ABSTRACT

Title of Dissertation:	**ASSESSING IMPACT OF CANCER AND DEPRESSION ON THE FINANCIAL HEALTH OF MIDDLE AGED AND OLDER AMERICANS**
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This dissertation examines the impact of cancer on financial outcomes for individuals aged 50 and older and documents how this relationship varies by sex and race/ethnicity. I then turn to the impact of depression on out-of-pocket medical spending among those with a history of cancer. Findings suggest cancer can have a deleterious effect on the financial outcomes of those who are diagnosed with cancer. Out-of-pocket spending rises in the year of diagnosis, reduced earnings persist beyond diagnosis, and depression increases out-of-pocket spending. I fail to find evidence that the relationship between cancer and financial outcomes is moderated by sex or race-ethnicity.

ASSESSING IMPACT OF CANCER AND DEPRESSION ON THE FINANCIAL HEALTH OF MIDDLE AGED AND OLDER AMERICANS

by

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Chapter 1: Introduction

Aims

There has been substantial innovation in cancer treatment over the last 10 years (American Cancer Society, 2015). Some of these treatments have led to substantial increases in longevity and quality of life. For example, immunotherapy has fewer side effects and better quality of life outcomes compared to chemotherapy (Nagao, Takei, Shimada, Tanigawa, & Suzuki, 2012). However, not all new treatments are effective— innovations like erlotinib (Tarceva®) demonstrate marginal clinical benefit to patients (Hardarce, 2016).

Technological innovation in cancer treatment has also come at large economic costs for patients and payers. In 2010, medical expenditures associated with cancer reached approximately $124.6 billion (Mariotto, Yabroff, Shao, Feuer, & Brown, 2011). Cancer-related medical expenditures for the year 2020 are projected to reach at minimum $158 billion (2010 dollars). These expenditures are driven, in part, by the high unit prices of individual treatments. For example, patients prescribed pralatrexate pay $30,000 per month for the medication (Yabroff, Lund, Kepka, & Mariotto 2011).

Not only does the financing of cancer treatment have societal consequences, but it also has important implications for many individuals and families. Cancer is among the leading causes of illness and mortality in the United States (U.S.) (American Society of Clinical Oncology, 2017). Approximately 33 percent of cancer survivors (aged 18 – 64) incur debt due to treatment, 55 percent have over $10,000 in debt, and 3 percent file for bankruptcy as a result of cancer related expenses

(American Society of Clinical Oncology, 2017). The adverse financial outcomes that result from the cost of cancer treatment have come to be known as financial toxicity (Zafar & Abernethy, 2013).

Adults over the age of 49 comprise the majority of incident cancer cases and thus the financial consequences of cancer treatment are an especially important concern for the elderly and near elderly (SEER Statistics, 2000 – 2015). Older adults are both at greater risk of experiencing financial burdens and the consequence of those burdens is often especially acute. Older adults have unique financial responsibilities. Forty-seven percent of adults in their 40's and 50's have a parent aged 65 or older and are raising or financially supporting a child under 18 – with 15 percent concurrently providing support to a child and an aging parent (Parker & Patten, 2013).

Cancer has also been shown to produce psychologic stresses – due to the physical symptoms and the emotional and mental strains, such as the inability to maintain daily life activities and roles (Smith, 2015; Satin, Linden, & Phillips, 2009; Slovacek, Slovackova, Slanska, Priester, Petera, Kopecky, Vanaskova, 2009). Specifically, depression is common among cancer patients and survivors. The rate of depression among cancer patients averages about three times higher than the general population (Vodermaier, Mackenzie, Greig, 2012). Fifteen to 20 percent of cancer survivors present clinically significant symptoms of psychological disorder (Recklitis & Syrjala, 2017).

While existing research has demonstrated the negative effects of cancer on finances and the relationship between cancer and depression, there is a dearth of research concerning the role the sex and race/ethnicity play in these relationships.

This dissertation evaluates the financial outcomes and depression experiences of cancer patients aged 50 and older, with a particular focus on the moderating influence of race-ethnicity and sex.

The specific aims are:

(1) Measure the impact of cancer diagnosis on a comprehensive set of financial outcomes.

(2) Assess race/ethnicity and sex as moderating factors that influence the relationship between cancer and financial outcomes.

(3) Assess the prevalence of depression among cancer patients, how this prevalence varies by race/ethnicity, and assess the race specific relationship between depression and out-of-pocket expenditures among cancer patients.

Summary of Methods

The aims of this project necessitate data that contain information on individual and household financial indicators, information pertaining to cancer diagnosis and depression, and correlates of financial health (the state of an individual's personal finances) for older adults. Although data, such as the National Institute of Health's Cancer SEER data and the National Health Interview Survey's Cancer Control Supplement, contain detailed information regarding the experiences of those diagnosed with cancer, these sources have insufficient data on financial outcomes.

The best available data for this study is the Health and Retirement Study (HRS). HRS is a longitudinal panel survey of a representative sample of individuals over age 50 in the U.S. The project is conducted by the Survey Research Center (SCR), with the support of the National Institute on Aging (NIA), at the Institute for Social Research (ISR) at the University of Michigan in Ann Arbor. HRS was created with the goal of providing a national data resource on the shifting health and economic conditions associated with aging in America. Importantly, HRS has detailed information on financial assets, income, medical out-of-pocket expenditures, cancer histories, and depression symptoms.

Aim 1 and Aim 2 will use an event study approach to compare outcomes before and after the index cancer diagnosis. Aim 3 will use multivariable regression analyses to compare the experiences of cancer patients with and without depression.

Organization of Chapters

This dissertation is organized into six primary chapters. Chapter 1 has focused on providing a broad overview of the purpose, goals, and methods to be employed throughout.

In Chapter 2, I provide an overview of existing literature. This overview is followed by a description of the conceptual model guiding hypotheses and the analytical approach.

The three empirical chapters (3-5) are comprehensive, describing relevant literature, methods, results, and conclusions. The literature review of these chapters is brief, and I refer readers to Chapter 2 for more details. Chapter 3 will focus on assessing the impact of cancer diagnosis on a comprehensive set of selected financial

outcomes using the Health and Retirement Study. In Chapter 4, I examine if race/ethnic and sex moderate the effect of cancer on financial outcomes. Chapter 5 documents the prevalence of depression among cancer patients, the association of depression and total out-of-pocket spending, and how these patterns vary by race-ethnicity. Lastly, in Chapter 6, I provide a comprehensive summary of my results and provide conclusions, implications, and future directions implied by the findings in Chapters 3 through 5.

Chapter 2: Background and Conceptual Model

Overview

This chapter begins with an overview of the cost of cancer care and the effect of these costs on the patient. Subsequently, I discuss prior literature focused on how a cancer diagnosis can negatively affect an individual's financial well-being along with the role race/ethnicity and sex may have in this effect. Lastly, I discuss the impact of co-existing cancer and depression along with prior literature focused on the moderating effect of race/ethnicity. This is followed by the presentation of the conceptual framework guiding the dissertation.

Background

Novel and enhanced cancer treatment methods continue to be developed, such as immunotherapy or methods involving molecular targeting. Although some interventions have saved and prolonged lives, others return only incremental benefits. Innovation has come with financial strain on patients who have witnessed prices for treatment skyrocket (Zafar et al, 2013). Prior to the year 2000, the average annual price of therapy or treatment, across all cancer treatments was $10,000. By 2005, this number had increased by three to five times with a range between $30,000 and $50,000. By 2012, thirteen new drugs were approved by the Food and Drug Administration (FDA). Twelve of these drugs averaged over $100,000 per year (Light & Kantarjian, 2013).

Not only are cancer-related treatments and services costly, but a substantial portion of the economic burden of cancer care has been shifted to patients (Kumar & Moy, 2013). Many cancer patients are now finding themselves accountable for a

larger share of their care. These costs have meaningful financial impacts on patients. While the magnitude is debated, healthcare-related expenditures were a compelling cause of personal bankruptcy filings prior to the Affordable Care Act (Ramsey Blough, Kirchhoff, Fedorenko, Snell, Kreizenbeck, Newcomb, Hollingworth, & Overstreet 2013; Himmelstein, Thorne, Warren, & Woolhandler, 2009).

Generally, cancer care costs are paid by private (44 percent), and public insurers (Medicare -33 percent; Medicaid - 4 percent; other state or federal insurance - 15 percent). However, these sources often do not fully cover the cost of care – with 4 percent of U.S. expenditures on health coming out of the pockets of patients and their families in poor families and up to 22 percent in higher income families (Gwet & Machlin, 2015). In recent years there has been an increase in enrollments in high-deductible health plans (HDHPs), which require higher cost-sharing requirements (Agarwal, Mazurenko, & Menachemi, 2017).

Additionally, while health insurance covers the cost of medical care it does not replace lost wages. These wages are often not adequately replaced by the social insurance system.

Financial toxicity describes the adverse financial experiences of patients. Financial toxicity is defined as the negative experiences patients endure due to costly medical care (Zafar, 2013). Such experiences often include material hardships when patients reduce spending in other areas of their budgets to accommodate cancer treatment, imperfect adherence to care when they cannot afford treatments, and psychological hardships.

Cancer and Financial Well-being

The broader connection between financial outcomes and the cost of health care services has been well studied. The connection between health care costs and bankruptcy has been an especially contentious issue. In 2005, Elizabeth Warren, now the senior U.S. Senator of Massachusetts, co-authored a paper suggesting that 54 percent of bankruptcies were caused by medical expenses (Himmelstein et al, 2005). While the paper was important for raising the issue of medical bankruptcy, it drew several critiques (Dranove & Millenson, 2006; Mathur, 2006). Its definition of medical bankruptcy was subjective and broad (i.e. those who had a medical expenditure more than $1,000; stated that their illness or injury caused their bankruptcy; missed over two weeks of work due to illness; or mortgaged their home to afford their medical expenses) and potentially overstated the prevalence of the issue. Furthermore, the authors' approach could not be credibly interpreted as identifying the causal relationship between health care utilization and debt.

More recent research has tried to overcome these limitations. Dobkin et al (2017), using an event study approach, found that hospital admissions increased out-of-pocket medical expenses, increased medical bills and bankruptcy, and reduced earnings and income among non-elderly adults with insurance (Dobkin, Finkelstein, Kluender, Notowidigo, 2017). However, results indicated that hospital admissions are a primary cause of bankruptcy for only 4 percent of non-elderly insured adults, 6 percent non-elderly uninsured adults, and utilization did not contribute to bankruptcies among the elderly. While their study used a strong design, it was

limited in its focus to hospital care and the exclusion of other potentially high-cost ambulatory care services (such as a lot of cancer care).

Despite the controversies surrounding the magnitude of the health care and bankruptcy connection, the literature shows that health care costs are a major source of financial instability in families. A clear test of the financial consequences of health care costs comes from studies of Medicaid expansion. Medicaid has little to no cost-sharing. It provides substantial risk-protection for consumers, relative to uninsurance or underinsurance in the private market. The Oregon Health Insurance Experiment, based on a randomized lottery design, found that Medicaid enrollment reduces financial strain (Finklestein, Taubman, Wright, et al 2008). In addition, evaluations of state Medicaid expansions under the 2010 Patient Protection and Affordable Care Act (ACA) suggest that the expansions decreased out-of-pocket medical spending, inability to pay medical bills, and worry concerning payment ability (Sommers, Blendon, Orav, & Epstein, 2016; McMorrow, Gates, Long, & Kenney, 2017). Not only has expansion been found to reduce medical bills, but it has also been shown to prevent new debt delinquencies, reduce the use of payday loans, and result in improved credit scores (Allen, Swanson, Wang, & Gross, 2017; Brevoort, Grodzicki, & Hackmann, 2017).

A smaller, but still insightful set of studies has focused specifically on the financial consequences of cancer. This research has demonstrated that a cancer diagnosis effects an individual or family's financial well-being, both in terms of material hardship (undergoing tangible financial sacrifices or adversities) and

psychological hardship (having mental distress regarding one's ability to financially satisfy substantial medical expenses).

Gupta et al (2017) concluded that cancer diagnoses are "financially destabilizing" – with increases in defaults, foreclosure, and bankruptcy filings – based on linking cancer records to administrative data in Washington State (Gupta, Morrison, Fedorenko, Ramsey, 2017). This destabilizing effect was attributed primarily to the direct and indirect costs of cancer treatment and employment loss. The study found that individuals with high pre-existing debt tended to be affected by this destabilization whereas those with positive equity experienced a buffer against the effect. Stage of cancer was also found to affect financial decisions with bankruptcy and refinancing being the method of choice for those who expected to live longer. On the other hand, those with a shorter expected lifespan tended to favor default and foreclosure. Wealth and assets were not broadly examined.

Cancer survivors have been shown to experience reductions in quality of work and ability to maintain employment compared to the general population with a 1.4 times greater likelihood of unemployment. Thirty percent of previously employed cancer survivors do not return to work five years following diagnosis (Koczwara, 2017).

Using nonprobability sample survey data (~4,719 cancer survivors), Banegas et. al (2016) examined the proportions of survivors who reported going into debt or filing for bankruptcy because of their cancer diagnosis, along with other financial hardship measures (i.e. amount of money borrowed, size of debt burden, worry concerning ability to pay large medical expenses, financial sacrifices, and types of

out-of-pocket spending). Approximately 33 percent of cancer survivors were shown to go into debt following their cancer diagnosis (Banegas, Guy, de Moor, Ekwueme, Virgo, Kent, Nutt, Zheng, Rechis, & Yabroff, 2016). Among this group, 55 percent possessed debt obligations of $10,000 or greater. Younger cancer survivors had a higher likelihood of experiencing substantial debt loads and potentially filing for bankruptcy including those using some form of public insurance and with lower incomes – in comparison to older cancer survivors with higher incomes and private insurance (Banegas et al, 2016). Cagle et. al (2016) reported similar findings using separate data and different modeling approaches to examine two outcome variables: financial strain (subjective assessment of financial burden on families and financial stress (objective assessment of financial burden on families. A quarter of cancer survivors reported that cost of care created a significant financial strain and was the primary cause of debt with approximately one-third using all or most of their personal savings to cover their expenses (Cagle, Carr, Hong, & Zimmerman 2016).

Using the *2011 Medical Expenditure Panel Survey Experiences with Cancer* questionnaire and separate multivariable logistic regression models stratified by age, Yabroff et al (2016) examined material and psychological hardships. Material hardship was measured by (1) debt, (2) bankruptcy, (3) inability to cover medical expenses, or (4) other financial sacrifices made due to cancer. Psychological hardship was measured based on individual concern regarding ability to cover medical expenses (Yabroff, Dowling, Guy, Banegas, Davidoff, Han, Virgo, McNeel, Chawla, Blanch-Hartigan, Kent, Li, Rodriguez, de Moor, Zheng, Jemal, & Ekwueme, 2016).

Those with a history of cancer were found to have a greater likelihood of experiencing material hardship – such as filing for bankruptcy, creating debt via borrowing, and lacking the ability to fully cover medical expenses – compared to individuals without a history of cancer. 41.9 percent of those 18 to 64 and 43.9 percent of those sixty-five and older were 5 or more years removed from their last cancer treatment, suggesting that the consequences have a long-term dimension. Among individuals aged 65 years and older, those who were younger have a greater likelihood of reporting material hardship (Yabroff et al, 2016).

Approximately 25 percent of cancer survivors report having experienced psychological hardship. Compared to higher income patients, lower-income patients had a greater likelihood of psychological financial hardship, controlling for socio-demographics and health insurance. Similar findings regarding material hardship were found for psychological hardship – with those 18 – 64 years of age presenting a greater likelihood of psychological hardship (Yabroff, et al, 2016).

