$3,831, $17,517]
Income (Up to $2,999 is reference)			
$3,000 to $3,999	-0.03	$426	$295
	[-0.08, 0.02]	[-$3,720, $4,571]	[-$3,550, $4,141]
$4,000 to $4,999	-0.03	-$1,174	-$1,204
	[-0.08, 0.01]	[-$5,100, $2,752]	[-$4,852, $2,445]
$5,000 to $7,499	-0.03	$1,985	$1,742
	[-0.07, 0.02]	[-$2,288, $6,258]	[-$2,238, $5,722]
$7,500 to $9,999	-0.01	-$1,823	-$1,738
	[-0.06, 0.04]	[-$5,836, $2,191]	[-$5,484, $2,008]
$10,000 and over	-0.02	$663	$530
	[-0.08, 0.03]	[-$3,745, $5,070]	[-$3,582, $4,642]
Spouse/Partner	0.01	$1,525	$1,438
	[-0.03, 0.04]	[-$1,407, $4,456]	[-$1,284, $4,161]
Number of Children under 18	0.01	-$914	-$820
	[-0.01, 0.02]	[-$2,148, $320]	[-$1,965, $325]

Note: This regression also controlled for the number of hospital beds per 1,000 pop; Active Medical Specialty Physicians (excluding GIM, Pediatrics & Psychiatry) per 10,000 pop; Active Family, General, General Internal Medicine, and Pediatric physicians per 10,000 pop; Active Psychiatry Specialty Physicians per 10,000 pop; and Census Region. The results are for a two-part model of future medical expenditures. The first part of the model uses a logit regression with the dependent variable equal to one if there were any expenditure. The second part of the model is a GLM (Gamma and log-link). The third column presents the results of the combined model. Average Marginal Effects are reported in columns. Confidence Intervals were estimated using a first-order Taylor series expansion. **Statistically Significant at the 5% level, *Statistically Significant at the 1% level***

Table 35. Sensitivity Analyses of the Two-Part Model Estimates of the Association between Health-Related Employer Support and Future Medical Expenditures, Controlling for Pain

		Original	(A)	(B)
Pain in the last 12 months	Risk Difference	**0.06 [0.04, 0.09]**	**0.05 [0.03, 0.08]**	**0.06 [0.04, 0.09]**
	Conditional Margin	*$2,535 [$233, $4,837]*	$3,514 [-$1,241, $8,269]	*$2,549 [$246, $4,851]*
	Unconditional Margin	*$2,618 [$460, $4,777]*	$3,448 [-$992, $7,888]	*$2,625 [$467, $4,783]*
Neither	Risk Difference	-0.003 [-0.06, 0.05]	-0.002 [-0.06, 0.06]	-0.01 [-0.06, 0.05]
	Conditional Margin	-$1,474 [-$6,012, $3,064]	-$4,035 [-$11,482, $3,413]	-$1,187 [-$5,771, $3,397]
	Unconditional Margin	$1,378 [-$5,582, $2,825]	-$3,764 [-$10,704, $3,175]	-$1,121 [-$5,364, $3,122]
No Physical Support	Risk Difference	-0.07 [-0.19, 0.05]	-0.07 [-0.18, 0.04]	-0.07 [-0.19, 0.05]
	Conditional Margin	-$2,862 [-$8,485, $2,761]	-$5,034 [-$15,085, $5,017]	-$2,793 [-$8,421, $2,834]
	Unconditional Margin	-$2,857 [-$7,911, $2,197]	-$4,844 [-$14,087, $4,400]	-$2,796 [-$7,854, $2,263]
No Emotional Support	Risk Difference	0.03 [-0.02, 0.07]	0.01 [-0.05, 0.06]	0.02 [-0.02, 0.07]
	Conditional Margin	-$3,153 [-$6,312, $5]	-$6,401 [-$13,027, $225]	-$2,944 [-$6,098, $210]
	Unconditional Margin	-$2,855 [-$5,814, $104]	-$5,954 [-$12,134, $226]	-$2,669 [-$5,621, $284]

Note: Risk Difference = Percentage Point Change in the Probability of Having Any Expenditure; Conditional Margin = Change in Expected Expenditures Conditional on Having > Zero; Unconditional Margin = Unconditional Change in Expected Expenditures. The results are for a two-part model of future medical expenditures. The first part of the model uses a logit regression with the dependent variable equal to one if there were any expenditures. The second part of the model is a GLM (Gamma and log-link). Confidence Intervals were estimated using a first-order Taylor series expansion. **Statistically Significant at the 1% level.** *Statistically Significant at the 5% level.*
(A) Controlling for previous medical expenditures (N=1371 1st part, N=1289 2nd part, 1 employer)
(B) Not controlling for "open and trusting environment" (N=1584 1st part, N=1469 2nd part, 1 employer)

Table 35. Sensitivity Analyses of the Two-Part Model Estimates of the Association between Health-Related Employer Support and Future Medical Expenditures Controlling for Pain (cont'd)

		Original	(C)
Pain in the last 12 months	Risk Difference	***0.06*** ***[0.04, 0.09]***	**0.08** **[0.06, 0.10]**
	Conditional Margin	**$2,535** **[$233, $4,837]**	**$1,182** **[$652, $1,713]**
	Unconditional Margin	**$2,618** **[$460, $4,777]**	**$1,013** **[$654, $1,372]**
Neither	Risk Difference	-0.003 [-0.06, 0.05]	-0.001 [-0.05, 0.05]
	Conditional Margin	-$1,474 [-$6,012, $3,064]	$97 [-$906, $1,101]
	Unconditional Margin	$1,378 [-$5,582, $2,825]	$61 [-$605, $728]
No Physical Support	Risk Difference	-0.07 [-0.19, 0.05]	-0.03 [-0.15, 0.09]
	Conditional Margin	-$2,862 [-$8,485, $2,761]	$193 [-$1,746, $2,133]
	Unconditional Margin	-$2,857 [-$7,911, $2,197]	$27 [-$1,233, $1,286]
No Emotional Support	Risk Difference	0.03 [-0.02, 0.07]	-0.003 [-0.06, 0.05]
	Conditional Margin	-$3,153 [-$6,312, $5]	$47 [-$1,179, $1,274]
	Unconditional Margin	-$2,855 [-$5,814, $104]	$22 [-$775, $818]

Note: The results are for a two-part model of future medical expenditures. The first part of the model uses a logit regression with the dependent variable equal to one if there were any expenditures. The second part of the model is a GLM (Gamma and log-link). Average Marginal Effects are reported in columns. Confidence Intervals were estimated using a first-order Taylor series expansion.
Statistically Significant at the 5% level, ***Statistically Significant at the 1% level***
(C) Expanded Sample with less strict eligibility requirements (N=9767 1st part, N=6176 2nd part, 2 employers)

Table 35. Sensitivity Analyses of the Two-Part Model Estimates of the Association between Health-Related Employer Support and Future Medical Expenditures Controlling for Pain (cont'd)

		Original	(D)	(E)
Pain in the last 12 months	Risk Difference	***0.06 [0.04, 0.09]***	***0.11 [0.06, 0.16]***	***0.03 [0.005, 0.05]***
	Conditional Margin	**$2,535 [$233, $4,837]**	$1,645 [-$1,100, $4,391]	**$4,311 [$1,324, $7,297]**
	Unconditional Margin	**$2,618 [$460, $4,777]**	$1,812 [-$607, $4,231]	***$4,339 [$1,428, $7,249]***
Neither	Risk Difference	-0.003 [-0.06, 0.05]	0.03 [-0.08, 0.14]	-0.01 [-0.07, 0.05]
	Conditional Margin	-$1,474 [-$6,012, $3,064]	-$900 [-$6,274, $4,473]	-$2,661 [-$8,119, $2,796]
	Unconditional Margin	$1,378 [-$5,582, $2,825]	-$703 [-$5,422, $4,015]	-$2,627 [-$7,898, $2,645]
No Physical Support	Risk Difference	-0.07 [-0.19, 0.05]	-0.09 [-0.30, 0.12]	-0.06 [-0.21, 0.10]
	Conditional Margin	-$2,862 [-$8,485, $2,761]	-$4,179 [-$8,783, $426]	-$2,146 [-$10,858, $6,565]
	Unconditional Margin	-$2,857 [-$7,911, $2,197]	-$3,768 [-$7,621, $86]	-$2,325 [-$10,555, $5,904]
No Emotional Support	Risk Difference	0.03 [-0.02, 0.07]	0.07 [-0.01, 0.16]	0.01 [-0.03, 0.04]
	Conditional Margin	-$3,153 [-$6,312, $5]	-$1,678 [-$6,175, $2,820]	**-$4,090 [-$7,894, -$286]**
	Unconditional Margin	-$2,855 [-$5,814, $104]	-$1,266 [-$5,291, $2,759]	**-$3,950 [-$7,649, $250]**

Note: The results are for a two-part model of future medical expenditures. The first part of the model uses a logit regression with the dependent variable equal to one if there were any expenditures. The second part of the model is a GLM (Gamma and log-link). Average Marginal Effects are reported in columns. Confidence Intervals were estimated using a first-order Taylor series expansion. **Statistically Significant at the 5% level**, ***Statistically Significant at the 1% level***

(D) Men only (N=655 1st part, N=570 2nd part)

(E) Women Only (N=927 1st part, N=899 2nd part)

Table 36. Expectations for Analysis of Sick Days with Bootstrapped 95% Confidence Intervals

	Estimate	Bias	Standard Error	Bias-corrected adjusted 95% Confidence Interval
Effect of Pain on Sick Days when Neither Type of Support is Present - Effect of Pain on Sick Days with Both Types of Support are Present	-0.02	0.00	0.06	[-0.14, 0.09]
Effect of Pain on Sick Days when No Physical Support is Present - Effect of Pain on Sick Days with Both Types of Support are Present	-0.12	0.00	0.14	[-0.47, 0.11]
Effect of Pain on Sick Days when No Emotional Support is Present - Effect of Pain on Sick Days with Both Types of Support are Present	-0.01	0.00	0.06	[-0.13, 0.11]
Effect of Pain on Sick Days with Both Types of Support are Present	0.21	0.00	0.02	[0.16, 0.26]
Effect of Pain on Sick Days when Neither Type of Support is Present	0.19	0.00	0.05	[0.08, 0.30]
Effect of Pain on Sick Days when No Physical Support is Present	0.09	0.00	0.14	[-0.26, 0.32]
Effect of Pain on Sick Days when No Emotional Support is Present	0.20	0.00	0.06	[0.09, 0.31]
E[SickDays|Pain=1, NoSupport=0, NoPhysicalSupport=0, NoEmotionalSupport=0, X]	0.58	0.00	0.02	[0.54, 0.62]
E[SickDays|Pain=0, NoSupport=0, NoPhysicalSupport=0, NoEmotionalSupport=0, X]	0.37	0.00	0.01	[0.34, 0.40]
E[SickDays|Pain=1, NoSupport=1, NoPhysicalSupport=0, NoEmotionalSupport=0, X]	0.55	0.00	0.04	[0.48, 0.65]
E[SickDays|Pain=0, NoSupport=1, NoPhysicalSupport=0, NoEmotionalSupport=0, X]	0.36	0.00	0.03	[0.30, 0.44]
E[Sick Days|Pain=1, NoSupport=0, NoPhysicalSupport=1, NoEmotionalSupport=0, X]	0.49	0.00	0.09	[0.33, 0.68]
E[SickDays|Pain=0, NoSupport=0, NoPhysicalSupport=1, NoEmotionalSupport=0, X]	0.40	0.00	0.10	[0.25, 0.67]
E[SickDays|Pain=1, NoSupport=0, NoPhysicalSupport=0, NoEmotionalSupport=1, X]	0.63	0.00	0.04	[0.55, 0.71]
E[SickDays|Pain=0, NoSupport=0, NoPhysicalSupport=0, NoEmotional Support=1, X]	0.43	0.00	0.04	[0.36, 0.51]

Table 37. Expectations for Analysis of Future Medical Expenditures with Bootstrapped 95% Confidence Intervals

	Estimate	Bias	Standard Error	Bias-corrected adjusted 95% Confidence Interval
Effect of Pain on Future Medical Expenditures when Neither Type of Support is Present - Effect of Pain on Future Medical Expenditures with Both Types of Support are Present	$1,459	-$779	$3,187	[-$3548, $10059]
Effect of Pain on Future Medical Expenditures when No Physical Support is Present - Effect of Pain on Future Medical Expenditures with Both Types of Support are Present	$39	-$483	$3,370	[-$5935, $6186]
Effect of Pain on Future Medical Expenditures when No Emotional Support is Present - Effect of Pain on Future Medical Expenditures with Both Types of Support are Present	$1,162	-$345	$1,817	[-$1,739, $5,796]
Effect of Pain on Future Medical Expenditures with Both Types of Support are Present	$2,328	$271	$1,162	[$106, $4,548]
Effect of Pain on Future Medical Expenditures when Neither Type of Support is Present	$3,787	-$508	$3,085	[-$1,187, $11,229]
Effect of Pain on Future Medical Expenditures when No Physical Support is Present	$2,367	-$212	$3,214	[-$3,138, $9,584]
Effect of Pain on Future Medical Expenditures when No Emotional Support is Present	$3,490	-$74	$1,590	[$918, $7,316]
E[FutureMedicalExpenditures | Pain=1, NoSupport=0, NoPhysicalSupport=0, NoEmotionalSupport=0, X]	$9,416	-$388	$1,734	[$4,845, $11,564]
E[FutureMedicalExpenditures | Pain=0, NoSupport=0, NoPhysicalSupport=0, NoEmotionalSupport=0, X]	$7,088	-$659	$1,397	[$5,106, $10,471]
E[FutureMedicalExpenditures | Pain=1, NoSupport=1, NoPhysicalSupport=0, NoEmotionalSupport=0, X]	$9,152	-$512	$2,945	[$4,691, $16,620]
E[FutureMedicalExpenditures | Pain=0, NoSupport=1, NoPhysicalSupport=0, NoEmotionalSupport=0, X]	$5,365	-$4	$2,021	[$2,337, $10,705]

E[FutureMedicalExpenditures | Pain=1, NoSupport=0, NoPhysicalSupport=1, NoEmotionalSupport=0, X]	$7,405	-$391	$2,537	[$3,612, $15,653]
E[FutureMedicalExpenditures | Pain=0, NoSupport=0, NoPhysicalSupport=1, NoEmotionalSupport=0, X]	$5,037	-$178	$2,468	[$1,601, $12,636]
E[FutureMedicalExpenditures | Pain=1, NoSupport=0, NoPhysicalSupport=0, NoEmotionalSupport=1, X]	$7,102	-$137	$1,760	[$3,437, $10,334]
E[FutureMedicalExpenditures | Pain=0, NoSupport=0, NoPhysicalSupport=0, NoEmotionalSupport=1, X]	$3,612	-$62	$968	[$1,745, $5,695]