Although Yabroff et al had many strengths, it utilized an online survey data collection method in which all participants were required to have computer access. The most precarious consumers were likely to have been underrepresented.

As studies of Medicaid expansion suggest, insurance may also play a vital role (Narang & Nicholas, 2017). Material and psychological hardship differed based on insurance status, as might be expected (Yabroff et al, 2015). At 43.3 percent, uninsured cancer survivors had the highest prevalence of material hardship, with public insured approximately 1 percent lower at 42.3 percent and private insurance at 23.7 percent. Those over sixty-five experienced similar material hardship regardless

of insurance type. At 43.3 percent, uninsured cancer survivors had the highest prevalence of psychological hardship, with public insurance at 31.1 percent and private insurance at 30 percent. Elevated levels of hardship among the uninsured are expected. Elevated levels among the publicly insured are a bit surprising, given the generosity of public programs. It is possible that the employment effects of cancer, and not the cost of care, was driving these findings.

Race/Ethnicity as a Moderator of Financial Toxicity

There is mixed evidence on the significance of race. Kale & Carroll (2016) found that being a member of a racial/ethnic minority was a significant predictor of self-reported financial burden (debt, bankruptcy, worry about large bills, inability to afford medical care, and other financial sacrifices) among cancer patients. Comparable results have been found in other studies (Yabroff et al 2015; Pisu, Kenzik, Oster, Drentrea, Ashing, Fouad, & Martin, 2015; Kent, Forsythe, Yabroff, Weaver, de Moor, Rodriguez, & Rowland, 2013). However, in one study, race/ethnicity was found to be only marginally significant for those 65 years and older, suggesting that Medicare might play an equalizing role (Yabroff et al, 2015). Other studies have found no significant association between race/ethnicity and financial toxicity (de Souza, Yap, Hlubocky, Wroblewski, Ratain, Cella, & Daugherty, 2014; Parikh, Amin, Hall, & Patel, 2017).

Sex as a Moderator of Financial Toxicity

Existing evidence suggest that being female is a significant indicator of financial burden among cancer patients (Maroto & Aylsworth, 2017; Theodos, Kalish, McKernan, & Ratcliffe, 2014; Kale & Carroll, 2016). Other work by de

Souza, Grogan, and Aschebrooke-Kilfoy (2016) found that women with thyroid cancer were more likely to experience financial toxicity – measured by out-of-pocket costs, loss of income, and bankruptcy—compared to similar men.

Mental Health and Cancer

Available evidence suggests mental health problems are more prevalent among those who have been diagnosed with cancer than those who have not been diagnosed (Naughton & Weaver, 2015; Singer, Das-Munshi, & Brähler, 2009). This is thought to stem from numerous factors, such as disruption to social relationships, financial strains, and general psychological distress associated with a cancer diagnosis that can signal an impending future of morbidity and mortality (Riedl & Schüßler, 2022; Niedzwiedz, Knifton, Robb, et al, 2019).

Depression amongst cancer patients has been found to be associated with less compliance with treatment plans, a reduction in quality of life, longer hospital stays, increased rates of suicide and increased likelihood of mortality. Cancer patients with major or minor depression having been found to have a 39% higher risk of death compared to cancer patients that are not depressed (Akechi, Nakano, Akizuki, Okamura, Sakuma, Nakanishi, Yoshikawa, & Uchitomi, 2003; Satin et al 2009).

The increased burdens posed by depression likely lead to higher medical out-of-pocket spending, a hypothesis I turn to in Aim 3 (Gu, Morgan, Li, et al, 2020).

Race/Ethnicity as a Moderator of Depression

While substantial literature has investigated the comorbidity of cancer and depression, not many studies have examined if the impact of depression among cancer patients varies by race/ethnicity.

Although racial minorities tend to experience lower socioeconomic status, greater discrimination based on race, and reduced access to healthcare, racial and ethnic minorities have been found to have lower rates of mental illness and depression than non-Hispanic Whites (McGuire & Miranda, 2008; Riolo, Nguyen, Greden, & King, 2005; Chatterji, Alegria, & Takeuchi, 2011). It is not well understood why mental illness stands in contrast to the well documented racial disparities for most other health outcomes. Some have argued that racial-ethnic minorities experience equal or greater symptoms but are less likely to be identified with an illness. Underlying reasons for lower mental health diagnoses in minority groups include an emphasis on family privacy, lack of diversity in the psychiatry field, unawareness of treatment availability, and a larger stigma regarding mental health concerns (Ward, Wiltshire, Detry, et al, 2013; Lin, Stamm, & Christidis, 2018). These issues may result in fewer individuals acknowledging mental illness, seeking treatment, and receiving appropriate treatment.

Patterns of mental illness prevalence in the general population might not generalize to cancer patients. Indeed, in one of the few studies to examine racial-ethnic difference in depressive symptoms among cancer patients, Black Americans were found to experience more depressive symptoms than White patients (Kurtz, Kurtz, Stommel, Given, & Given, 2002). Elevated rates of depression among African

Americans with a cancer diagnosis might result from increased allostatic load and chronic stress. The marginal stress experienced during a cancer episode layers on top of the chronic stress of belonging to a marginalized group (Rodriquez, Livaudais-Toman, & Gregorich, et al 2018).

Not only might depression incidence vary by race-ethnicity within the population of cancer patients, but the effect of depression on overall morbidity and health care resource use might also vary. Depressed Black and Hispanic respondents have been found to have a higher likelihood of being negatively affected by a cancer diagnosis than NH Whites (Alcala 2014) with mortality being equal to or higher than NH Whites (Chen, Boreta, Braunstein, et al, 2022).

There is a dearth of evidence on how race-ethnicity patterns the relationship between depression and health care experiences among cancer patients. Particularly, my work investigates whether race-ethnicity moderates the relationship between depression and total out-of-pocket spending. Such a relationship could cause adverse feedback loops in which depression and excessive out-of-pocket spending accelerate declines in wellbeing. Such patterns would be particularly burdensome for race-ethnic minorities that are already facing precarity.

Theoretical Foundations

This section will describe the foundational theories that will be used in this dissertation.

Financial Toxicity and Life-Cycle Savings

The Life Cycle Hypothesis (LCH) is a model which attempts to predict individual consumption and saving behavior. LCH states that behavior decisions are motivated by individuals' desires to balance out consumption over the course of their life cycle. Thus, consumers borrow during their youth when they are making less money; earn more, save and repay debts during their middle years in preparation for reduced finances during retirement; and dis-save their savings amassed throughout the earlier periods of their lives during their retirement years. Dis-saving refers to spending more than one has earned within a given period of time. A diagnosis of cancer may potentially alter the LCH for an individual, because individuals with impending retirement prospects may face difficulties significantly reducing their debt burden and accumulating savings in preparation for retirement given limited time in which they are capable of generating income from work or assets. Those who are already retired are likely to have to withdraw a substantial portion of their savings.

Additionally, research has shown dis-saving may not occur at the rates projected by the LCH – which may be linked to the lack of accounting for the concept of uncertainty regarding future resources – particularly for an older population. This uncertainty is addressed by the concept of precautionary saving.

Precautionary saving is a form of saving in which consumption is reduced and income is set aside when individuals experience uncertainty – specifically fear of losing future income or having reduced earnings potential. The creation of a precautionary reserve is motivated by the desire to insure against the effects of an

economic downturn in the future (e.g. reduced income) and maintain a stable life cycle consumption.

Alterations in one's finances can drive changes in consumption patterns which can be demonstrated in spending and debt accumulation. Households are more likely to save less and borrow in times of reduced income to maintain their optimal level of consumption (Lantz & Sarte, 2001). Repayment of debts occurs during periods of increased income (Bryant, 1990). A cancer diagnosis may affect present and future income expectations. Specifically, individuals with a present or past history of cancer may be more likely to increase spending and debt and decrease savings in response to current financial demands.

Depression and Cancer in the Stress Response Model

The Stress Process Model aims to explain the role of social stress in the development of mental health disparities (Pearlin et al., 1981). The model is comprised of three components: (1) sources of stress, (2) mediators of stress, and (3) manifestations of stress. Sources of stress refer to conditions which can upset the adaptive capacity of an individual (Pearlin, 1999). Stress mediators are behaviors, perceptions, and cognitions that may alter sources of stress and their impact. Lastly, manifestations of stressors refer to the effects of stressful conditions, such as distress and other health outcomes (Pearlin, 1989).

Events or experiences (i.e., cancer) can create life strains and/or exacerbate prior strains. These strains eventually become stress (Pearlin & Lieberman, 1979). These events and strains have a greater likelihood of creating stress if they compound other disadvantages, such as racial discrimination or socioeconomic status (Fleming,

Lamont, & Welburn, 2012; Pearlin, Schieman, Fazio, et al, 2005; Twenge & Campbell, 2002; Pearlin, 1981). Individuals experiencing diminishment of self may be more vulnerable to experiencing more depressive symptoms than those with higher or increased self-concept, such as proficiency and self-esteem (Pearlin, 1981).

People with the stressor of cancer are more likely to experience depression as a manifestation of stress compared to the general population (Mitchell, Chan, Bhatti, et al, 2011). Depression likely arises from events or chronic stress inherent to the trajectory of a cancer experience such as diagnosis, treatment, etc. (Pitman, Suleman, Hyde, et al, 2018). Among cancer patients, the prevalence of depression has been found to range from as low as 8% to as high as 38% (Mitchell, Chan, Bhatti, et al, 2011; Kessler, Petukhova, Sampson, et al, 2012; Krebber, Buffart, Kleijn, et al, 2014).

Depressed cancer patients are more likely to utilize healthcare resources compared to those without depression (Mausbach & Irwin, 2016). Mausbach and Irwin (2016) found that depressed cancer patients had an increased risk of having an emergency department visit, being hospitalized, and being readmitted within a 30-day span. This increase in resource utilization may result in an increase in overall healthcare spending and greater likelihood of experiencing financial burden linked to the confluence of these illnesses with elements affecting sense of self increasing or decreasing this risk.

Race-Ethnicity and Sex as Moderators

Aims 2 and 3 examine how race-ethnicity and sex shape the experience of cancer patients. To a considerable extent, the prediction that these social identities

increase financial strain is largely driven by well-established empirical facts that women and racial-ethnic minorities have fewer financial resources to buttress against the financial losses inherent in a financial diagnosis. For example, Black American ($24,100) and Hispanic families ($36,100) possess substantially less median wealth compared to White families ($188,200) with White families over the age of 55 having between $101,700 and $261,100 more in median wealth compared to other racial/ethnic groups (Bhutta, Change, Dettling et al 2020; Federal Reserve Board, 2019 Survey of Consumer Finances). Furthermore, Black and Hispanic Americans fare worse in the labor market: Black Americans have an unemployment rate of 11.4% with Hispanics at 10.4% compared to White Americans at 7.4% (Bureau of Labor Statistics, Report 1095, 2020).

Such patterns are reflective of the historic racism in the United States. Jones describes racism as operating via three levels: institutionalized, personally mediated, and internalized (Jones, 2000). Institutionalized refers to "access to the goods, services, and opportunities of society by race" manifesting in material goods and access to power. Personally mediated refers to prejudice (differential assumptions about the abilities, motives, and intentions of others according to their race) and discrimination (differential actions according to an individual's race). Internalized references "acceptance by members of the stigmatized races of negative messages about their own abilities and intrinsic worth" based on race. The process of racism described by Jones manifests itself in labor markets, wealth accumulation, and in other resource distributions such as health insurance markets.

Sex has also been shown to have negative effects on household finances. Overall, a gap of 18% to 20% exists between male and female workers (Foster, Murray-Close, Landivar, 2020). Theodos et al (2014) utilizing FINRA Investor Education Foundation's 2012 National Financial Capability Survey examined differences among men and women in financial knowledge, financial behavior, and financial well-being. Women had a 15 percent higher likelihood of reporting difficulty covering their expenses than their male counterparts (Theodos et al, 2014). Although, married women and men reported similar difficulty in covering expenses, unmarried women were 21 percent more likely to report difficulties compared to unmarried men. There were no statistically significant differences between men and women regarding retirement savings. However, women reported slightly higher satisfaction with their overall economic situation (assets, debts, and savings) compared to men.

The excess financial hardships that women endure are representative of a history of institutional and interpersonal sexism in the U.S. that plays out through gender norms that regulate work inside and outside of the home and the occupations that people sort into (United States Census Bureau, 2021).

While the deleterious effects of racism and sexism share similar features, they have unique conceptual drivers. However, they both can be considered within the social-ecological model. Attributed primarily to Brofenbrenner, the social-ecological model emphasizes the role of an individual's biological and psychological makeup stemming from their background and genetic makeup. These traits interact with the environment (microsystem), followed by interactions with that environment

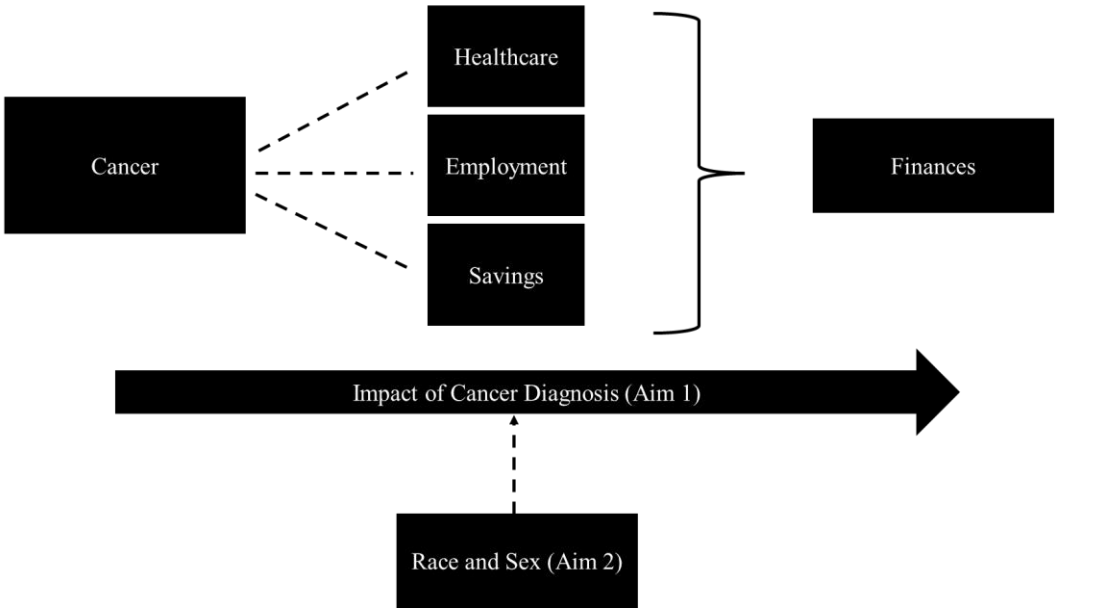
(mesosystem), which are affected by social, economic, and political structures (exosystem). These cross-level interactions are influenced by the belief and attitudes of the broader society (Brofenbrenner, 1977; Bukatko & Daehler, 1998). Contextualizing the role of race and sex within a social ecological model allows for a multifaceted understanding of how social membership can affect not only susceptibility to an illness, but the management and outcome of that illness (Harper Browne & O'Connor, 2021).

Conceptual Models

This study will utilize a conceptual model that draws on the above theoretical framework and existing empirical work. I have broken the model into two parts, for the sake of simplicity. The first model guides Aims 1 and 2. The second guides Aim 3.

Figure 1.1 details the conceptual model being examined in Aims 1 and 2.