Appendix 1. Employer with Dependents (EWD) Sample

Figure 1. Sample Flowchart for Employer with Dependents Sample

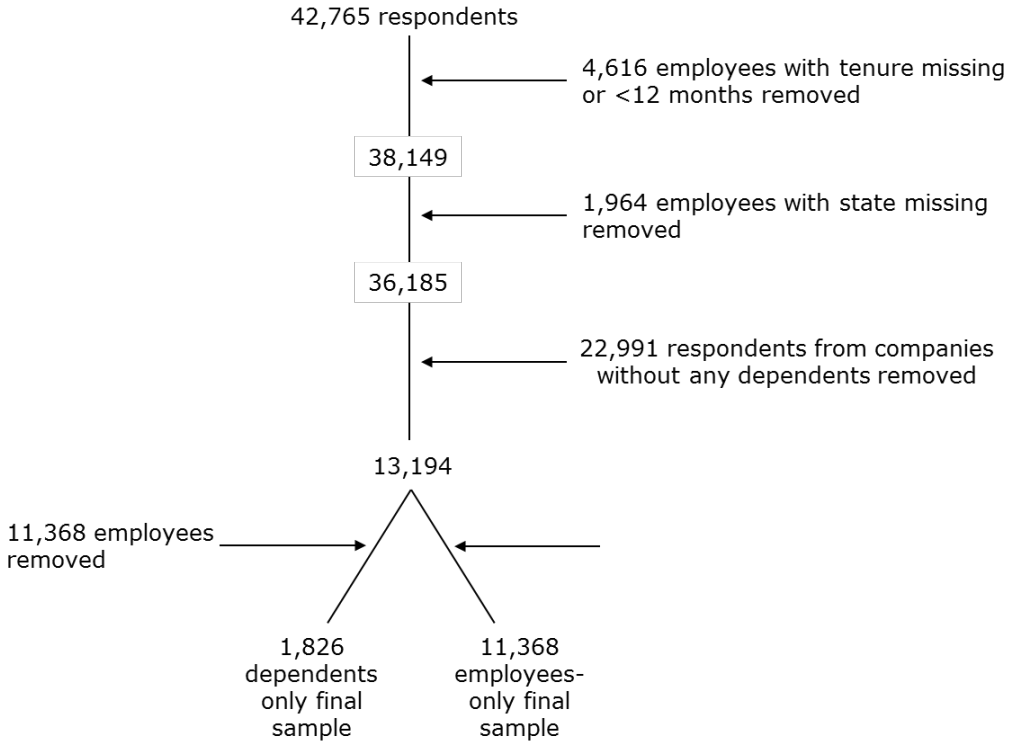


Table 2. Descriptive Statistics for the Employer with Dependents Sample

	Employees	**Dependents**
Dependent Variables	Mean or Percent (Standard Deviation)	Mean or Percent (Standard Deviation)
Number of days missed for health reasons in the past 28	0.60 (3.57)	0.87 (6.92)
Own Productivity Rating	8.43 (1.22)	8.73 (1.17)
Rating of Usual Worker Productivity	7.51 (1.40)	7.60 (1.50)
Own-Usual	0.92 (1.42)	1.12 (1.50)
Recurring Pain in the last 12 months	42.03%	39.49%
Predictors		
Health-related Employer Support[1]		
Both Physical & Emotional	63.68%	64.24%
Neither Physical or Emotional	17.37%	22.23%
Physical Only	16.52%	10.08%
Emotional Only	2.43%	3045.00%
Unsatisfied with job	18.26%	14.58%
Do not use strengths every day	22.54%	16.12%
Supervisor does not create a trusting and open environment	16.21%	23.52%
Tenure on the Job	13.13 (10.09)	8.24 (8.03)
Number of Children under 18	0.81 (1.13)	0.98 (1.07)
Provides informal care	17.06%	13.08%
Married/Partner	66.91%	97.62%
Current Smoker	8.09%	7.35%
Exercise in past week		
0 times	22.19%	22.19%
1 or 2 times	28.86%	28.86%
3 or more time	48.96%	48.96%
AMI (ever told)	0.53%	1.04%
Asthma (ever told)	9.14%	8.27%
Cancer (ever told)	3.71%	3.89%
Depression (ever told)	12.57%	9.31%
Diabetes (ever told)	5.60%	5.59%
High Blood Pressure (ever told)	21.99%	20.70%
High Cholesterol (ever told)	22.63%	21.91%
Age	43.86 (10.36)	45.69 (10.05)
BMI	28.54 (6.79)	27.46 (5.69)
Emotional Health Index	7.56 (2.72)	8.17 (2.35)
Health Ladder	7.59 (4.29)	8.14 (5.39)
Can count on family/friends if in trouble	96.27%	97.33%

Male	35.71%	54.87%
Highest level of completed education		
Less than high school diploma	16.26%	6.90%
High school degree or diploma	11.13%	15.55%
Technical/vocational school	6.67%	5.97%
Some college	24.59%	24.10%
College graduate	29.39%	31.82%
Post graduate work or degree	10.48%	13.75%

Notes: This table gives the descriptive statistics for the analyses using productivity at work and pain as outcomes for the sensitivity from one employer that had dependents take surveys.
[1] Totals do not sum to 100 because some individual reported values for only 1 question. 13.28% reported an answer for physical but not emotional, 5.61% did the reverse, and 12.88% did not report either answer.

Appendix 2. Expanded Medical Expenditures Sample

Figure 1. Sample Flowchart for Expanded Medical Expenditures Sample

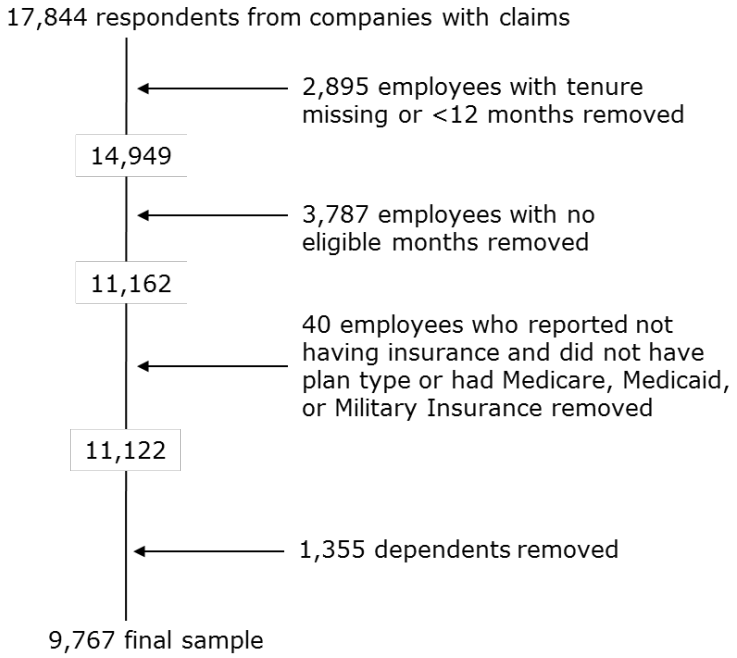


Table 2. Descriptive Statistics for Expanded Medical Expenditures Sample

Characteristic	Mean (SD) or Percent[3]
Dependent Variable	
Aggregate Medical Expenditures $	$2,769 ($14,921)
Predictors	
Health-related Employer Support[4]	
Physical & Emotional	66.36%
Neither Physical nor Emotional	4.56%
Emotional Only	0.97%
Physical Only	5.90%
Unsatisfied with job	15.99%
Do not use strengths every day	21.37%
Supervisor does not create a trusting and open environment	16.89%
Men	36.77%
Pain	42.01%
Age (years)	44.40 (10.53)
Current Smoker	9.20%
BMI	28.53 (6.74)
Charlson Comorbidity Index Score	0.22 (0.78)
Asthma (ever told)	10.00%
Depression (ever told)	13.62%
High Blood Pressure (ever told)	23.02%
High Cholesterol (ever told)	23.63%
Emotional Health Index	7.75 (2.65)
Health Ladder	7.75 (3.96)
Monthly Household Income	
$0 to $1,999	7.22%
$2,000 to $2,999	9.95%
$3,000 to $3,999	9.74%
$4,000 to $4,999	9.79%
$5,000 to $7,499	16.79%
$7,500 to $9,999	10.31%
$10,000 and over	14.12%
Spouse or Partner	66.90%
Number of Children under 18 in household	0.78 (1.50)
Health Insurance Type	
PPO	92.99%
HMO-Gate Keeper	3.78%
HMO-Open Access or POS	6.3%

[3] Totals may not sum to 100% because of missing data.
[4] Totals do not sum to 100 because some individual reported values for only 1 question.

Indemnity	0.71%
Census Region	
Midwest	41.47%
Northeast	13.20%
South	38.34%
West	6.99%
Health System – state level	
Hospital Beds per 1,000 population	2.96 (0.68)
Active Family, General, General Internal Medicine, and Pediatric physicians per 10,000 population	5.14 (1.83)
Active Medical & Surgical Specialty Physicians per 10,000 population (excluding GIM, Pediatrics, & Psychiatry)	13.97 (2.85)
Active Psychiatry Physicians per 10,000 population	1.12 (0.05)

Appendix 3. Regression Estimates for Sick Days Model

Table 1. Regression Results of the Two-Part Model of the Association between Heath-related Employer Support and Sick Days, Controlling for Pain

Variable	Dependent Variable = Any Sick Days	Dependent Variable = Number of Sick Days given at least one
	Coefficient [95% Confidence Interval]	Coefficient [95% Confidence Interval]
Pain	***0.37***	***0.16***
	[0.31, 0.42]	***[0.12,0.19]***
Health-related Employer Support (Both is reference)		
Neither	0.03	-0.02
	[-0.07, 0.14]	[-0.10,0.06]
No Physical Support	-0.02	0.12
	[-0.25, 0.21]	[-0.10,0.34]
No Emotional Support	0.07	0.03
	[-0.06, 0.20]	[-0.10,0.15]
Unsatisfied	0.07	0.01
	[-0.02, 0.16]	[-0.06,0.07]
Does not get to use strengths	0.10	-0.01
	[0.03, 0.18]	[-0.06,0.04]
Not trusting and open environment	0.02	***0.09***
	[-0.06, 0.10]	***[0.04,0.14]***
Tenure on the Job (years)	***-0.01***	***-0.003***
	[-0.01, 0.00]	***[-0.005,-0.001]***
Number of Children under 18	0.02	-0.01
	[-0.01, 0.04]	[-0.02,0.004]
Provides informal care	**0.10**	0.02
	[0.02, 0.17]	[-0.02,0.06]
Spouse/Partner	***-0.12***	0.02
	[-0.18, -0.06]	[-0.01,0.06]
Exercise in past week (0 times is reference)		
1 or 2 times	-0.07	***-0.12***
	[-0.15, 0.00]	***[-0.17,-0.08]***
3 or more times	***-0.22***	***-0.11***
	[-0.30, -0.15]	***[-0.15,-0.07]***
Current Smoker	***0.21***	**-0.07**
	[0.12, 0.30]	**[-0.12,-0.02]**
AMI	0.21	**0.14**
	[-0.09, 0.50]	**[0.02,0.27]**
Asthma	***0.15***	0.003

	[0.06, 0.24]	[-0.04,0.05]
Cancer	***0.38***	***0.31***
	[0.24, 0.51]	***[0.25,0.37]***
Depression	***0.54***	***0.09***
	[0.46, 0.62]	***[0.05,0.13]***
Diabetes	***0.25***	-0.002
	[0.13, 0.37]	[-0.06,0.06]
High Blood Pressure	0.05	***0.13***
	[-0.03, 0.12]	***[0.10,0.17]***
High Cholesterol	-0.06	-0.03
	[-0.13, 0.01]	[-0.07,0.01]
Age (years)	-0.001	***0.01***
	[-0.005, 0.002]	***[0.01,0.01]***
BMI	***0.01***	-0.0005
	[0.01, 0.02]	[-0.003,0.002]
Emotional Health Index (out of 100)	***-0.001***	0.001
	[-0.02, 0.01]	[-0.01,0.01]
Health Ladder (0 to 10)	***-0.02***	***-0.02***
	[-0.03, -0.01]	***[-0.03,-0.01]***
Highest level of completed education (Less than high school diploma is reference)		
High school degree or diploma	***0.23***	**0.11**
	[0.07, 0.40]	**[0.02,0.20]**
Technical/vocational school	0.03	0.07
	[-0.15, 0.22]	[-0.04,0.17]
Some college	***0.21***	**0.10**
	[0.06, 0.36]	**[0.01,0.18]**
College graduate	0.06	0.03
	[-0.09, 0.20]	[-0.06,0.11]
Post graduate work or degree	-0.12	-0.07
	[-0.29, 0.04]	[-0.16,0.02]
Occupation category (Professional worker is reference)		
Manager, executive, or official	***-0.24***	-0.02
	[-0.33, -0.16]	[-0.07,0.04]
Sales worker	-0.01	-0.01
	[-0.21, 0.19]	[-0.17,0.16]
Clerical or office worker	***0.13***	-0.01
	[0.05, 0.22]	[-0.06,0.03]
Manufacturing or production worker	***-0.19***	***0.24***
	[-0.34, -0.05]	***[0.15,0.33]***
Business owner	**0.32**	0.17
	[0.03, 0.61]	[-0.05,0.38]

Service worker	0.12	**0.13**
	[-0.05, 0.29]	**[0.03,0.23]**
Construction or mining worker	0.16	**0.40**
	[-0.31, 0.63]	**[0.02,0.79]**
Transportation worker	-0.09	0.23
	[-0.52, 0.34]	[-0.15,0.60]
Installation or repair worker	0.29	***0.30***
	[-0.01, 0.58]	***[0.16,0.45]***
Farming, fishing, or forestry worker	0.28	0.03
	[-0.20, 0.77]	[-0.24,0.30]
Other Occupation	0.04	0.06
	[-0.07, 0.15]	[-0.002,0.12]
Constant	***-1.04***	***0.41***
	[-1.31, -0.76]	***[0.26,0.57]***
Notes: This regression also controls for Census Region and Employer. The results are for a two-part model of sick days. The first part of the model uses a logit regression with the dependent variable equal to one if any sick days were reported. The second part of the model is a GLM (Poisson and log-link). **Statistically Significant at the 5% level,** ***Statistically Significant at the 1% level***		

Appendix 4. Regression Estimates of the Future Medical Expenditures Model

Table 1. Regression Results of the Analysis of the Association between Heath-related Employer Support and Future Medical Expenditures, Controlling for Pain

Variable	Dependent Variable = Any Expenditures	Dependent Variable = Level of Expenditures given > $0
	Coefficient [95% Confidence Interval]	Coefficient [95% Confidence Interval]
Pain	***1.18***	**0.30**
	[0.65, 1.71]	**[0.03, 0.57]**
Health-related Employer Support (Both is reference)		
Neither	-0.06	-0.17
	[-1.01, 0.90]	[-0.75, 0.40]
No Physical Support	-0.91	-0.37
	[-2.15, 0.33]	[-1.24, 0.49]
No Emotional Support	0.53	-0.42
	[-0.47, 1.53]	[-0.90, 0.06]
Does not learn new things	-0.13	-0.04
	[-0.76, 0.51]	[-0.44, 0.35]
Does not have fun	0.07	-0.10
	[-0.53, 0.67]	[-0.48, 0.27]
Does not have enough resources	-0.35	-0.22
	[-1.10, 0.41]	[-0.69, 0.24]
Job Insecurity	0.60	-0.09
	[-0.28, 1.48]	[-0.56, 0.39]
Unsatisfied	0.40	-0.16
	[-0.85, 1.65]	[-0.75, 0.44]
Does not get to use strengths	-0.50	0.40
	[-1.10, 0.11]	[-0.01, 0.82]
Not trusting and open environment	-0.37	0.14
	[-0.98, 0.24]	[-0.22, 0.50]
Typical Hours Worked	-0.001	0.002
	[-0.02, 0.02]	[-0.01, 0.02]
Charlson Index Score ≥ 1	***2.85***	***1.29***
	[1.38, 4.33]	***[0.98, 1.60]***
Asthma	-0.02	***-0.53***
	[-0.77, 0.72]	***[-0.89, -0.17]***
Depression	**1.08**	***0.59***
	[0.11, 2.05]	***[0.22, 0.96]***
High Blood Pressure	**0.89**	-0.02
	[0.11, 1.67]	[-0.34, 0.30]
High Cholesterol	**0.81**	-0.02
	[0.08, 1.54]	[-0.34, 0.31]
Smoking Status	-0.60	-0.23