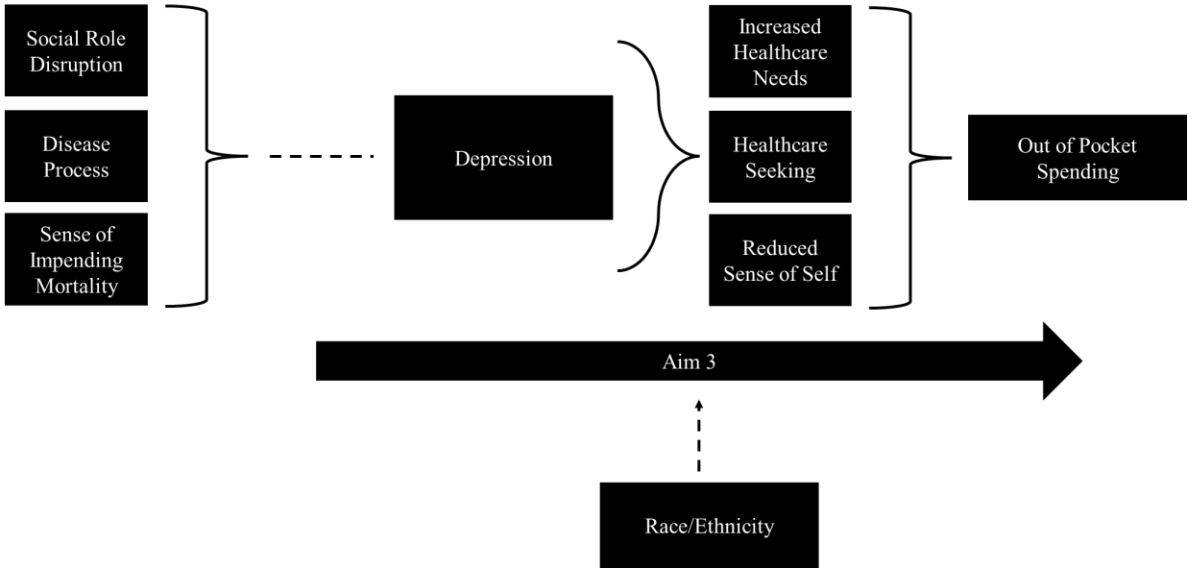
Figure 1.1 Impact of Cancer Diagnosis on Financial Health and Moderating Role of Race and Sex



Although the level of economic resources available to an individual represents the proximate cause of financial outcomes, the diagnosis of cancer acts as a distal cause. A cancer diagnosis will affect financial outcomes by impacting economic resources (i.e. income, savings, borrowing, and spending) – due to significant medical expenses ("healthcare" in Figure 1) and reductions in labor earnings brought on by inability to work. I expect the impact of cancer to larger for women vs men and for non-Hispanic Black and Hispanics compared to non-Hispanic Whites.

Figure 1.2 details the conceptual model employed for Aim 3. Cancer patients are thought to be at higher risk of depression due to cancer's biological disease process, effect on social roles, and effect on one's outlook (a process that is taken as given in the current study). Depression is predicted to increase out-of-pocket spending because it interferes with treatment adherence, leading to otherwise avoidable complications. It also might generate health care seeking behavior. The literature also suggests that depression has a yet to be articulated general effect on physical health (i.e. "non-specific"). The pressures experienced by racial-ethnic minorities due the multi-level expression of racism described by Jones might exacerbate these patterns.

Figure 1.2 Impact of Race/Ethnicity on Prevalence of Depression Among Cancer Patients



Chapter 3: Impact of Cancer Diagnosis on Financial Health of Older Adults

Overview

Cancer is among the leading causes of illness and mortality in the United States (U.S.) (American Society of Clinical Oncology, 2017). Over the last twenty years, there has been substantial innovation in cancer treatment (American Cancer Society, 2015), with novel treatments leading to substantial increases in longevity and quality of life for survivors (Nagao, Takei, Shimada, Tanigawa, & Suzuki, 2012). Technological innovation in cancer treatment has also come at large economic costs. In 2010, medical expenditures associated with cancer reached approximately $124.6 billion (Mariotto, Yabroff, Shao, Feuer, & Brown, 2011). These expenditures are driven, in part, by the high unit prices of individual treatments.

In the US, a substantial portion of cancer-related medical expenditures are financed by individuals and their families. Approximately 33 percent of cancer survivors (aged 18– 64) incur debt due to treatment, 55 percent have over $10,000 in debt, and 3 percent file for bankruptcy because of cancer related expenses (American Society of Clinical Oncology, 2017). The adverse financial outcomes that result from the cost of cancer treatment have come to be known as financial toxicity (Zafar & Abernethy, 2013).

Adults over the age of 49 comprise most incident cancer cases. The financial consequences of cancer treatment are an especially important concern for the elderly and near elderly (SEER Statistics, 2000 – 2015). Older adults are both at greater risk of experiencing financial burdens and the consequence of those burdens is often

especially acute. Older adults have unique financial responsibilities. Forty-seven percent of adults in their 40's and 50's have a parent aged 65 or older and are raising a child under 18 or financially supporting a child 18 or older – with 15 percent concurrently providing support to a child and an aging parent (Parker & Patten, 2013).

While an existing literature has examined the financial toxicity of cancer treatment, basic unanswered questions remain, such as a focus on older adults – a segment of the population most affected by health shocks. Adults over the age of 49 comprise most incident cancer cases and thus the financial consequences of cancer treatment are an especially important concern for the elderly and near elderly (SEER Statistics, 2000 – 2015). Older adults are both at greater risk of experiencing financial burdens and the consequence of those burdens is often especially acute creating a great need for more research around this issue. Chapter 2 outlines a conceptual model describing the relationships of interest and a complete literature review.

In this chapter I address the following Aim:

(1) Measure the impact of cancer diagnosis on a comprehensive set of financial outcomes.

Methods

Data

The study sample was drawn from the 2016 Health and Retirement Study (HRS). HRS is a longitudinal panel survey of a representative sample of individuals over age 50 in the U.S. Data has been collected every two years since 1992. HRS was created with the goal of providing a national data resource on the shifting health and economic conditions associated with aging in America with extensive data on health, economic, and psychosocial elements. I used a version of the HRS created by RAND (St. Clair et al., 2011). The RAND HRS data file is a cleaned and streamlined version of the HRS with derived variables covering a broad range of measures. The files include imputations for income, assets and medical expenditures developed at RAND.

The HRS sample includes over 20,000 respondents. Initial baseline interviews are generally done in person in the respondent's home (Fisher & Ryan, 2017). From 1994 to 2004, follow-up interviews were typically done via telephone – with those requesting face to face interviews and those over the age of 80 meet face to face. Since the 2006 survey, half of participants have received face-to-face interviews with the other half receiving telephone interviews along with alternative modes. Response rates for HRS range from 82 percent to 90 percent. The high overall panel response rate aids in the reduction of attrition bias. Re-interview and re-contact response rates average over 90 percent (Sonnega, Faul, Langa, Phillips, & Weir, 2014).

Analytical Sample

This study focused on individuals that were first diagnosed with cancer during their participation in the HRS. I required that cancer onset occurred in the second or later wave of participation to ensure at least one wave of pre-cancer data. Respondents that reported a cancer diagnosis in their first wave of participation or never obtained a cancer diagnosis were excluded. Furthermore, to be included in the study, subjects must have been insured and must have obtained their cancer diagnosis when they were between the ages of 50-64. Finally, to be included in the sample respondents must self-identify as non-Hispanic White, non-Hispanic Black, or Hispanic. This criterion was imposed to ensure that the sample in this chapter aligns with the sample used in Chapter 4.

Cancer diagnosis was based on self-response to the following questions posed by HRS for new and returning interviewees:

(1) Has a doctor ever told you that you have cancer or a malignant tumor, excluding minor skin cancer?

(2) Since we last talked to you, has a doctor told you that you have cancer or a malignant tumor, excluding minor skin cancer?

I focus on insured individuals because this study seeks to provide greater understanding of the financial well-being of patients who have the apparent security of insurance. Furthermore, the experience of insured and uninsured likely varies, but the HRS does not have a robust sample size of uninsured near-elderly people experiencing a cancer diagnosis. An individual is defined as insured if he or she self-reported having any form of health insurance. I limit the sample to those diagnosed

between 50–64-years of age to allow for the examination of older adults who were not eligible for Medicare at the time of diagnosis.

The baseline sample consists of 1,731 unique insured adults that were aged 50 to 64 at the time of diagnosis. These 1,731 unique people represent a weighted population of 9,983,624 unique persons. I observed 10,627 unweighted and 53,723,987 weighted person-wave observations.

Outcomes

The principal dependent variables of interest include measures of financial health. For the purposes of this study, financial health is defined by the following domains: (1) Medical spending, (2) earnings, and (3) borrowing. All outcomes are derived from self-reported information and missing values are imputed by RAND. The Consumer Price Index (CPI) was used to adjust all dollar amounts to 2021 levels.

Spending is determined based on out-of-pocket medical expenditures. Out-of-pocket expenditures capture a compilation of various expenditure categories that include hospital spending, healthcare utilization, and insurance coverage (Fahle McGarry, & Skinner, 2016). I examine two expenditure outcomes: **(1)** Continuous out-of-pocket expenditures, measured in dollars; and **(2)** A 0/1 indicator of medical financial burden. An individual is determined to be experiencing financial burden if he or she spends 10 percent or more of his or her income on out-of-pocket medical expenses (Chino, Peppercorn, Rushing, Kamal, Altomare, Samsa, & Zafar, 2017).

The second category of financial health, earnings, is defined as a respondent's earnings from wage/salary employment and is measured on a continuous scale.

Finally, borrowing is measured as the debt to asset ratio – comparing assets to consumer and housing debt information collected by HRS. A comprehensive picture of debt, which includes debt for nonmedical items, is important as people faced with high medical costs will have less budget to support other necessities. A debt-to-asset ratio provides information about the ability of an individual to liquidate assets to pay off all debt. Winger and Frasca (2002) suggest a ratio of 50% or less is an appropriate threshold to determine financial health. Ratios above 50% are associated with greater difficulty handling debt payments and declining solvency, particularly during economically tempestuous times (Winger & Frasca, 2002; Tenney, 2017). This study utilizes binary indicators of 'unacceptable debt.' A debt to asset ratio above 50 percent was categorized as Unacceptable Debt, whereas a debt to asset ratio at or below 50 percent was categorized as Acceptable Debt.

Independent Variable of Interest

The independent variable of interest is relative time until/after cancer diagnosis and is defined as the interview wave minus wave of diagnosis. Relative time was measured in 2 years intervals, corresponding to HRS interview wave intervals.

Covariates

I also make use of a set of rich covariate information collected by HRS. Relevant covariates are those that vary within person, over time (for reasons described below). These include age (in years), marital status, labor force status, and insurance type. These covariates are measured using self-reported survey items.

Summary of Variables

The variables discussed above are summarized in Table 3.1. The table describes the concepts, variable types, and levels of the measured variables.

Table 3.1. Summary of Variables

Concept	Variable Type	Levels
Out-of-Pocket Spending	Dependent Variable	Continuous
Medical Financial Burden	Dependent Variable	No (0); Yes (1)
Earnings	Dependent Variable	Continuous
Unacceptable Debt-to-Asset Ratio	Dependent Variable	No (0); Yes (1)
Relative Time Until/After Diagnosis	Independent Variable	Categorical indicators for each level in the range of -3 to 3
Age	Covariate	Continuous
Marital Status	Covariate	No (0); Yes (1)
Labor Force Status	Covariate	Full-time (1); Part-time (2); Unemployed (3); Partly Retired (4); Retired (5); Disabled (6); Not in Labor Force (7)
Insurance Type	Covariate	Private (0); Public (1)

Empirical Approach

An event study approach with the use of individual fixed effects following Dobkin et al (2017) was employed. The design compares outcomes for an individual, before and after their index cancer diagnosis. The advantage of the event study design is that it allows for the assessment of the pattern of outcomes relative to year of cancer diagnosis. Furthermore, by using each person as their own control, I net out all time-invariant characteristics that determine underlying cancer risk and might also impact the outcomes. The model is:

$$y_{it} = \delta_i + \gamma_t + X_{it}\alpha + \sum_{r=S}^{-2} \mu_r + \sum_{r=0}^{R} \mu_r + \varepsilon_{it},$$

where Y_{it} indicates some outcome (e.g., Out-of-Pocket Medical Expenditures, Unacceptable Debt-to-Asset Ratio) for individual *i* at survey wave *t.* Individual fixed effects (δ_i) ensure that comparisons occur within individual. γ_t are coefficients on survey wave effects and account for secular trending in the outcomes. X_{it} refers to time-varying covariates: age, marital status, labor force status, and insurance type. μ_r are the coefficients of interest on indicators for time relative to the cancer diagnosis. Event time *r* refers to the current survey wave relative to the survey wave in which the Individual's diagnosis occurred (the index cancer diagnosis is set to $r = 0$). The period prior to cancer onset ($r = -1$) was the omitted reference category. Only individuals that experience cancer onset after their first survey wave will be included such that *r* will have a range of -3 to 3 (S=-3; R= 3). The μ_r coefficients represent the differences in each outcome between period *r* and the period just prior to cancer onset. The evaluation of the coefficients from -3 to -1 allows for determination of the existence of pre-trending in the outcome leading up cancer onset (i.e., a sign of confounding). The evolution of coefficients from 0 to 3 allows me to determine how the effect of cancer on the outcomes progresses over time.

The advantage of the event study design is that it allows treatment effects to flexibly vary over time and allows for the assessment of the pattern of outcomes relative to year of cancer diagnosis. That assessment both provides a natural check on the study design (i.e., the degree of pre-trending) and of the evaluation of outcomes after the index event. Binary outcomes will be modeled using a linear probability model and continuous outcomes using linear regression.

Standard errors are clustered on individual to account for intra-person correlations stemming from repeated measures over time. All estimates are weighted by the HRS provided sampling weight.

Results

Summary Statistics

Table 3.2 presents basic summary statistics for the primary analysis sample.

Table 3.2 Selected Summary Statistics of HRS Respondents with an Observed Onset of Cancer

	Mean, Percent, or N
Age at Interview Wave	64.78
Age at Diagnosis	57.04
Married	
Not Married	45.93%
Married	54.07%
Insurance Type	
Public Insurance	65.97%
Private Insurance	34.03%
Labor Force Status	
Full-time	21.84%
Part-time	3.18%
Unemployed	0.92%
Partly Retired	6.82%
Retired	57.37%
Disabled	7.39%
Not in Labor Force	42.48%
Sample Sizes	
Unweighted Unique People	1,727
Unweighted Person-Waves	10,627
Weighted Unique People	10,014,748
Weighted Person-Waves	53,723,987

Source: Health and Retirement Survey. All estimates are weighted, unless otherwise noted.