	[-1.21, 0.001]	[-0.65, 0.19]
Male	***-1.56***	**-0.36**
	[-2.04, -1.08]	**[-0.64, -0.08]**
Age (years)	0.01	0.01
	[-0.01, 0.03]	[0.00, 0.03]
BMI	0.02	0.01
	[-0.02, 0.06]	[-0.02, 0.03]
Emotional Health Index 10 point scale	0.04	-0.04
	[-0.08, 0.15]	[-0.11, 0.03]
Health Status 10pt scale	0.01	0.002
	[-0.16, 0.18]	[-0.09, 0.10]
Health Insurance Type (PPO is reference)		
HMO - gatekeeper	-0.26	-0.05
	[-1.04, 0.52]	[-0.42, 0.32]
HMO - POS or Open Access	-0.16	0.10
	[-1.01, 0.69]	[-0.30, 0.50]
Indemnity/HAS	-0.63	0.65
	[-1.83, 0.57]	[-0.09, 1.39]
Income (Up to $2,999 is reference)		
$3,000 to $3,999	-0.50	0.05
	[-1.47, 0.47]	[-0.43, 0.53]
$4,000 to $4,999	-0.61	-0.15
	[-1.49, 0.27]	[-0.65, 0.35]
$5,000 to $7,499	-0.49	0.21
	[-1.34, 0.36]	[-0.24, 0.67]
$7,500 to $9,999	-0.22	-0.24
	[-1.21, 0.76]	[-0.78, 0.30]
$10,000 and over	-0.44	0.08
	[-1.50, 0.62]	[-0.42, 0.57]
Spouse/Partner	0.11	0.18
	[-0.46, 0.68]	[-0.16, 0.51]
Number of Children under 18	0.13	-0.11
	[-0.09, 0.34]	[-0.24, 0.03]

Note: This regression also controlled for the number of hospital beds per 1,000 pop; Active Medical Specialty Physicians (excluding GIM, Pediatrics & Psychiatry) per 10,000 pop; Active Family, General, General Internal Medicine, and Pediatric physicians per 10,000 pop; Active Psychiatry Specialty Physicians per 10,000 pop; and Census Region. The results are for a two-part model of future medical expenditures. The first part of the model uses a logit regression with the dependent variable equal to one if there were any expenditure. The second part of the model is a GLM (Gamma and log-link). **Statistically Significant at the 5% level, *Statistically Significant at the 1% level***

References

1. *Relieving Pain in America, A Blueprint for Transforming Prevention, Care, Education and Research*, C. Committee on Advancing Pain Research, and Education, Editor 2011, Institute of Medicine: Washington DC.
2. Christensen, J.O. and S. Knardahl, *Work and neck pain: a prospective study of psychological, social, and mechanical risk factors.* Pain, 2010. **151**(1): p. 162-73.
3. Smith, M., et al., *Aging baby boomers and the rising cost of chronic back pain: secular trend analysis of longitudinal Medical Expenditures Panel Survey data for years 2000 to 2007.* J Manipulative Physiol Ther, 2013. **36**(1): p. 2-11.
4. Schnall, P., M. Dobson, and E. Rosskam, eds. *Unhealthy Work: Causes, Consequences, Cures*. 2009, Baywood Publishing.
5. State Health Access Data Assistance Center, *State-Level Trends in Employer-Sponsored Health Insurance*, 2011, Robert Wood Johnson Foundation: Princeton, NJ.
6. Mayfield, M., *Health, Wellness, and Employee Assistance: A Holistic Approach to Employee Benefits*, 2011, U.S. Bureau of Labor Statistics: online.
7. Crimmins, T.J. and J. Halberg, *Measuring Success in Creating a "Culture of Health".* Journal of Occupational and Environmental Medicine, 2009. **51**(3): p. 351-355.
8. Baicker, K., D. Cutler, and Z. Song, *Workplace Wellness Programs Can Generate Savings.* Health Affairs, 2010. **29**(2): p. 304-311.
9. Goetzel, R.Z. and R.J. Ozminkowski, *The Health and Cost Benefits of Work Site Health-Promotion Programs.* Annual Review of Public Health, 2008. **29**(1): p. 303-323.
10. *The Research Compendium: The NIOSH Total Worker Health™ Program: Seminal Research Papers 2012* P.H.S. U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Editor 2012: Washington, DC. p. 1-214.
11. Moen, P., et al., *Changing work, changing health: can real work-time flexibility promote health behaviors and well-being?* J Health Soc Behav, 2011. **52**(4): p. 404-29.
12. Siu, A.M., et al., *Work limitations, workplace concerns, and job satisfaction of persons with chronic disease.* Work, 2013.
13. van den Heuvel, S., et al., *Productivity Loss at Work; Health-Related and Work-Related Factors.* Journal of Occupational Rehabilitation, 2010. **20**(3): p. 331-339.
14. Alavinia, S.M., D. Molenaar, and A. Burdorf, *Productivity loss in the workforce: associations with health, work demands, and individual characteristics.* American Journal of Industrial Medicine, 2009. **52**(1): p. 49-56.
15. Lenssinck, M.L., et al., *Consequences of inflammatory arthritis for workplace productivity loss and sick leave: a systematic review.* Ann Rheum Dis, 2013. **72**(4): p. 493-505.
16. Cotton, P. and P.M. Hart, *Occupational Wellbeing and Performance: A Review of Organisational Health Research.* Australian Psychologist, 2003. **38**(2): p. 118-127.
17. Siltaloppi, M., U. Kinnunen, and T. Feldt, *Recovery experiences as moderators between psychosocial work characteristics and occupational well-being.* Work & Stress, 2009. **23**(4): p. 330-348.
18. Baltes, B.B., et al., *Flexible and Compressed Workweek Schedules: A Meta-Analysis of Their Effects on Work-Related Criteria.* Journal of Applied Psychology, 1999. **84**(4): p. 496-513.
19. Rael, E.G., et al., *Sickness absence in the Whitehall II study, London: the role of social support and material problems.* Journal of Epidemiology and Community Health, 1995. **49**(5): p. 474-481.

20. Melchior, M., et al., *Do psychosocial work factors and social relations exert independent effects on sickness absence? A six year prospective study of the GAZEL cohort.* Journal of Epidemiology and Community Health, 2003. **57**(4): p. 285-293.
21. Gary, J., *Attendance Dynamics at Work: The Antecedents and Correlates of Presenteeism, Absenteeism, and Productivity Loss.* Journal of Occupational Health Psychology, 2011. **16**(4): p. 483-500.
22. Burton, W.N., et al., *The Association of Health Risks With On-the-Job Productivity.* Journal of Occupational and Environmental Medicine, 2005. **47**(8): p. 769-777.
23. Johns, G., *Presenteeism in the workplace: A review and research agenda.* Journal of Organizational Behavior, 2010. **31**(4): p. 519-542.
24. Côté, P., et al., *The Burden and Determinants of Neck Pain in Workers: Results of the Bone and Joint Decade 2000–2010 Task Force on Neck Pain and Its Associated Disorders.* European Spine Journal, 2008. **17**(1, Supplement): p. 60-74.
25. Sverke, M., J. Hellgren, and K. Näswall, *No security: A meta-analysis and review of job insecurity and its consequences. .* Journal of Occupational Health Psychology, 2002. **7**(3): p. 242-264.
26. Darr, W. and G. Johns, *Work Strain, Health, and Absenteeism: A Meta-Analysis.* Journal of Occupational Health Psychology, 2008. **13**(4): p. 293–318.
27. Tamers, S.L., et al., *Exploring the role of co-worker social support on health care utilization and sickness absence.* J Occup Environ Med, 2011. **53**(7): p. 751-7.
28. Rothstein, M.A. and H.L. Harrell, *Health risk reduction programs in employer-sponsored health plans: Part I-efficacy.* J Occup Environ Med, 2009. **51**(8): p. 943-50.
29. Nelson, N.A. and R.E. Hughes, *Quantifying relationships between selected work-related risk factors and back pain: A systematic review of objective biomechanical measures and cost-related health outcomes.* International Journal of Industrial Ergonomics, 2009. **39**(1): p. 202-210.
30. Punnett, L. and D.H. Wegman, *Work-related musculoskeletal disorders: the epidemiologic evidence and the debate.* Journal of Electromyography and Kinesiology, 2004. **14**(1): p. 13-23.
31. Hogg-Johnson, S., et al., *The Burden and Determinants of Neck Pain in the General Population: Results of the Bone and Joint Decade 2000–2010 Task Force on Neck Pain and Its Associated Disorders.* Journal of Manipulative and Physiological Therapeutics, 2009. **32**(2, Supplement): p. S46-S60.
32. Janwantanakul, P., et al., *Associations between prevalence of self-reported musculoskeletal symptoms of the spine and biopsychosocial factors among office workers.* J Occup Health, 2009. **51**(2): p. 114-22.
33. Hammig, O., et al., *Work-life conflict and musculoskeletal disorders: a cross-sectional study of an unexplored association.* BMC Musculoskeletal Disorders, 2011. **12**(1): p. 60.
34. Nixon, A.E., et al., *Can work make you sick? A meta-analysis of the relationships between job stressors and physical symptoms.* Work & Stress, 2011. **25**(1): p. 1-22.
35. Hoy, D., et al., *The Epidemiology of low back pain.* Best Practice & Research Clinical Rheumatology, 2010. **24**(6): p. 769-781.
36. Liu, C., P.E. Spector, and L. Shi, *Cross-national job stress: a quantitative and qualitative study.* Journal of Organizational Behavior, 2007. **28**(2): p. 209-239.
37. Haukka, E., et al., *Mental stress and psychosocial factors at work in relation to multiple-site musculoskeletal pain: A longitudinal study of kitchen workers.* European Journal of Pain, 2011. **15**: p. 432-438.
38. Woods, V., *Work-related musculoskeletal health and social support.* Occupational Medicine, 2005. **55**(3): p. 177-189.
39. Uchino, B., *Social Support and Health: A Review of Physiological Processes Potentially Underlying Links to Disease Outcomes.* Journal of Behavioral Medicine, 2006. **29**(4): p. 377-387.

40. Shi, Y., et al., *The association between modifiable well-being risks and productivity: a longitudinal study in pooled employer sample.* J Occup Environ Med, 2013. **55**(4): p. 353-64.
41. Ganster, D.C., M.L. Fox, and D.J. Dwyer, *Explaining employees' health care costs: a prospective examination of stressful job demands, personal control, and physiological reactivity.* J Appl Psychol, 2001. **86**(5): p. 954-64.
42. Allen, H., D. Hubbard, and S. Sullivan, *The burden of pain on employee health and productivity at a major provider of business services.* J Occup Environ Med, 2005. **47**(7): p. 658-70.
43. Goetzel, R.Z., et al., *Health, absence, disability, and presenteeism cost estimates of certain physical and mental health conditions affecting U.S. employers.* J Occup Environ Med, 2004. **46**(4): p. 398-412.
44. Rizzo, J.A., T.A. Abbott, 3rd, and M.L. Berger, *The labor productivity effects of chronic backache in the United States.* Med Care, 1998. **36**(10): p. 1471-88.
45. Van Eerd, D., et al., *The course of work absenteeism involving neck pain: a cohort study of ontario lost-time claimants.* Spine, 2011. **36**(12): p. 977-82.
46. Martin, B.I., et al., *Expenditures and Health Status Among Adults With Back and Neck Problems.* JAMA: The Journal of the American Medical Association, 2008. **299**(6): p. 656-664.
47. Nimgade, A., et al., *Increased expenditures for other health conditions after an incident of low back pain.* Spine, 2010. **35**(7): p. 769-77.
48. Dagenais, S., J. Caro, and S. Haldeman, *A systematic review of low back pain cost of illness studies in the United States and internationally.* The Spine Journal. **8**(1): p. 8-20.
49. Goetzel, R.Z., et al., *The health and productivity cost burden of the "top 10" physical and mental health conditions affecting six large U.S. employers in 1999.* J Occup Environ Med, 2003. **45**(1): p. 5-14.
50. Kessler, R.C., et al., *The effects of rheumatoid arthritis on labor force participation, work performance, and healthcare costs in two workplace samples.* J Occup Environ Med, 2008. **50**(1): p. 88-98.
51. Loeppke, R., et al., *Health and productivity as a business strategy: a multiemployer study.* J Occup Environ Med, 2009. **51**(4): p. 411-28.
52. Dollard, M.F. and A.B. Bakker, *Psychosocial safety climate as a precursor to conducive work environments, psychological health problems, and employee engagement.* Journal of Occupational and Organizational Psychology, 2010. **83**(3): p. 579-599.
53. Böckerman, P. and E. Laukkanen, *Predictors of sickness absence and presenteeism: does the pattern differ by a respondent's health?* J Occup Environ Med, 2010. **52**(3): p. 332-5.
54. Schultz, A.B., C. Chin-Yu, and D.W. Edington, *The Cost and Impact of Health Conditions on Presenteeism to Employers.* PharmacoEconomics, 2009. **27**(5): p. 365-378.
55. Gatchel, R., et al., *Biopsychosocial Approaches to Understanding Chronic Pain and Disability*, in *Handbook of Pain and Palliative Care*, R.J. Moore, Editor 2012, Springer New York. p. 1-16.
56. Karasek, R.A., Jr., *Job Demands, Job Decision Latitude, and Mental Strain: Implications for Job Redesign.* Administrative Science Quarterly, 1979. **24**(2): p. 285-308.
57. Dobson, M. and P. Schnall, *Chapter 7: From Stress to Distress: The impact of Work on Mental Health*, in *Unhealthy Work: Causes, Consequences, Cures*, P. Schnall, M. Dobson, and E. Rosskam, Editors. 2009, Baywood Publishing.
58. Amick, B.C., 3rd, et al., *Relationship of job strain and iso-strain to health status in a cohort of women in the United States.* Scand J Work Environ Health, 1998. **24**(1): p. 54-61.
59. Schnall, P., *UCLA EHS M270/CHS278 Session 2*, 2011.
60. Schnall, P., *UCLA EHS M270/CHS278 Session 3*, 2011.
61. BROWN, A.R. and G.P. MULLEY, *Injuries sustained by caregivers of disabled elderly people.* Age and Ageing, 1997. **26**(1): p. 21-23.