Respondents are just under 65 years old, on average, at the time of interview. The average age at diagnosis is 57. Public insurance was the source of insurance

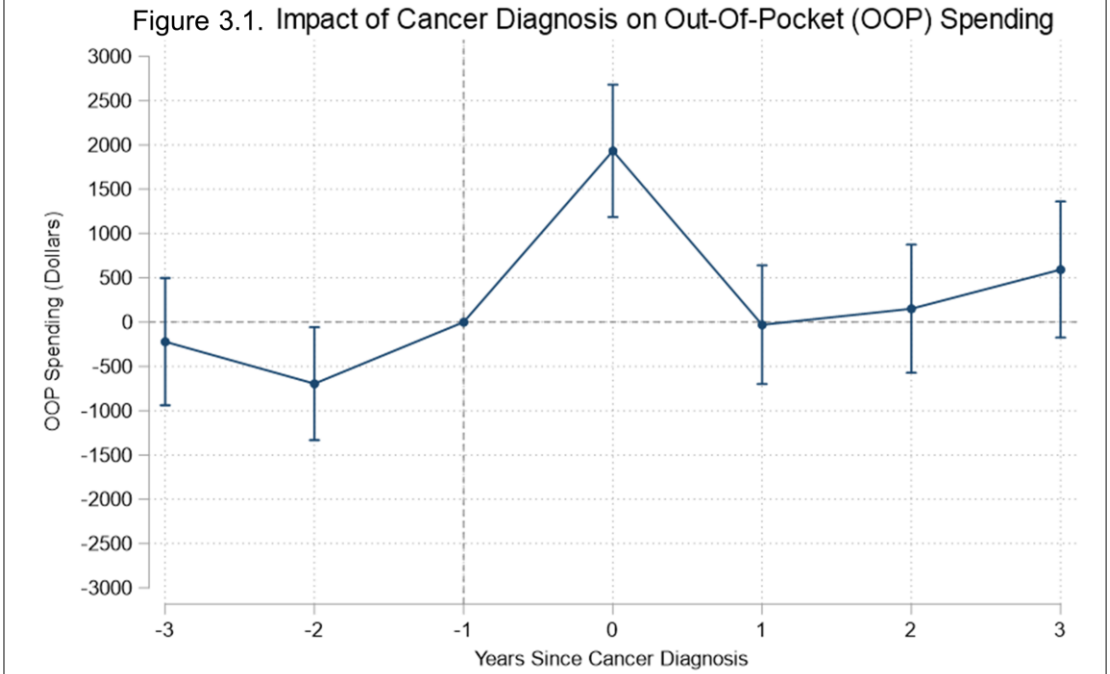
(65.9%) for many respondents in a given wave. 54% reported they were married in a given wave. Most of the sample were either employed full-time (23%) or fully retired (57%) – making up approximately 80 percent of person-wave observations.

Event Study Results

The following figures plot the coefficients of interest from the event study models (μ_r). I have organized the results in the following order: (1) Continous Out-of-Pocket Spendings; (2) Medical Financial Burden; (3) Earnings; (4) Unacceptable Debt-to-Asset Ratios. Complete regression results are provided in the appendix.

Continuous Out-of-Pocket Spending

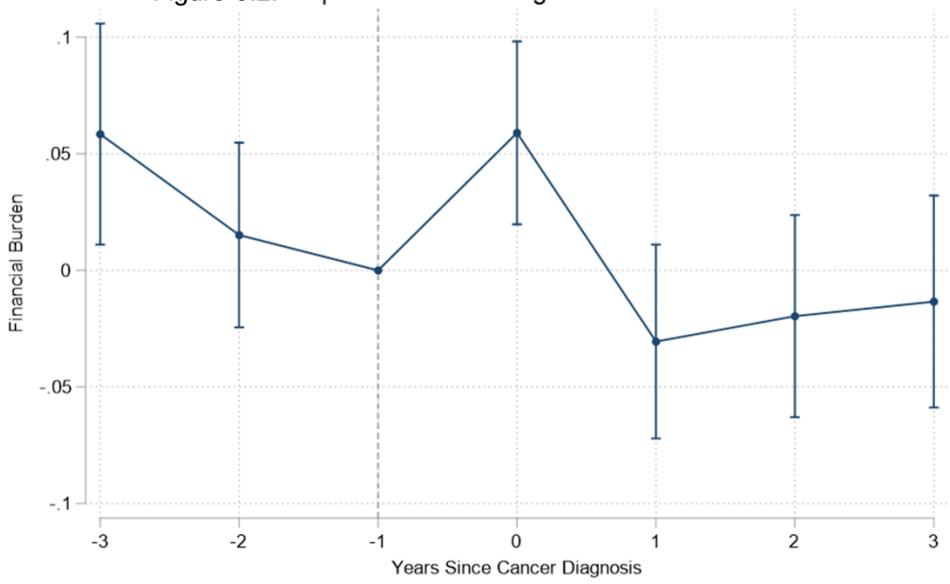
In the wave of a respondent's cancer diagnosis, there was a statistically significant increase in continuous out-of-pocket spending, of approximately $2000, relative to the wave prior to diagnosis (Figure 3.1). There was an ensuing drop to pre-cancer levels, one year following a respondent's cancer diagnosis, that persisted over time.



Medical Financial Burden

In the wave of diagnosis, there was a statistically significant increase in medical financial burden of approximately 6 percentage points, relative to the wave prior to diagnosis (Figure 3.2). However, burden levels then subsequently fell below pre-cancer levels.

Figure 3.2. Impact of Cancer Diagnosis on Financial Burden



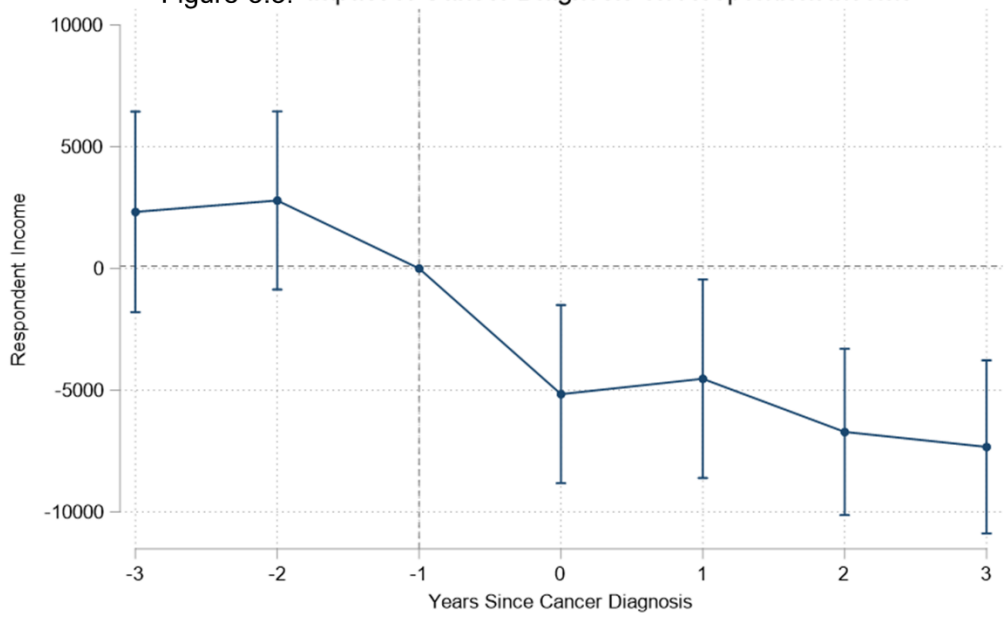
Each point represents the estimated effects of event time - the μrs from the nonparametric event study. The year of diagnosis (the event) is normalized to zero. The caps on the lines extending from each point present the 95 percent confidence intervals. All estimates are weighted using survey weights.

Figure 3.2 suggests there is pre-cancer trending in the burden measure. While the pre-cancer trend is an interesting empirical finding its own right, it also suggests caution in interpreting the post-cancer coefficients. The post-cancer coefficients might not reflect the causal impact of cancer itself.

Earnings

Figure 3.3 suggests a clear and persistent statistically significant decline in respondent earnings after a cancer diagnosis. In the wave of diagnosis there is a statistically significant $5,000 drop in earnings. This persists over time.

Figure 3.3. Impact of Cancer Diagnosis on Respondent Income

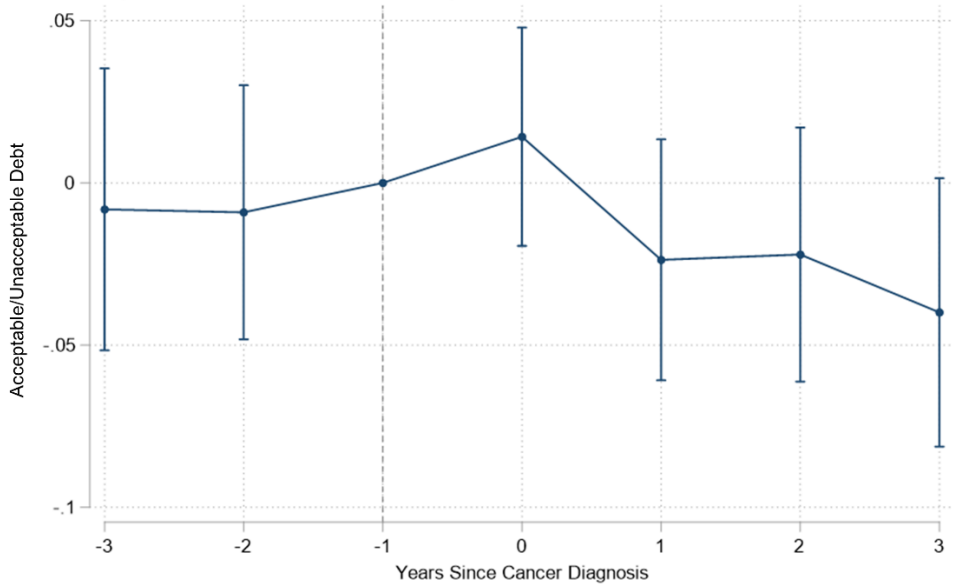


Each point represents the estimated effects of event time - the μrs from the nonparametric event study. The year of diagnosis (the event) is normalized to zero. The caps on the lines extending from each point present the 95 percent confidence intervals. All estimates are weighted using survey weights.

Unacceptable Debt-to-Asset Ratios

Figure 3.4 describes associations between cancer onset and unacceptable debt-to-asset ratios. I failed to find a statistically significant association between the timing of cancer diagnosis and unacceptable debt-to-asset ratios.

Figure 3.4. Impact of Cancer Diagnosis on Acceptable/Unacceptable Debt



Each point represents the estimated effects of event time - the μrs from the nonparametric event study. The year of diagnosis (the event) is normalized to zero. The caps on the lines extending from each point present the 95 percent confidence intervals. All estimates are weighted using survey weights.

Discussion

This study examined the impact of cancer diagnosis on financial outcome measures. I utilized an individual fixed effects model to trace-out the evolution of these outcomes from before to after cancer diagnosis. My study design rules out time-invariant factors that might select people experiencing cancer.

My results suggest an out-of-pocket spending spike in the year of diagnosis, but then a return to pre-cancer levels after that. Results for spending burden (out-of-pocket spending that is in excess of 10% of income) suggested a similar pattern, but the results were inconclusive to due to strong pre-cancer trending in the outcome. I failed to find evidence of changes in borrowing. However, a much clearer picture emerged of earnings. My results suggest that those with a cancer diagnosis experience substantial and persistent reductions in earnings.

Overall, this study demonstrates that cancer patients' out-of-pocket spending increases by about $2,000 on average, during the year of diagnosis. The increase in financial liabilities is accompanied by a substantial reduction in earnings capacity. Given inconclusive evidence on borrowing, it is unclear how respondents navigate these experiences. They may receive informal support from friends and family, resources that would not necessarily be counted in the HRS measures. Given the hardships that cancer itself imposes, these additional hardships should concern policymakers. Particularly, these results suggest that cancer patients would benefit from wage-replacement policies that insure their incomes.

My work is consistent with findings that a cancer diagnosis is associated with material consequences, such as reduced income and a depletion of savings (Lentz, Benson, Kirscher, 2018). Like this study, Syse, Tretli, and Kravdal (2008) found that those diagnosed with cancer experienced reduced earnings. This study is inconsistent with prior findings of significant increased borrowing and debt following a cancer diagnosis (Gilligan, Alberts, Roe, 2018). However, my work has strengths in that it utilized an individual fixed effects design and considered a rich set of financial indicators that is unique to the HRS.

Although this study possessed many strengths, it also had limitations. The use of survey data opens the possibility of incomplete reporting and misclassification due to the self-reported nature of the data. Attrition is also an important concern. Those with the most severe disease prognosis are likely to have higher attrition rates and the HRS might not generalize to the complete universe of cancer patients. However, these concerns are curtailed by HRS's data collection methodology. Response rates for

HRS range from a low of approximately 82 percent to a high of 90 percent. Re-interview and re-contact response rates average between a low to mid-90 percent (Sonnega, Faul, Langa, Phillips, & Weir, 2014).

I was also unable, in this study, to consider the effects of different cancers. A review by Iragorri et al. (2021) suggests that monthly out-of-pocket spending can range from $344 for hematological cancers to $87 for head and neck cancers (Iragorri, Oliviera, Fitzgerald, et al. 2021). The disabling nature of different cancers also likely have different effects on earnings. The results I present here average over this important source of heterogeneity.

Another important limitation is that this study covered a lengthy period of time in which there was a considerable amount of health insurance policy change. The passage of Medicare Part D and the Affordable Care Act are just two examples of changes that affected the near-elderly population I study. Furthermore, cancer technology changed in ways that might have been paid differently by insurers. For example, treatments that are provided in-patient versus out-patient and treatments that are more or less medication based might have been paid differently. While the use of a lengthy period was necessary to obtain sufficient sample sizes, my results average over these sources of variation.

Conclusion

The onset of cancer can have deleterious effects on the financial health of those diagnosed with cancer, particularly in older populations who comprise a substantial portion of those diagnosed each year in the United States. Older adults are more likely to experience the harshest effects of a diagnosis due to their greater likelihood of having more costly cancers coupled with a reduced ability to increase annual income or regain employment after a period of work-limiting disability. With the cost of cancer rising each year, this trend is likely to be exacerbated. The present study has shown that this financial strain is being experienced by those aged 50 and over, particularly in out-of-pocket spending in the year of diagnosis and persistent declines in employment earnings.

Chapter 4: Examining the Influence of Race and Sex Group Differences on Financial Burden Among Middle-Aged and Older Americans

Overview

Cancer is among the leading causes of illness and mortality in the United States (U.S.) (American Society of Clinical Oncology, 2017) and can be the cause of great financial distress (Zafar & Abernethy, 2013). Most incident cancer cases, and financial consequences of cancer treatment, have been demonstrated among adults aged 49 and over (SEER Statistics, 2000 – 2015).

Cancer-related financial concerns can be exacerbated by membership in societally disadvantaged groups (Jong & Madamba, 2001). Prior research has demonstrated the existence of racial and sex gaps in financial outcomes fueled by current and past policies, laws, and discrimination which created barriers against the accumulation of wealth and financial well-being for minorities and women (Sullivan & Meschede, 2016; Brown, 2011; Chang 2015; Rhee, 2013).

Typically, White households possess greater wealth than Black households (Shapiro, Meschede, & Sullivan, 2010). Using calculations from the 2013 Survey of Consumer Finances, Sullivan and Meschede found that the median White households held about $141,900 in assets compared with just $11,000 for African Americans, and $13,700 for Latinos. Women tend to have lower earnings also which results in

reduced retirement incomes and savings when compared to men (Richard, 2014). Thus, race and sex may create additional barriers to financial health for adults with cancer due to the impact the unequal distribution of wealth. Further research is needed to create a more robust evidence base regarding the impact of these elements and their role in addressing health inequities in the financial effect of cancer care.

Race/Ethnicity

Although being Black does not cause observed differences in financial hardship, due to the history of racism in the United States, being Black has been associated with several conditions that influence financial hardship – such as socioeconomic status, income, human capital, etc. These racial differences have been shown to contribute to cancer's effect on financial indicators – with African Americans being more likely to experience the effects of debt in the short term and long-term (Yabroff et al, 2015).

Kale & Carroll (2016) found that being a member of a racial/ethnic minority was a significant predictor of self-reported financial burden (debt, bankruptcy, worry about large bills, inability to afford medical care, and other financial sacrifices) among cancer patients. Minority races/ethnicities have demonstrated a greater likelihood of experiencing material hardship (Yabroff et al 2015; Pisu, Kenzik, Oster, Drentrea, Ashing, Fouad, & Martin, 2015; Kent, Forsythe, Yabroff, Weaver, de Moor, Rodriguez, & Rowland, 2013) – however race/ethnicity was found to be only marginally significant for those 65 years and older (Yabroff et al, 2015). A few studies have found no significant association between race/ethnicity and financial

toxicity (de Souza, Yap, Hlubocky, Wroblewski, Ratain, Cella, & Daugherty, 2014; Parikh, Amin, Hall, & Patel, 2017).