62. Tong, H.C., et al., *Low back pain in adult female caregivers of children with physical disabilities.* Archives of Pediatrics & Adolescent Medicine, 2003. **157**(11): p. 1128-1133.
63. Finkelstein, M.M., *Back pain and parenthood.* Occupational and Environmental Medicine, 1995. **52**: p. 51-53.
64. Brown, J.L., et al., *Social Support and Experimental Pain.* Psychosomatic Medicine, 2003. **65**(2): p. 276-283.
65. Pinquart, M. and S. Sörensen, *Correlates of Physical Health of Informal Caregivers: A Meta-Analysis.* The Journals of Gerontology Series B: Psychological Sciences and Social Sciences, 2007. **62**(2): p. P126-P137.
66. Kehlet, H., T.S. Jensen, and C.J. Woolf, *Persistent postsurgical pain: risk factors and prevention.* The Lancet. **367**(9522): p. 1618-1625.
67. Bair, M.J., et al., *Association of Depression and Anxiety Alone and in Combination With Chronic Musculoskeletal Pain in Primary Care Patients.* Psychosomatic Medicine, 2008. **70**(8): p. 890-897.
68. *Using Alcohol to Relieve Your Pain: What Are the Risks?*, in *U.S. Department of Health and Human Services, National Institutes of Health*, N.I.o.A.A.a. Alcoholism, Editor.
69. Andersen, R.M., *Revisiting the Behavioral Model and Access to Medical Care: Does it Matter?* Journal of Health and Social Behavior, 1995. **36**(1): p. 1-10.
70. Fillingim, R.B., et al., *Sex, Gender, and Pain: A Review of Recent Clinical and Experimental Findings.* The Journal of Pain, 2009. **10**(5): p. 447-485.
71. Cain, K., et al., *Gender Differences in Gastrointestinal, Psychological, and Somatic Symptoms in Irritable Bowel Syndrome.* Digestive Diseases and Sciences, 2009. **54**(7): p. 1542-1549.
72. Li, C.Y., X. Mao, and L. Wei, *Genes and (common) pathways underlying drug addiction.* PLoS Comput Biol, 2008. **4**(1): p. e2.
73. Blundell, R. and T. Macurdy, *Chapter 27 Labor supply: A review of alternative approaches*, in *Handbook of Labor Economics*, C.A. Orley and C. David, Editors. 1999, Elsevier. p. 1559-1695.
74. Card, D., *Chapter 30 The causal effect of education on earnings*, in *Handbook of Labor Economics*, C.A. Orley and C. David, Editors. 1999, Elsevier. p. 1801-1863.
75. Acemoglu, D. and D. Autor, *Chapter 12 - Skills, Tasks and Technologies: Implications for Employment and Earnings*, in *Handbook of Labor Economics*, A. Orley and C. David, Editors. 2011, Elsevier. p. 1043-1171.
76. Almond, D. and J. Currie, *Chapter 15 - Human Capital Development before Age Five*, in *Handbook of Labor Economics*, A. Orley and C. David, Editors. 2011, Elsevier. p. 1315-1486.
77. Cunha, F. and J. Heckman, *The Technology of Skill Formation.* The American Economic Review, 2007. **97**(2): p. 31-47
78. Rosen, S., *Human Capital*, in *The New Palgrave Dictionary of Economics, 2nd Edition*, S.N. Durlauf and L.E. Blume, Editors. 2008, Macmillan: New York.
79. Becker, G.S., *Human Capital: A Theoretical and Empirical Analysis, with Special Reference to Education*. 3rd ed1993, Chicago and London: The University of Chicago Press.
80. Bloom, N. and J. Van Reenen, *Chapter 19 - Human Resource Management and Productivity*, in *Handbook of Labor Economics*, A. Orley and C. David, Editors. 2011, Elsevier. p. 1697-1767.
81. Laaksonen, M., et al., *Work Arrangements, Physical Working Conditions, and Psychosocial Working Conditions as Risk Factors for Sickness Absence: Bayesian Analysis of Prospective Data.* Annals of Epidemiology, 2010. **20**(5): p. 332-338.
82. Rebitzer, J.B. and L.J. Taylor, *Chapter 8 - Extrinsic Rewards and Intrinsic Motives: Standard and Behavioral Approaches to Agency and Labor Markets*, in *Handbook of Labor Economics*, A. Orley and C. David, Editors. 2011, Elsevier. p. 701-772.
83. Harter, J.K., et al. *Q12® Meta-Analysis: The Relationship Between Engagement at Work and Organizational Outcomes*. 2009.

84. Landsbergis, P.A., et al. *Lean Production and Worker Health: A Discussion*. 1998.
85. Pelletier, B., M. Boles, and W. Lynch, *Change in health risks and work productivity over time.* J Occup Environ Med, 2004. **46**(7): p. 746-54.
86. Collins, J.J., et al., *The assessment of chronic health conditions on work performance, absence, and total economic impact for employers.* J Occup Environ Med, 2005. **47**(6): p. 547-57.
87. Munir, F., et al., *Work Factors Related to Psychological and Health-Related Distress Among Employees with Chronic Illnesses.* Journal of Occupational Rehabilitation, 2007. **17**(2): p. 259-277.
88. Andersen, R. and J.F. Newman, *Societal and Individual Determinants of Medical Care Utilization in the United States.* The Milbank Memorial Fund Quarterly. Health and Society, 1973. **51**(1): p. 95-124.
89. Grossman, M., *On the Concept of Health Capital and the Demand for Health.* Journal of Political Economy, 1972. **80**(2): p. 223-255.
90. Muurinen, J.-M., *Demand for health: A generalised Grossman model.* Journal of Health Economics, 1982. **1**(1): p. 5-28.
91. Arrow, K.J., *Uncertainty and the Welfare Economics of Medical Care.* The American Economic Review, 1963. **53**(5): p. 941-973.
92. Rice, T.H. and R.J. Labelle, *Do Physicians Induce Demand for Medical Services?* Journal of Health Politics, Policy and Law, 1989. **14**(3): p. 587-600.
93. Zweifel, P., *Supplier-induced demand in a model of physician behavior*, in *Health, economics, and health economics : proceedings of the World Congress on Health Economics, Leiden, The Netherlands, September 1980*, J.v.d. Gaag and M. Perlman, Editors. 1981, Elsevier North-Holland: North-Holland, Amsterdam. p. 245-267.
94. *The Dartmouth Atlas of Health Care*, 2009.
95. Fuchs, V.R., M. McClellan, and J. Skinner, *Area Differences in Utilization of Medical Care and Mortality Among U.S. Elderly.* National Bureau of Economic Research Working Paper Series, 2001. **No. 8628**(published as published relationship to a non-chapter. This should not happen. Please contact NBER.).
96. *Geographic Variation in Health Care Spending*, 2008, The Congressional Budget Office: Washington DC.
97. Wright, J.G., et al., *Physician enthusiasm as an explanation for area variation in the utilization of knee replacement surgery.* Med Care, 1999. **37**(9): p. 946-56.
98. Cartwright, W.S., T.-w. Hu, and L.-f.J. Huang, *Impact of varying Medigap insurance coverage on the use of medical services of the elderly.* Applied Economics, 1992. **24**(5): p. 529-539.
99. Manning, W.G., et al., *Health Insurance and the Demand for Medical Care: Evidence from a Randomized Experiment.* The American Economic Review, 1987. **77**(3): p. 251-277.
100. Ronald Andersen, T.R., Gerald Kominski, *Changing the U.S. Health Care System*2007, San Francisco: John Wiley & Sons.
101. O'Connor, A.M., H.A. Llewellyn-Thomas, and A.B. Flood, *Modifying Unwarranted Variations In Health Care: Shared Decision Making Using Patient Decision Aids.* Health Affairs, 2004.
102. Baecke, J.A., J. Burema, and J.E. Frijters, *A short questionnaire for the measurement of habitual physical activity in epidemiological studies.* The American Journal of Clinical Nutrition, 1982. **36**(5): p. 936-42.
103. Dejoy, D.M., et al., *Development of the Environmental Assessment Tool (EAT) to measure organizational physical and social support for worksite obesity prevention programs.* J Occup Environ Med, 2008. **50**(2): p. 126-37.

104. Golaszewski, T., D. Barr, and N. Pronk, *Development of Assessment Tools to Measure Organizational Support for Employee Health.* American Journal of Health Behavior, 2003. **27**(1): p. 43-54.
105. Mearns, K., et al., *Investment in workforce health: Exploring the implications for workforce safety climate and commitment.* Accident Analysis & Prevention, 2010. **42**(5): p. 1445-1454.
106. Basen-Engquist, K., et al., *Worksite Health and Safety Climate: Scale Development and Effects of a Health Promotion Intervention.* Preventive Medicine, 1998. **27**(1): p. 111-119.
107. Walker, S.N., K.R. Sechrist, and N.J. Pender, *The Health-Promoting Lifestyle Profile: development and psychometric characteristics.* Nurs Res, 1987. **36**(2): p. 76-81.
108. Perez-Fortis, A., S.M. Ulla Diez, and J.L. Padilla, *Psychometric properties of the Spanish version of the Health-Promoting Lifestyle Profile II.* Res Nurs Health, 2012. **35**(3): p. 301-13.
109. Healthways Inc., *Factor Analysis on WBA*.
110. Poleshuck, E.L., et al., *Psychosocial stress and anxiety in musculoskeletal pain patients with and without depression.* General Hospital Psychiatry, 2009. **31**(2): p. 116-122.
111. Karasek, R., et al., *The Job Content Questionnaire (JCQ): An Instrument for Internationally Comparative Assessments of Psychosocial Job Characteristic.* Journal of Occupational Health Psychology, 1998. **3**(4): p. 322-355.
112. Siegrist, J., et al., *The measurement of effort-reward imbalance at work: European comparisons.* Soc Sci Med, 2004. **58**(8): p. 1483-99.
113. Hurrell, J.J. and M. McLaney, *Exposure to job stress- A new psychometric instrument.* Scand J Work Environ Health, 1988. **14**: p. 27-27.
114. Maslach, C., S. Jackson, and M. Leiter, *Maslach Burnout Inventory Manual*1996, Palo Alto, CA: Consulting Psychologist Press.
115. RM, M., et al., *Evaluation of a Best-Practice Worksite Wellness Program in a Small-Employer Setting Using Selected Well-being Indices.* J Occup Environ Med, 2011. **53**(4): p. 448-454.
116. Gallup-Healthways *Gallup-Healthways Well-Being Index: Methodology Report for Indexes*. 2009.
117. Gallup-Healthways *Gallup-Healthways Well-Being Assessment*. 2008.
118. Stewart, W.F., et al., *Lost productive work time costs from health conditions in the United States: results from the American Productivity Audit.* J Occup Environ Med, 2003. **45**(12): p. 1234-46.
119. Koopman, C., et al., *Stanford Presenteeism Scale: Health Status and Employee Productivity.* Journal of Occupational and Environmental Medicine, 2002. **44**(1): p. 14-20.
120. Brooks, A., et al., *Presenteeism: critical issues.* J Occup Environ Med, 2010. **52**(11): p. 1055-67.
121. Prochaska, J.O., et al., *The well-being assessment for productivity: a well-being approach to presenteeism.* J Occup Environ Med, 2011. **53**(7): p. 735-42.
122. Wynne-Jones, G., et al., *What Happens to Work if you're Unwell? Beliefs and Attitudes of Managers and Employees With Musculoskeletal Pain in a Public Sector Setting.* Journal of Occupational Rehabilitation, 2011. **21**(1): p. 31-42.
123. Biron, M. and P. Bamberger, *Aversive Workplace Conditions and Absenteeism: Taking Referent Group Norms and Supervisor Support Into Account.* Journal of Applied Psychology, 2002. **97**(4): p. 901–912.
124. Crout, L.A., E. Chang, and J. Cioffi, *Why do registered nurses work when ill?* J Nurs Adm, 2005. **35**(1): p. 23-8.
125. Lerner, D., et al., *The Work Limitations Questionnaire.* Medical Care, 2001. **39**(1): p. 72-85.
126. *World Health Organization Health and Work Performance Questionnaire (HPQ)*. 2005 8/15/2011]; Available from: http://www.hcp.med.harvard.edu/hpq/.
127. von Thiele Schwarz, U. and H. Hasson, *Employee self-rated productivity and objective organizational production levels: effects of worksite health interventions involving reduced work hours and physical exercise.* J Occup Environ Med, 2011. **53**(8): p. 838-44.

128. Goetzel, R.Z., et al., *Ten modifiable health risk factors are linked to more than one-fifth of employer-employee health care spending.* Health Aff (Millwood), 2012. **31**(11): p. 2474-84.
129. Gallup-Healthways *Gallup-Healthways Well-Being Index*. 2008.
130. Wooldridge, J.M., *Econometric Analysis of Cross Section and Panel Data*2001, Cambridge: The MIT Press.
131. *Area Resource File (ARF)*, H.R.a.S.A. US Department of Health and Human Services, Bureau of Health Professions, Editor 2011-2012: Rockville, MD.
132. Deyo, R.A., D.C. Cherkin, and M.A. Ciol, *Adapting a clinical comorbidity index for use with ICD-9-CM administrative databases.* J Clin Epidemiol, 1992. **45**(6): p. 613-619.
133. Allison, P.D., *Missing Data*. Quantitative Applications in the Social Sciences Vol. 136. 2001: SAGE Publications, Inc.
134. Graham, J.W., A.E. Olchowski, and T.D. Gilreath, *How many imputations are really needed? Some practical clarifications of multiple imputation theory.* Prev Sci, 2007. **8**(3): p. 206-13.
135. Long, J.S. and J. Freese, *Regression Models for Categorical Data Using Stata, 2nd Edition*2006, College Station, TX: Stata Press.
136. Cameron, A.C. and P.K. Trivedi, *Regression Analysis of Count Data*. Econometric Society Monograph No.301998: Cambridge University Press.
137. Raftery, A.E., *Bayesian model selection in social research*, in *Sociological Methodology*, P.V. Marsden, Editor 1996, Blackwell: Oxford. p. 111-163.
138. Afifi, A.A., et al., *Methods for improving regression analysis for skewed continuous or counted responses.* Annu Rev Public Health, 2007. **28**: p. 95-111.
139. Greene, W.H., *Econometric Analysis*. 4th ed2000, New York: Prentice Hall.
140. StataCorp, *Stata Statistical Software: Release 12*, 2011, StataCorp LP: College Station, TX.
141. StataCorp, *STATA User's Guide Release 11*2009, College Station, TX: Stata Press.
142. Kenny, D.A. *Moderation*. 2011 [cited 09/2011; Available from: http://davidakenny.net/cm/moderation.htm.
143. Baron, R. and D. Kenny, *The Moderator-Mediator Variable Distinction in Social Psychological Research: Conceptual, Strategic, and Statistical Considerations.* J Pers Soc Psychol, 1986. **51**(6): p. 1173 - 1182.
144. Manning, W.G. and J. Mullahy, *Estimating log models: to transform or not to transform?* J Health Econ, 2001. **20**(4): p. 461-94.
145. Mullahy, J., *Econometric Modeling of Health Care Costs and Expenditures: A Survey of Analytical Issues and Related Policy Considerations.* Medical Care, 2009. **47**(7 Suppl. 1): p. S104-S108.
146. Deb, P., W. Manning, and E. Norton, *Preconference Course: Modeling Health Care Costs and Counts*, in *ASHEcon – Minneapolis Conference*2012.
147. Korn, E.L. and B.I. Graubard, *Analysis of health surveys*1999, New York: John Wiley and Sons.
148. Kenny, D.A. *Mediation*. 2011 [cited 09/2011; Available from: http://davidakenny.net/cm/mediate.htm#REF.
149. Preacher, K. and A. Hayes, *Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models.* Behavior Research Methods, 2008. **40**(3): p. 879-891.
150. Hayes, A.F., *Beyond Baron and Kenny: Statistical Mediation Analysis in the New Millennium.* Communication Monographs, 2009. **76**(4): p. 408-420.
151. Sibille, K.T., et al., *Affect balance style, experimental pain sensitivity, and pain-related responses.* Clin J Pain, 2012. **28**(5): p. 410-7.
152. Huyser, B.A. and J.C. Parker, *Negative affect and pain in arthritis.* Rheum Dis Clin North Am, 1999. **25**(1): p. 105-21, vi.

153. Zautra, A.J., L.M. Johnson, and M.C. Davis, *Positive affect as a source of resilience for women in chronic pain.* J Consult Clin Psychol, 2005. **73**(2): p. 212-20.
154. Zautra, A.J., et al., *Arthritis and perceptions of quality of life: an examination of positive and negative affect in rheumatoid arthritis patients.* Health Psychol, 1995. **14**(5): p. 399-408.
155. Smith, J.A., M.A. Lumley, and D.J. Longo, *Contrasting emotional approach coping with passive coping for chronic myofascial pain.* Ann Behav Med, 2002. **24**(4): p. 326-35.
156. Slaughter, J., *Coercive Wellness Programs Create New Headaches*, in *Labor Notes*2013.
157. The National Institute for Occupational Safety and Health. *Total Worker Health*. 11/28/2012 3/21/2013]; Available from: http://www.cdc.gov/niosh/twh/.
158. Schnall, P., M. Dobson, and P. Landsbergis. *Where is Work Organization in Total Worker Health?* in *Work, Stress, and Health*. 2013. Los Angeles, CA.