Sex

Being female has been shown to be a significant indicator of financial burden (Maroto & Aylsworth, 2017; Theodos, Kalish, McKernan, & Ratcliffe, 2014) and among those with cancer (Kale & Carroll, 2016).

Objectives

The aim of this analysis is to examine the influence of race/ethnicity and sex on the association between cancer onset and selected financial outcomes using a study design that accounts for time-invariant differences between those who do and do not get cancer. The aim addressed is:

> **(2)** Assess race/ethnicity and sex as moderating factors that influence the relationship between cancer and financial outcomes.

Methods

Data

The study sample was drawn from the 2000 – 2016 waves of the Health and Retirement Study (HRS). HRS is a longitudinal panel survey of a representative sample of individuals over age 50 in the U.S. Data has been collected every two years since 1992. HRS was created with the goal of providing a national data resource on the shifting health and economic conditions associated with aging in America with extensive data on health, economic, and psychosocial elements. I used a version of

the HRS created by RAND (St. Clair et al., 2011). The RAND HRS data file is a cleaned and streamlined version of the HRS with derived variables covering a broad range of measures. The files include imputations for income, assets and medical expenditures developed at RAND.

The HRS sample includes over 20,000 respondents. Initial baseline interviews are generally done in person in the respondent's home (Fisher & Ryan, 2017). From 1992 to 2004, follow-up was typically done via phone – with those requesting face to face or who were over the age of 80 receiving face to face follow up. Since 2006, half of the participants have been interviewed face to face with the other half receiving telephone interviews. The mode of interview is alternated between participants each wave. Response rates for HRS range from 82 percent to 90 percent. The generally high overall panel response rate aids in the reduction of attrition bias. Re-interview and re-contact response rates average over 90 percent (Sonnega, Faul, Langa, Phillips, & Weir, 2014).

Analytical Sample

This study focused on individuals that were first diagnosed with cancer during their participation in the HRS. I required that cancer onset occurred in the second or later wave of participation, in order to ensure at least one wave of pre-cancer data. Respondents that reported a cancer diagnosis in their first wave of participation or never obtained a cancer diagnosis were excluded. Furthermore, to be included in the study, the individual must have been insured and must have obtained their cancer diagnosis when they were between the ages of 50-64. As discussed in more detail

below, I also require that to be included in the sample, you must self-identify as non-Hispanic White, non-Hispanic Black, or Hispanic.

Cancer diagnosis was based on self-response to the following questions posed by HRS for new and returning interviewees:

(1) Has a doctor ever told you that you have cancer or a malignant tumor, excluding minor skin cancer?

(2) Since we last talked to you, has a doctor told you that you have cancer or a malignant tumor, excluding minor skin cancer?

I focus on insured individuals because this study seeks to provide greater understanding of the financial well-being of patients who have the apparent security of insurance. Furthermore, the experience of insured and uninsured likely varies, but the HRS does not have a robust sample size of uninsured near-elderly people experiencing a cancer diagnosis. An individual is defined as insured if he or she self-reported having any form of health insurance. I limit the sample to those diagnosed between 50–64-years of age to allow for the examination of older adults who were not eligible for Medicare at the time of diagnosis.

Variables

Primary Independent Variables. The primary independent variable is relative time until/after cancer diagnosis, measured as the number of survey waves since (or until) diagnosis.

Moderators. I examine if the association between cancer diagnosis and financial outcomes is moderated by race/ethnicity or sex. Race/ethnicity is categorized into mutually exclusive self-identified groups (1) non-Hispanic white, (2)

non-Hispanic Black, and (3) Hispanic. Individuals identifying ethnically as Hispanic are excluded from the non-Hispanic black and non-Hispanic White groupings, regardless of racial identification. Other racial categorizations were not examined due to insufficient sample size. Subjects reporting another race/ethnicity were excluded from the study. Sex was categorized as male or female based on self-identification within HRS. Per HRS survey rules, male and female are mutually exclusive and exhaustive.

Primary Dependent Variables. The principal dependent variables of interest are: **(1)** Continuous out-of-pocket medical expenditures; and **(2)** A binary indicator of medical financial burden. Out-of-pocket spending is measured via a compilation of data on spending, utilization, and insurance coverage for various expenditure categories (Fahle McGarry, & Skinner, 2016). An individual is determined to be experiencing financial burden if he or she spends 10 percent or more of his or her household income on out-of-pocket medical expenses (Chino, Peppercorn, Rushing, Kamal, Altomare, Samsa, & Zafar, 2017). All outcomes are derived from self-reported information and missing values are imputed by RAND. The Consumer Price Index (CPI) was used to adjust all dollar amounts to 2021-year dollars.

Covariates. The study design (described below) uses individual fixed effects to control for all time-invariant observed unobserved factors. I also directly control for a series of time-varying individual covariates: Marital status (married vs unmarried), insurance status (private insurance, public insurance, and both), labor force status, and age.

Summary of Variables

Table 4.1 summarizes the variables of interest by the concept being measured, the variable type, and the measured levels.

Table 4.1. Summary of Variables

Concept	Variable Type	Levels
Out-of-Pocket Spending	Dependent Variables	Continuous
Medical Financial Burden	Dependent Variables	No (0); Yes (1)
Relative Time Until/After Diagnosis	Independent Variable	Continuous
Age	Covariate	Continuous
Marital Status	Covariate	No (0); Yes (1)
Labor Force Status	Covariate	Full-time (1); Part-time (2); Unemployed (3); Partly Retired (4); Retired (5); Disabled (6); Not in Labor Force (7)
Insurance Type	Covariate	Private (0); Public (1)
Race/Ethnicity	Moderator	Non-Hispanic White (1); Non-Hispanic Black (2); Hispanic (3)
Sex	Moderator	Male (1); Female (2)

Empirical Approach

Econometric Model

An event study approach based on Dobkin et al (2017) was employed to compare individual outcomes before and after an index cancer diagnosis. The advantage of the event study design is that it allows for the assessment of the pattern of outcomes relative to year of cancer diagnosis and it excludes comparisons of those with and without a cancer diagnosis which might be confounded by pre-existing characteristics that are correlated with the outcomes.

The model for determining the association between cancer diagnosis and out-of-pocket spending outcomes is shown below. It is estimated separately for each stratum of interest.

$$y_{it} = \delta_i + \gamma_t + X_{it}\alpha + \sum_{r=S}^{-2} \mu_r + \sum_{r=0}^{R} \mu_r + \varepsilon_{it},$$

where Y_{it} indicates some economic outcome (e.g., Out-of-Pocket Medical Expenditures, Financial Burden) in individual *i* at time *t* (survey wave). The outcome measure will be a binary variable equal to 1 if individual *i* exhibits a financial burden – 10 percent or more of income spent on medical expenses. γ_t are coefficients on survey wave effects. X_{it} refers to covariates. ε_{it} is the error term. μ_r are the coefficients of interest on indicators for time relative to the cancer diagnosis. Event time *r* refers to the survey wave relative to the survey wave in which the individual's diagnosis occurred (the index cancer diagnosis is set to $r = 0$). The period prior to cancer onset ($r = -1$) will be the omitted reference category. Only individuals that experience cancer onset after their first survey wave will be included such that *r* could have a possible range of -10 to 10. In practice, I bound the range to be -3 to 3, like Dobkin et al. The μ_r coefficients represent the differences in a given outcome between period *r* and the period just prior to cancer onset. The evaluation of the coefficients from -3 to -1 allows for determination of the existence of pre-trending in the outcome leading up cancer onset (i.e., a sign of confounding). The evolution of coefficients after -1 allows me to determine how the effect of cancer on the outcomes progresses over time.

Individual fixed effects (δ_i) ensure that comparison occurs within individual. Standard errors are clustered on individual to account for intra-person correlations stemming from repeated measures over time. All estimates are weighted by the HRS provided sampling weight.

Subgroups and Moderation

I estimate these models for each group (by race/ethnicity and then sex) to measure associations within each group. I report the coefficients of interest from these subgroup regressions. I then repeat the models after altering them by interacting time to diagnosis with group indicators. In the interaction models testing for differences in cancer effects across race-ethnicity, the sample is restricted to have only non-Hispanic White and either non-Hispanic Black or Hispanics. I report the event study coefficients from the stratified samples and indicate significant interaction effects from the interaction models if I detect them.

Results

Subgroup Specific Sample Sizes

Table 4.2 describes stratum specific sample sizes. The baseline sample consists of 1,269 non-Hispanic White, 376 non-Hispanic Black, and 82 Hispanic unique persons.

Table 4.2. Weighted and Unweighted Sample Sizes, by Group

	Unique Persons		Person-Waves	
	Unweighted	Weighted	Unweighted	Weighted
Race				
Non-Hispanic White	1269	8,516,031	8390	46,762,934
Non-Hispanic Black	376	1,128,150	1918	5,637,323
Hispanic	82	336,448	312	1,245,580
Sex				
Male	731	4,436,533	4710	24,713,034
Female	1000	5,578,215	5917	29,010,953

Source: RAND Health and Retirement Survey. Note: The weighted counts in this table slightly differ from the weighted counts in Chapter 3, because for the purpose of counting unique people, different survey waves were selected.

Summary Statistics

Basic summary statistics are presented in Table 4.3 (by race-ethnicity) and Table 4.4 (by sex).

Table 4.3. Selected Summary Statistics of HRS Respondents with Observed Onset of Cancer by Race/Ethnicity

	White	Black	Hispanic
Age at Interview Wave	65.51 (SD:7.94)	63.09 (SD: 7.04)	61.62 (SD: 6.12)
Mean Age at Diagnosis	57.16 (SD: 4.28)	56.86 (SD: 4.37)	55.96 (SD: 4.32)
Married			
Not Married	39.01%	65.16%	63.41%
Married	60.99%	34.84%	36.59%
Insurance Type			
Public Insurance	64.54%	70.74%	67.07%
Private Insurance	35.46%	29.26%	32.93%
Labor Force Status			
Full-time	22.54%	19.15%	23.17%
Part-time	3.31%	1.60%	8.54%
Unemployed	0.79%	1.60%	0.00%
Partly Retired	7.57%	5.32%	2.44%
Retired	57.60%	58.51%	48.78%
Disabled	5.67%	12.50%	10.98%
Not in Labor Force	2.52%	1.33%	6.10%
Total	73.48%	21.77%	4.75%

Source: RAND Health and Retirement Survey.

In the analytic population, non-Hispanic Whites, non-Hispanic Blacks, and those of Hispanic ethnicity represent approximately 74 percent, 22 percent, and 5 percent of respondents with a slight over representation of Whites and Blacks and an

under representation of the Hispanic ethnic group, relative to the general population (U.S. Census Bureau, 2019). The under-representation of Hispanics is consistent with their lower incident cancer rates, which are 75% that of non-Hispanic Whites. Consistent with higher levels of SES in the general population, in this population of near-elderly adults experiencing a cancer diagnosis, non-Hispanic Whites were more likely to be married, less likely to have public insurance, and less likely to be out of the labor force compared to non-Hispanic Black or Hispanics.

The sex distribution was like that of the U.S. population, with a slight over-representation of women by ~5% (Table 4.4). Females are less likely to be married and more likely to not be in the labor force, compared to males.

Table 4.4. Selected Summary Statistics of HRS Respondents with Observed Onset of Cancer by Sex

	Male	Female
Age at Interview Wave	65.58 (SD: 7.87)	64.2 (SD: 7.64)
Mean Age at Diagnosis	57.90 (SD: 3.96)	56.41 (SD: 4.29)
Married		
Not Married	34.75%	54.10%
Married	65.25%)	45.90%
Insurance Type		
Public Insurance	66.62%	65.50%
Private Insurance	33.38%	34.50%
Labor Force Status		
Full-time	23.26%	20.80%
Part-time	1.78%	4.20%
Unemployed	0.68%	1.10%
Partly Retired	6.84%	6.80%
Retired	59.92%	55.50%
Disabled	6.84%	7.80%
Not in Labor Force	0.68%	3.80%
Total	44.32%	55.68%

Source: Health and Retirement Survey.

Event Study Results

In the figures below I plot the coefficients of interest (μ_r) for each outcome and strata. If I find statistically significant interaction coefficients in the interaction models, I indicate them with significance stars on a given coefficient. The interaction tests are versus non-Hispanic Whites or males as the reference category. I begin with describing stratum specific and moderation effects for out-of-pocket spending and then turn to medical financial burden.

Out-of-Pocket Spending

Non-Hispanic White Respondents. For non-Hispanic Whites, there was a statistically significant increase in OOP spending of about $2,000 in the wave of diagnosis, relative to the wave prior to diagnosis (Figure 4.1). However, OOP spending quickly rebounded to pre-cancer levels.

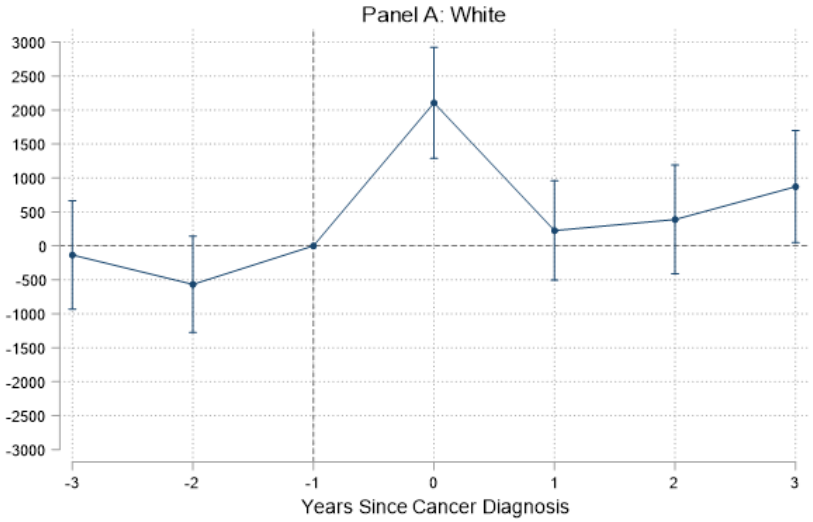


FIGURE 4.1: IMPACT OF CANCER DIAGNOSIS ON OUT-OF-POCKET SPENDING (WHITE)

Each point represents the estimated effects of event time - the μrs from the nonparametric event study. The year of diagnosis (the event) is normalized to zero. The caps on the lines extending from each point present the 95 percent confidence intervals. All estimates are weighted using survey weights. All variables are observed from 2002 to 2016.

Non-Hispanic Black Respondents I found no statistically significant evidence that OOP spending in the wave of diagnosis or in any subsequent wave was different than the wave prior to diagnosis for non-Hispanic Blacks (Figure 4.2).

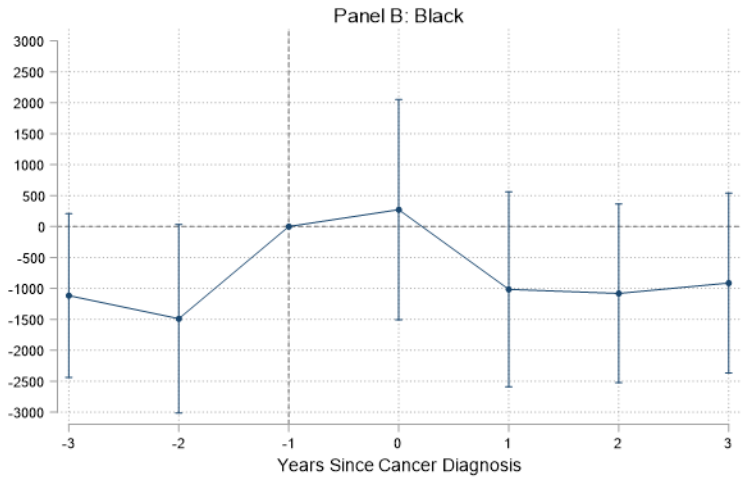


FIGURE 4.2: IMPACT OF CANCER DIAGNOSIS ON OUT-OF-POCKET SPENDING (BLACK)

Each point represents the estimated effects of event time - the μrs from the nonparametric event study. The year of diagnosis (the event) is normalized to zero. The caps on the lines extending from each point present the 95 percent confidence intervals. All estimates are weighted using survey weights. All variables are observed from 2002 to 2016.

Hispanic Respondents. I failed to find a statistically significant association between relative wave of diagnosis and OOP spending for Hispanics (Figure 4.3).

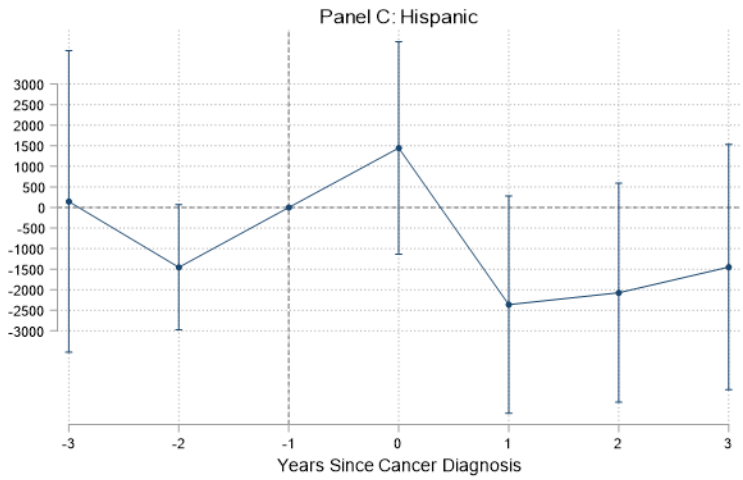


FIGURE 4.3: IMPACT OF CANCER DIAGNOSIS ON OUT-OF-POCKET SPENDING (BLACK)

Each point represents the estimated effects of event time - the μrs from the nonparametric event study. The year of diagnosis (the event) is normalized to zero. The caps on the lines extending from each point present the 95 percent confidence intervals. All estimates are weighted using survey weights. All variables are observed from 2002 to 2016.

Moderation by Race/Ethnicity. I failed to find any statistically significant evidence of moderation by race-ethnicity on the association of diagnosis timing and OOP spending.

Sex. For both male and female respondents, there was statistically significant evidence that OOP spending spiked in the wave of cancer diagnosis, relative to wave prior to diagnosis (Figures 4.4 and 4.5). However, OOP spending fell in subsequent waves to levels that were statistically indistinguishable from the wave prior to diagnosis. I failed to find significant evidence of moderation by sex.

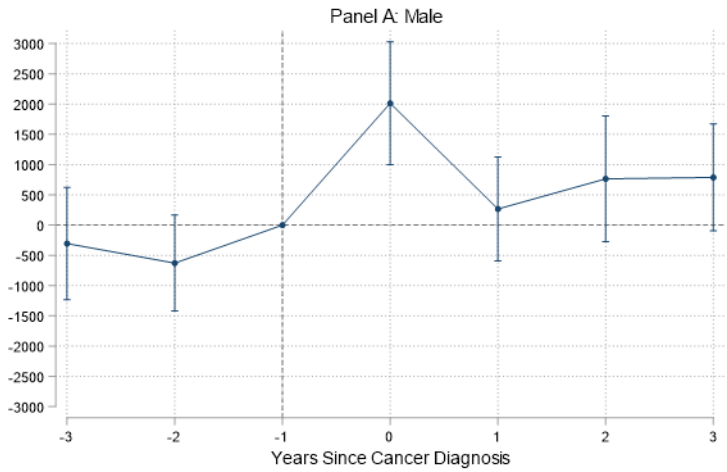


FIGURE 4.4: IMPACT OF CANCER DIAGNOSIS ON OUT-OF-POCKET SPENDING (MALE)

Each point represents the estimated effects of event time - the μrs from the nonparametric event study. The year of diagnosis (the event) is normalized to zero. The caps on the lines extending from each point present the 95 percent confidence intervals. All estimates are weighted using survey weights. All variables are observed from 2002 to 2016.

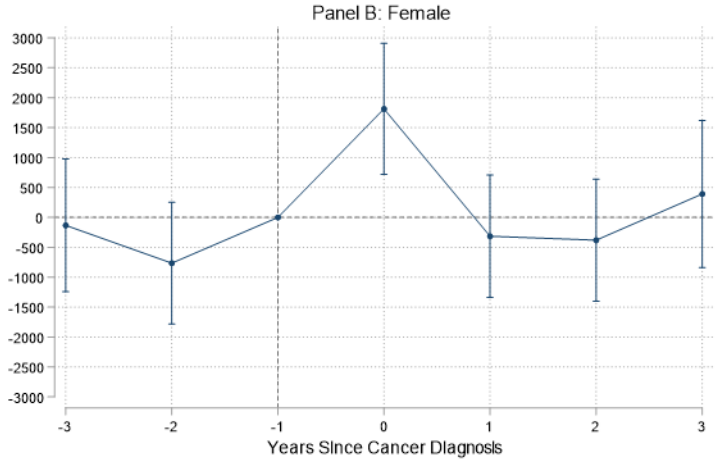


FIGURE 4.5: IMPACT OF CANCER DIAGNOSIS ON OUT-OF-POCKET SPENDING (FEMALE)

Each point represents the estimated effects of event time - the μrs from the nonparametric event study. The year of diagnosis (the event) is normalized to zero. The caps on the lines extending from each point present the 95 percent confidence intervals. All estimates are weighted using survey weights. All variables are observed from 2002 to 2016.

Medical Financial Burden

Non-Hispanic White. For respondents identifying as White, Non-Hispanic, I found a statistically significant increase in medical financial burden in the wave of diagnosis, of approximately 5 percentage points (Figure 4.6). Burden levels returned to pre-cancer levels after that.

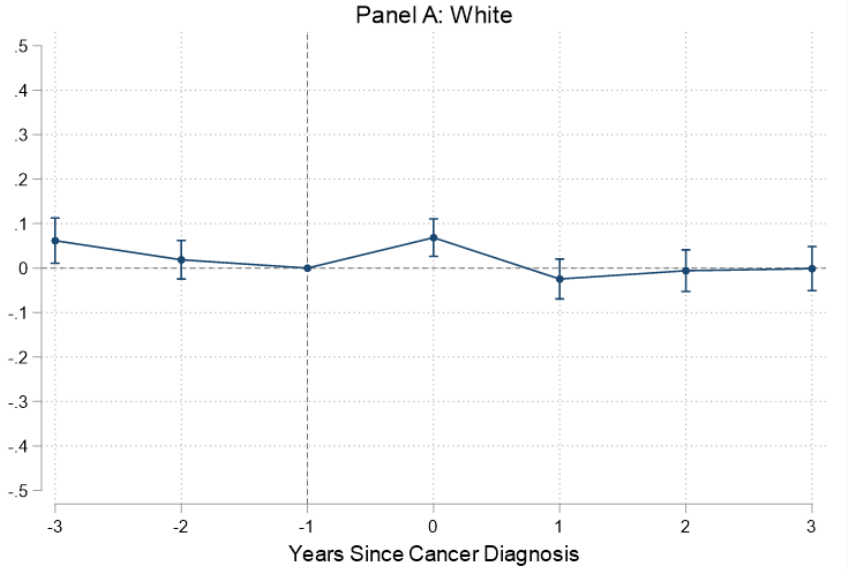


FIGURE 4.6: IMPACT OF CANCER DIAGNOSIS ON FINANCIAL BURDEN (WHITE)

Each point represents the estimated effects of event time - the μrs from the nonparametric event study. The year of diagnosis (the event) is normalized to zero. The caps on the lines extending from each point present the 95 percent confidence intervals. All estimates are weighted using survey weights. All variables are observed from 2002 to 2016.

Non-Hispanic Black Respondents. For respondents identifying as Black, Non-Hispanic I did not find a statistically significant associations between financial burden and relative wave of cancer diagnosis. However, the interaction models did not

suggest evidence that the effect for non-Hispanic Black and non-Hispanic Whites differed (Figure 4.7).

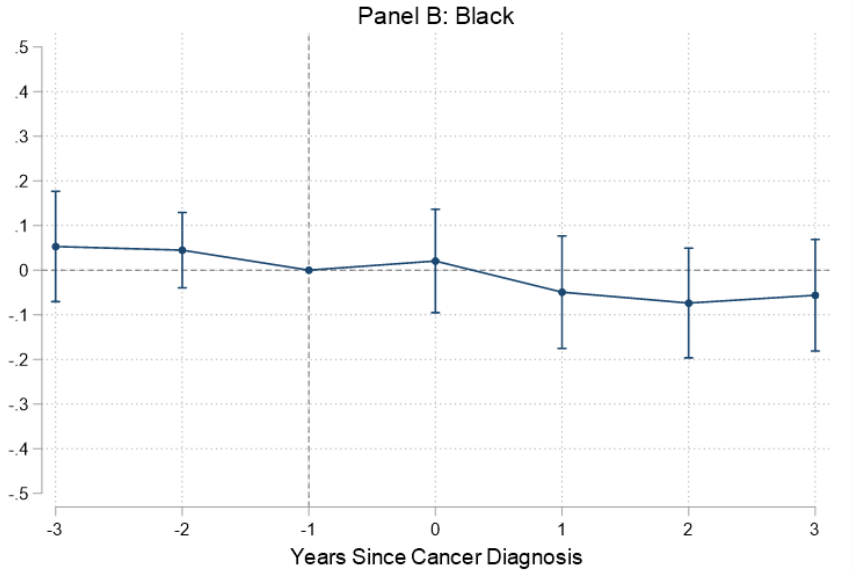


FIGURE 4.7: IMPACT OF CANCER DIAGNOSIS ON FINANCIAL BURDEN (BLACK)

Each point represents the estimated effects of event time - the μrs from the nonparametric event study. The year of diagnosis (the event) is normalized to zero. The caps on the lines extending from each point present the 95 percent confidence intervals. All estimates are weighted using survey weights. All variables are observed from 2002 to 2016.

Hispanic Respondents. I failed to find a statistically significant association between burden and the timing of cancer onset of Hispanics. I also did not find evidence that the association for Hispanics was different from that of White, Non-Hispanics.

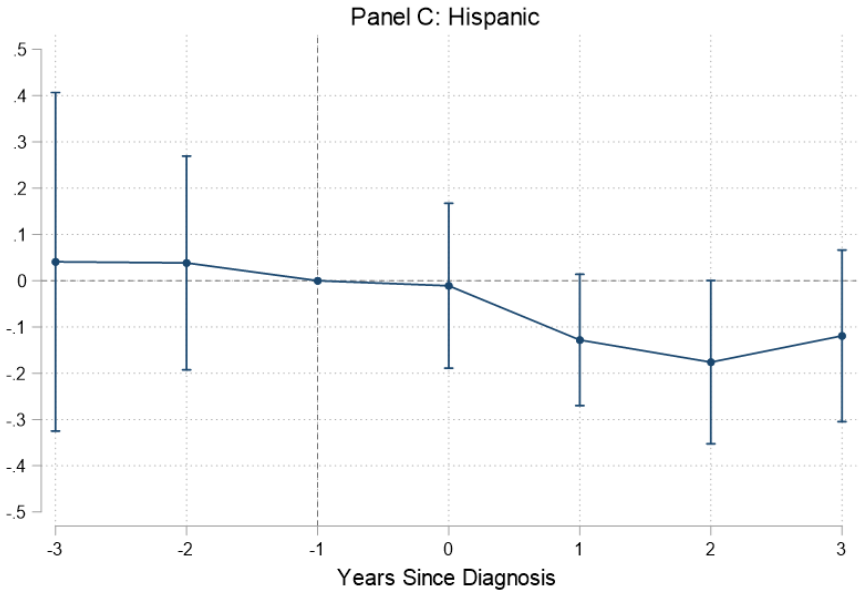


FIGURE 4.8: IMPACT OF CANCER DIAGNOSIS ON FINANCIAL BURDEN (HISPANIC)

Each point represents the estimated effects of event time - the μrs from the nonparametric event study. The year of diagnosis (the event) is normalized to zero. The caps on the lines extending from each point present the 95 percent confidence intervals. All estimates are weighted using survey weights. All variables are observed from 2002 to 2016.

Sex. I did not find a statistically significant association between burden and cancer timing for males (Figure 4.9) but did find an effect for females that was concentrated in the wave of diagnosis (Figure 4.10). However, I failed to find evidence of a significant moderation effect.

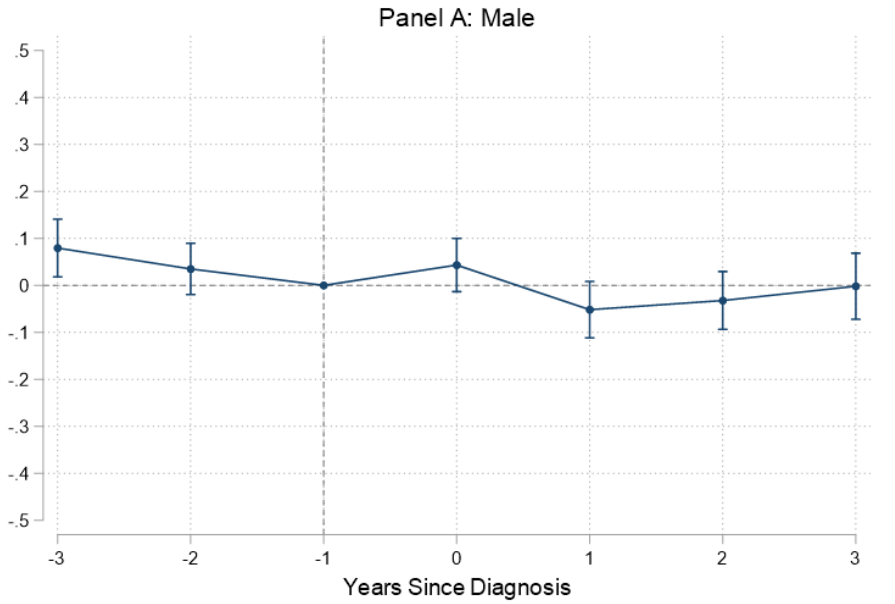


FIGURE 4.9: IMPACT OF CANCER DIAGNOSIS ON FINANCIAL BURDEN (MALE)

Each point represents the estimated effects of event time - the μrs from the nonparametric event study. The year of diagnosis (the event) is normalized to zero. The caps on the lines extending from each point present the 95 percent confidence intervals. All estimates are weighted using survey weights. All variables are observed from 2002 to 2016.

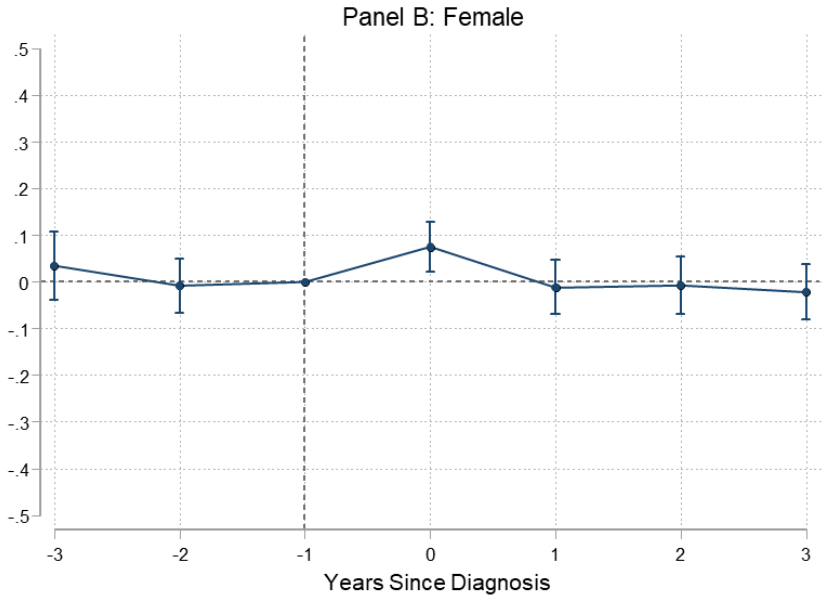


FIGURE 4.10: IMPACT OF CANCER DIAGNOSIS ON FINANCIAL BURDEN (FEMALE)

Each point represents the estimated effects of event time - the μrs from the nonparametric event study. The year of diagnosis (the event) is normalized to zero. The caps on the lines extending from each point present the 95 percent confidence intervals. All estimates are weighted using survey weights. All variables are observed from 2002 to 2016.

Complete Regression Results

In the appendix, I report complete regression results.

Discussion

This study examined if financial toxicity measures experienced by cancer patients varied by race-ethnicity and sex. For near-elderly non-Hispanic White adults, both continuous OOP and binary indicators of financial burden spiked in the year of cancer diagnosis and then returned to pre-diagnosis levels. This is consistent with

treatment spending around the time of diagnosis. For non-Hispanic Black and Hispanic near-elderly adults, the results were not so clear. I did not find clear evidence of the expected association between financial burden and cancer diagnosis in those groups. However, I could also could not detect significant moderation effects versus non-Hispanic Whites. Nonetheless, lower spending among non-Hispanic Black patients and Hispanics, conditional on medical need, is consistent with prior evidence in other settings (Charron-Chénier, Mueller, 2018).

The lack of a jump in financial distress for racial-ethnic minority patients could be explained by two distinct processes. It is possible that non-Hispanic Black and Hispanics simply face less financial risk, either due to better financial protection or because they have less severe diagnoses. Alternatively, it is possible that non-Hispanic Black and Hispanic patients have inadequate access to care and this constrained access prevents them from incurring the medical expenses that might have returns to health. The evidence in this study is not sufficient to distinguish between these channels. However, the large body of evidence suggesting that Black and non-Hispanic patients generally have worse access to care, are more likely to be diagnoses with later stage cancers and are more likely die conditional on a diagnosis suggests that the access channel is the most likely explanation (Wolf, Alpert, Tran, et al 2019; Noel & Fiscella, 2019; Moaven, Richman, Reddy, et al 2019).

For both males and females, I observed statistically significant associations between diagnosis and continuous OOP spending in the year of diagnosis. Spending quickly recovered to pre-diagnosis levels. The distress experienced in the wave of

diagnosis was not negligible. This suggests that our current insurance system does not offer adequate financial protection.

While this study has focused on the expenditure side of the financial burden equation it is also possible that diagnoses disrupt income in important ways as suggested in Chapter 3. Likewise, previous work has shown that hospitalization is strongly associated with employment disruptions (Dobkin et al. 2017). More work is needed to see if earning results differ by sex. Policymakers should attend both to protecting patients from excessive expenses and from job loss.

I had hypothesized that females would experience higher levels of toxicity but failed to find evidence of that. My null results stand in contrast to prior literature which demonstrate excess financial burdens among women (Smith, Lopez-Olivo, Advani, et al 2019).

While this study was focused on how race/ethnicity and sex moderated the effects of cancer diagnosis on financial outcomes, some of the results from the covariates are worth comment (see results in the Appendix). Specifically, private insurance versus public insurance was associated with reduced spending across groups and this finding is worthy of additional study. This finding is consistent with previous literature concerning the utility of private insurance. Privately insured patients have been shown to have a lower risk of financial toxicity (Farooq, Merath, Hyer, et al., 2019) with patients without private insurance presenting a greater likelihood of advanced disease progression (Walker, Grant, Guadagnolo, et al., 2014). The presence of private insurance prior to or at the time diagnosis may serve as a protective factor in that in the occurrence of a health shock – like cancer, ultimately

reducing overall OOP expenses. However, I could not rule out the possibility that those with private insurance tend to have less severe disease or if private insurers are more likely to impose utilization management techniques that reduce services (and if such utilization management is health neutral). More work is needed.

Limitations

This study had limitations. Data was based on self-report. While the panel nature of the study reduced the risk of recall bias, the panel interval was 2 years and recall error, including seem bias, cannot be excluded. Furthermore, while medical expenses are salient in people's lives as a general concern, the exact levels may not be, leading to response bias. I also observed that in some groups the outcomes tended to be changing prior to diagnosis. While that is an interesting finding, it also suggests caution in interpreting post-diagnosis changes as the causal result of diagnosis.

Finally, while the HRS has been extensively used in many studies, including studies of cancer patients (Chen & Janke, 2014; Mullins, Kler, Eastman, et al, 2022; Mahmood, Kedia, Dillon, et al 2023), it is possible that it was not sufficiently powered for the research questions addressed here. With approximately 1731 participants, type II error caused assessed serious concern, particularly in the non-Hispanic Black and Hispanic subgroups I considered. Conducting this study with a larger sample size – particularly with oversampling of racial/ethnic minorities – to assess if these results are replicated would be beneficial.

Spousal labor force status was not controlled within this study. Due to the role one's spouse can have on an individual's finances and sources of assistance in the face of health shock and ensuing financial consequences. Subsequent analyses were

run controlling for spousal labor force status. Spousal labor force status was not shown to be a statistically significant variable – nor did it substantially alter the results of the findings within other variables or the overarching analysis.

Additionally, due to the age range of my population of focus (those aged 50 and over) – it is possible that wealth or net worth measures may have been relevant in the selected financial health measures. Prior literature has demonstrated a reduction in wealth following a diagnosis (Pak, Kim, & Kim, 2020). Although, the effect of this measure was generally captured within the use of a debt-to-asset ratio in this study, there may exist distinctions within a focus exclusively on net worth or wealth that would provide an alternative depiction of financial health for this age group. Nonetheless, debt to asset ratio is a highly relevant measure of personal finance – particularly for older Americans and it is an under researched measure within the literature. Thus, this study is novel in its inclusion of debt-to-asset ratios and provides the groundwork for decisions concerning its use in future financial toxicity studies, especially those focused on older cancer patients in the U.S.

Conclusion

The financial toxicity of cancer care is a serious policy problem. However, devising appropriate solutions must account for the varied experiences and structural barriers that distinct groups of patients face. In this study I failed to find the significant moderation effects I expected to find. Associations within historically marginalized groups were often null. Untangling if these effects result from improved financial protection or reductions in clinically indicated utilization is a crucial task for on-going work.

Chapter 5: Out of Pocket Spending by Depressed Cancer Patients by Race/Ethnicity

Overview

Cancer is the second leading cause of death in the United States (American Cancer Society, 2022). Approximately 40% of men and women will experience a cancer diagnosis in their lifetimes (National Cancer Institute, SEER 2015-2017) The incidence of cancer is not evenly distributed in the population Overall, Non-Hispanic White (NH White) and Non-Hispanic Black (NH Black) people have the highest rate of new cancers at 476.3 and 459.0 per 100,000, respectively. {(National Cancer Institute, SEER 22). However, NH Black people are less likely to survive a cancer episode. having the highest mortality rate among all groups at 174.7 per 100,000(National Cancer Institute, SEER 22).

Not only does cancer impose increased mortality risk, but is often accompanied by substantial morbidity, disability, detachment from the labor force, financial strain, and disruption to social relationships (National Cancer Institute – Cancer Disparities, 2022)). As such, cancer can have large effects on psychological wellbeing as predicted by the stress process model (SPM) (Pearlin, 1999). In addition to the health induced strains on psychological well-being, the biology of some cancers (or the side effects of some treatments) might directly influence the onset of depression via the hypothalamic-pituitary-adrenal axis, particularly diurnal variation in cortisol and melatonin (Geise-Davis & Spiegel, 2003). Indeed, evidence suggests that mental health problems are more prevalent among those who have been diagnosed with cancer than those who have not (Zhu, Fang, Sjölander, et al, 2017).

Some 8% to 24% of cancer patients concurrently obtain a diagnosis of depression (Krebber, Buffart et al, 2014). Depression has been found to be associated with less compliance to treatment plans, a reduction in quality of life, longer hospital stays, increased rates of suicide and a 39% higher risk of death compared to cancer patients without depression (Akechi, Nakano, Akizuki. et al, 2003; Satin, Linden, & Phillips, 2009). Depression is a major clinical issue among cancer patients.

Despite the well documented connections between cancer and depression, less is known about how the effects of depression on cancer patients varies across different patient groups. The goal of this study was to examine if the association between depression and total health care expenditures among those with a cancer diagnosis varies by race-ethnicity.

Theoretical predictions about how the effects of depression among cancer patients might vary by race-ethnicity are ambiguous. Although racial minorities tend to experience lower socioeconomic status, greater discrimination based on race, reduced access to healthcare, and generally have worse health outcomes compared to non-Hispanic White patients, Black Americans have been found to have lower rates of mental illness and depression compared to NH Whites (McGuire & Miranda, 2008). Hispanics and African Americans have been found to experience depression and anxiety at lower rates than non-Hispanic Whites (Riolo, Nguyen, Greden, & King, 2005). Asian Americans experienced depression at lower rates than Hispanics (Chatterji, Alegria, & Takeuchi, 2011).

The reasons for why mental illness stands in contrast to the well documented racial disparities for most other health outcomes is not well understood. There exist disparities in mental health care services, quality of care, and access to culturally competent care (Rice & Harris, 2021; SAMHSA, 2015). Underlying reasons for lower mental health diagnoses in minority groups include an emphasis on family privacy, lack of diversity in the psychiatry field, unawareness of treatment availability, and a larger stigma regarding mental health concerns (Ward, Wiltshire, Detry, et al, 2013; Lin, Stamm, & Christidis, 2018). These issues may result in fewer individuals acknowledging mental illness, seeking treatment, and receiving appropriate treatment.

Patterns of mental illness prevalence in the general population might not generalize to cancer patients. Indeed, in one of the few studies to examine racial-ethnic difference in depressive symptoms among cancer patients, Black Americans were found to experience more depressive symptoms than White patients (Kurtz, Kurtz, Stommel, Given, & Given, 2002). Elevated rates of depression among African Americans with a cancer diagnosis might result from the role of allostatic load and chronic stress. Chronic stress during adulthood may worsen racial and ethnic minorities likelihood of developing depression due to the marginal stress experienced during a cancer episode (Rodriquez, Livaudais-Toman, & Gregorich, et al 2018).

Not only might depression incidence vary by race-ethnicity within the population of cancer patients, but the effect of depression on overall morbidity and health care resource use might also vary. Depressed Black and Hispanic respondents have been found to have a higher likelihood of being negatively affected by a cancer

diagnosis than NH Whites (Alcala 2014) with mortality being equal to or higher than NH Whites (Chen, Boreta, Braunstein, et al, 2022). The reasons for mental illness prevalence in minority groups may also function as underlying factors for reduced use of the healthcare system and the higher propensity for poor outcomes linked to the coupling of cancer and depression compared to NH Whites.

This study addresses my third aim: **(3)** Assess the prevalence of depression among cancer patients, how this prevalence varies by race/ethnicity, and assess the race specific experience of depression as a predictor of out-of-pocket expenditures among cancer patients.

To accomplish that aim, I address the following specific objectives:

1) Describe the prevalence of depression among those diagnosed with cancer, by race-ethnicity.
2) Determine if those with depression have greater OOP spending across all racial groups.
3) Determine if the association between depression and OOP spending among those with a cancer diagnosis varies by race-ethnicity.

Methods

Data

The study sample was drawn from the 2000 – 2016 waves of the Health and Retirement Study (HRS). HRS is a longitudinal panel survey of a representative sample of individuals over age 50 in the U.S. Data has been collected every two years since 1992. HRS was created with the goal of providing a national data resource on the shifting health and economic conditions associated with aging in America with

extensive data on health, economic, and psychosocial elements. I used a version of the HRS created by RAND (St. Clair et al., 2011). The RAND HRS data file is a cleaned and streamlined version of the HRS with derived variables covering a broad range of measures. The files include imputations for income, assets and medical expenditures developed at RAND.

The HRS sample includes over 20,000 respondents. Initial baseline interviews are generally done in person in the respondent's home (Fisher & Ryan, 2017). From 1992 to 2004, follow-up was typically done via phone – with those requesting face to face or who were over the age of 80 receiving face to face follow up. Since 2006, half of the participants have been interviewed face to face with the other half receiving telephone interviews. Response rates for HRS range from 82 percent to 90 percent. The generally high overall panel response rate aids in the reduction of attrition bias. Re-interview and re-contact response rates average over 90 percent (Sonequa, Faul, Langa, Phillips, & Weir, 2014).

Analytical Sample

The sample for this analysis included a cross-section of respondents extracted from HRS. Unlike Chapter 3 and 4, each subject is observed once. The wave selected for each respondent was the first wave they first reported a cancer diagnosis. My results pertain to the wave of cancer diagnosis where the wave selected can vary by respondent. Furthermore, to be included in the study, the individual must have been insured and must have obtained their cancer diagnosis when they were between the ages of 50-64. Finally, to be consistent with Chapters 3 and 4, I also require that

respondents self-report that are non-Hispanic White, non-Hispanic Black, or Hispanic.

Cancer diagnosis was based on self-response to the following questions posed by HRS for new and returning interviewees:

(1) Has a doctor ever told you that you have cancer or a malignant tumor, excluding minor skin cancer?

(2) Since we last talked to you, has a doctor told you that you have cancer or a malignant tumor, excluding minor skin cancer?

I focus on insured individuals because this study seeks to provide greater understanding of the financial well-being of patients who have the apparent security of insurance. Furthermore, the experience of insured and uninsured likely varies, but the HRS does not have a robust sample size of uninsured near-elderly people experiencing a cancer diagnosis. An individual is defined as insured if he or she self-reported having any form of health insurance. I limit the sample to those diagnosed between 50–64-years of age to allow for the examination of older adults who were not eligible for Medicare at the time of diagnosis.

Variables and Measurement

Independent Variable

HRS has included a shortened version of the Center for Epidemiologic Studies Depression scale (CES-D) since its inception. CES-D is a screening tool for depression and depressive disorder. For each item, respondents report whether they have experienced a symptom “much of the time during the past week.” A summary

score of 0 to 8 indicates the total number of symptoms experienced. Scores equal to or greater than 3 are indicative of a diagnosis of depression. The CES-D determines likelihood of a depression diagnosis, not severity (Steffick 2000; Nelson, Kessler, & Mroczek, 1998). The scale is widely used and has been previously validated (Steffick 2000). For this study, respondents were classified as Not Depressed (score range: 0 – 2) versus Depressed (score range: 3 – 8).

Dependent Variable

Continuous out-of-pocket spending is measured via a compilation of data on spending, utilization, and insurance coverage for various expenditure categories (Fahle McGarry, & Skinner, 2016). Missing values are imputed by RAND.

Moderators

Race/ethnicity is categorized into mutually exclusive self-identified groups (1) non-Hispanic white, (2) non-Hispanic black, and (3) Hispanic. Individuals identifying ethnically as Hispanic are excluded from the non-Hispanic black and non-Hispanic White groupings, regardless of racial identification. Other racial categorizations were not examined due to insufficient sample size. Those reporting another race were excluded from the study.

Covariates

I included the following variables as covariates: age, sex, education, marital status, labor force status, age, year of interview, and insurance status.

Summary of Variables

Table 5.1 summarizes the variables described above, listing the concept of interest, the variable type, and the levels of measurement.

Table 5.1. Summary of Variables

Concept	**Variable Type**	**Levels**
Out-of-Pocket Spending	Dependent Variables	Continuous
Depression (based on CES-D)	Independent Variable	No (0); Yes (1)
Age	Covariate	Continuous
Marital Status	Covariate	No (0); Yes (1)
Labor Force Status	Covariate	Full-time (1); Part-time (2); Unemployed (3); Partly Retired (4); Retired (5); Disabled (6); Not in Labor Force (7)
Insurance Type	Covariate	Private (0); Public (1)
Race/Ethnicity	Moderator	White (1); Black (2); Hispanic (3)

Empirical Approach

Empirical Model

Multivariable linear regression analyses were used to measure the association between depression and out-of-pocket spending. The regression took the form:

$$OOP = \beta_0 + \mu DEPRESSED + \beta_1\, sex + \beta_2 race + \beta_3 insurance + \beta_4 + \beta_5 education + \beta_6\, married + \beta_7 labor + \beta_8\, age + \beta_9\, interview\_year$$

To assess moderation by race/ethnicity, I run a separate regression that modifies the equation above by interacting the depression indicator with race-ethnicity indicators.

I prefer linear regression because I can directly interpret the coefficients on the dollar scale. However, I assess if my results are robust to alternative specifications by re-running the regressions of interest using a general linear model with a log-link and a gamma distribution. I report coefficients from both specifications.

Results

Summary Statistics

Whites, Blacks, and those of Hispanic ethnicity represented approximately 86 percent, 11 percent, and 4 percent of respondents with an over representation of Whites and Blacks and an under representation of the Hispanic ethnic group, relative to the general population (U.S. Census Bureau, 2019).

TABLE 5.2 – SELECTED SUMMARY STATISTICS	
Age at Interview Wave	64.04 (SD: 0.21)
Mean Age of Diagnosis	56.40 (SD: 0.13)
Race/Ethnicity	
White	85.5%
Black	11.30%
Hispanic	3.21%
Sex	
Male	43.22%
Female	55.68%
Race/Ethnicity	
Light High School	11.3%
GED	5.06%
High School Graduate	26.21%
Some College	27.67%
College and above	29.76%
Employment Status	
Full-time	26.33%
Part-time	3.48%
Unemployed	.89%
Partly Retired	8.63%
Retired	52.97%
Disabled	5.02%
Not in Labor Force	2.69%
Insurance Type	
Private	39.61%
Public	60.39%
Marital Status	
Not Married	44.39%
Married	55.61%
Sample Size	
Unweighted Unique People	1612
Weighted Unique People	9,533,952
Source: RAND Health and Retirement Study	

Female respondents were over-represented in the study with an under-representation of male respondents compared to the general U.S. population. Most

respondents (83.64%) had graduated high school or achieved some form of education above high school. Many respondents were retired (52.97%), employed full-time (26.33), and publicly insured (60.39%) *(Table 5.2).*

Statistical Results

Prevalence of Depression Among Cancer Patients

Approximately 29% of the sample were determined to have a CESD score of 3 or above (Table 5.2). For each, racial/ethnic group, depression had a much higher prevalence than in the general U.S. population (Brody, Pratt, & Hughes, 2018). Race/ethnicity was statistically associated with depression. Hispanics (54.6%) and non-Hispanic Blacks (38.48%) had a much higher prevalence than non-Hispanic Whites (26.29%).

Table 5.2. Prevalence Of Depression Among Cancer Patients by Race/Ethnicity

	% With Depression	**95% Confidence Interval**	**P-Value**
Race			0.00
White, Non-Hispanic	26.29	23.38 – 29.43	
Black, Non-Hispanic	38.48	30.96 – 46.59	
Hispanic	54.62	39.35 – 69.07	
Total	28.58	25.84 – 31.49	
Source: RAND Health and Retirement Survey.			

The Association of Depression and OOP Spending

Table 5.3 describes the complete coefficient results from the linear regression of continuous out-of-pocket spending on depression. Although there was no statistical significance between depression and OOP spending found in the linear regression; depression was found to be statistically significant in the GLM regression.

Table 5.3. Full Coefficient Results for OOP Spending among Depressed						
	Out-of-Pocket					
	Linear Regression			GLM Regression		
	Coefficient	*SE*	*P-Value*	*Coefficient*	*SE*	*P-Value*
CESD						
Not Depressed	REF	REF	REF	REF	REF	REF
Depressed	821.111	578.475	0.156	.218	.112	.051
Race/Ethnicity						
White	REF	REF	REF	REF	REF	REF
Black	-1750.091	439.814	.000	-.572	.138	.000
Hispanic	-2837.875	535.580	.000	-1.355	.321	.000
Sex						
Male	REF	REF	REF	REF	REF	REF
Female	-243.405	621.123	.389	.084	.098	.389
Age	-73.317	68.604	.285	-.007	.009	.461
Year of Interview	-144.325	.74.705	.054	-.037	.011	.001
Marital Status						
Not Married	REF	REF	REF	REF	REF	REF
Married	333.285	485.997	.493	.089	.105	.399
Education						
None	REF	REF	REF	REF	REF	REF
GED	1434.248	823.249	.082	.490	.228	.032
High School	2157.335	788.636	.006	.655	.191	.001
Some College	2048.777	1201.276	.088	.582	.181	.001
College and beyond	2253.044	823.135	.006	.707	.181	.000
Labor Force Status						
Full-time	REF	REF	REF	REF	REF	REF
Part-time	429.046	1051.576	.909	-.002	.248	.909
Unemployed	1486.644	1443.965	.337	.172	.341	.337
Partly Retired	335.469	609.772	.971	-.045	.173	.971
Retired	1487.425	632.486	.018	.278	.133	.018
Disabled	2097.545	1988.229	.263	.316	.338	.263
Not in Labor Force	6786.488	5426.463	.036	.982	.541	.036
Government Insurance						
Private	REF	REF	REF	REF	REF	REF
Public	-1302.286	1235.192	.292	-.428	.146	.003
Mean of Y: 3689.03 (SE:195.399)						
Sample Size: 1612						

Source: RAND Health and Retirement Study

Race/Ethnicity as a Moderator for Depression and OOP Spending

Table 5.4 reports the full coefficient results from the linear regression that interacts depression and race/ethnicity indicators. The coefficient on depressed represents the effect of depression for non-Hispanic Whites on continuous out-of-pocket spending. For non-Hispanic Whites, depression was associated with a statistically significant $755 increase in continuous out of pocket spending.

The coefficients on non-Hispanic Black and Hispanic, represent the association between a given race/ethnic category, versus non-Hispanic Whites, for those that did not meet the CES-D threshold for depression. Non-Hispanic Blacks without depression, had a statistically significant $1,868 less in OOP spending, compared to non-Hispanic Whites. Hispanics had a statically significant $3,111 less in OOP spending.

The interaction terms were not statistically significant, suggesting a lack of evidence of a moderation effect.

Table 5.4. Full Coefficient Results for OOP Spending among Depressed (Race/Ethnicity Moderation)

	Out-of-Pocket Spending					
	Linear Regression			**GLM Regression**		
	Coefficient	*SE*	*P-Value*	*Coefficient*	*SE*	*P-Value*
CESD						
Not Depressed	REF	REF	REF	REF	REF	REF
Depressed	755.251	708.871	0.287	.204	.127	.107
Race/Ethnicity						
White	REF	REF	REF	REF	REF	REF
Black	-1868.972	469.291	0.000	-.594	.160	.000
Hispanic	-3111.072	987.628	0.002	-1.431	.368	.000
CESD*Race/Ethnicity				REF	REF	REF

Black	331.001	927.036	0.721	.061	.281	.830
Hispanic	531.593	1507.366	0.724	.144	.613	.814
Sex						
Male	REF	REF	REF	REF	REF	REF
Female	-252.438	630.327	0.689	.083	.098	.394
Age	-72.826	68.313	0.287	-.007	.009	.468
Year of Interview	-144.554	75.073	0.054	-.037	.011	.001
Marital Status						
Not Married	REF	REF	REF	REF	REF	REF
Married	323.677	479.634	0500	.087	.106	.412
Education						
None	REF	REF	REF	REF	REF	REF
GED	1457.213	849.817	0.087	.493	.229	.031
High School	2175.145	799.859	0.007	.655	.192	.001
Some College	2066.842	1229.895	0.093	.580	.181	.001
College and beyond	2264.945	839.642	0.007	.706	.182	.000
Labor Force Status						
Full-time	REF	REF	REF	REF	REF	REF
Part-time	1061.001	.248	0.670	-.005	.248	.984
Unemployed	1463.172	.342	. 0.319	.169	.342	.621
Partly Retired	631.518	.172	0.588	-.045	.172	.788
Retired	1488.882	.132	0.019	.283	.132	.033
Disabled	1983.949	.339	0.293	.320	.339	.344
Not in Labor Force	5493.002	.543	0.214	.993	.543	.068
Government Insurance						
Private	REF	REF	REF	REF	REF	REF
Public	-1310.185	1226.881	0.286	-.432	.147	.003
						Mean of Y: 3698.032 (SE:239.897)
						Source: RAND Health and Retirement Study

Discussion

This study makes several important contributions. I document the prevalence of depression among those with a cancer diagnosis and how the prevalence varies by race-ethnicity. I document the association of depression and total out-of-pocket spending and examine if race-ethnicity moderates that relationship.

First, I find high rates of depression among those with a cancer diagnosis (28.58%). Importantly, my measurement of depression is based on symptom reports in a nationally representative sample. The use of self-reported symptoms overcomes limitations of using diagnosis measures that might be confounded by access barriers. Elevated rates of depression are perhaps not surprising given the stress and strain of a cancer diagnosis. However, my results provide evidence of that pattern and will be useful to clinicians working with cancer patients.

Second, in contrast to patterns of depression in the general population (McGuire & Miranda, 2008; Riolo, Nguyen, Greden, & King, 2005), I find that in the population of cancer patients, Non-Hispanic Black and Hispanic patients have elevated rates of depression compared to non-Hispanic White persons. This result is consistent with work by Kurtz, Kurtz, Stommel, Given, & Given (2000). However, my estimates have a particular advantage due to the use of the rich set of data that is unique to the HRS.

Third, I show that, on average, depression symptoms are associated with increased out-of-pocket spending. While, the coefficient was not statistically significant at the 0.05 level, the coefficient was relatively large and precise enough to rule out $0 at the 10% level. This pattern underscores that depression not only affects

the wellbeing of patients but might increase total health service use in ways that puts financial pressures on patients. This finding is consistent with Mausbach and Irwin (2016).

I did not find evidence that the relationship between depression and OOP was moderated by race/ethnicity. This is somewhat promising news as it suggests that interventions that can help reduce OOP burdens among cancer survivors with depression might be effective for all groups. However, while my results suggest similar associations between depression and OOP spending across groups, racial-ethnic minorities experience a higher burden given their elevated prevalence.

A key limitation was the lack of differentiation between types of public insurance. Those who may have enrolled in Medicare by 65 or those who may have qualified for Medicaid may have different requirements and restrictions on OOP spending which may result in an underestimation or overestimation of the role of race/ethnicity in OOP expenses.

Another key limitation was my relative lack of power. I observed only 503 people. Samples by race, particularly for Hispanics, were quite small and I likely lacked sufficient power to detect the interaction effects of interest. Future work, using larger samples, is warranted.

Conclusion

This research provides further rationale for investments in the psychological well-being of cancer patients, especially Black and Hispanic patients who experience

especially high rates of depression. These investments will improve the lives of cancer survivors and reduce overall health care resource use.

Chapter 6: Conclusions and Implications

Overview

In this chapter I summarize results from Chapters 3-5 and put results in context with my greater conceptual framework. Additionally, I discuss the policy implications and future directions for this work.

Summary of Findings

In Chapter 3, I measured the impact of cancer diagnosis on a comprehensive set of financial outcomes for those aged 50 to 64 at the time of cancer diagnosis. I found that OOP spending rises in the year of diagnosis and then reverts to pre-cancer levels. Cancer also appears to significantly affect labor-market earnings and this affect persists over time. However, I did not find evidence of changes in OOP burdens (spending in excess of 10% of income) or in unacceptable borrowing levels.

Chapter 4 examined the influence of race and sex group differences on financial burden among middle-aged and older Americans. I found that both OOP and financial burden spiked in the year of cancer diagnosis and then returned to pre-diagnosis levels for Non-Hispanic Whites. However, I did not find clear evidence of the expected association or detect moderation between financial burden and cancer among non-Hispanic Black patients and Hispanics. For both males and females, I observed statistically significant associations between diagnosis and OOP spending in the year of diagnosis with spending quickly recovered to pre-diagnosis levels. However, the distress experienced in the wave of diagnosis was not negligible.

Additionally, cancer diagnosis was associated with significant increases in financial burden for females.

Chapter 5 describes the prevalence of depression among those diagnosed with cancer, by race-ethnicity, explores OOP spending across all racial groups, and examines if the association between depression and OOP spending among those with a cancer diagnosis varies by race-ethnicity. I found high rates of depression among those with a cancer diagnosis (28.58%) and that Non-Hispanic Black and Hispanic had elevated rates of depression compared to non-Hispanic White persons. Depression was shown to be associated with increased OOP spending, but this association was not shown to be moderated by race/ethnicity.

Implications

Healthcare-based financial burden is common in the U.S (Yabroff, Zhao, Han, et al, 2019). This burden is higher for cancer patients, who pay more out of pocket for care than those who have not had cancer (Zafar, 2015). The financial pressure placed on cancer patients continues to grow - fueled by the cost of treatment and increased cost-sharing. Financial toxicity goes beyond economic concerns; these issues can negatively impact cancer mortality, psychological well-being, and other outcomes (Rotter, Spencer, & Wheeler, 2019).

The results of this project reinforce that cancer can have a deleterious effect on the financial status of those who are diagnosed. Older cancer patients continue to bear the brunt of financial toxicity, with older adults already more likely to experience the harsher effects of a diagnosis, and thus more costly cancers and complications along with a reduced ability to replenish individual and household

finances. As the cost of cancer continues to increase, this trend is likely to be exacerbated. My results indicate that loss of earnings is a major source of economic distress.

This study is pertinent towards the aim of supporting the formulation of solutions and interventions intended to prevent or alleviate financial distress among cancer survivors. First, the fact that I found increased OOP spending in the year of treatment, among a sample of insured older Americans, reinforces the need for policymakers to address the adequacy of existing insurance policies. Recent policy efforts have focused on pharmaceutical costs. Indeed, bringing consumer relief from high drug costs will likely benefit cancer patients. A number of these proposals have focused on capping prices. While that might better protect consumers, such proposals must be weighed against the tradeoff of reducing drug company incentives to develop novel innovations that benefit patients.

The data did not support my hypothesis of moderation in financial toxicity by race-ethnicity. In fact, I found no evidence that Black and Hispanic patients experienced a spike in OOP. This might be caused by relatively more generous health plans (via their over-representation in public programs that have low to no cost-sharing) or due to access barriers that are preventing them from incurring expenditures in the first place. More work needs to be done to support minority patients.

A key finding from Aim 1 was that cancer survivors withdraw from the labor force. This suggests that a critical area for policy innovation is income supports that help keep people engaged in labor markets. The lack of consistent paid sick leave

policies at the federal level is an important problem whose solution might benefit cancer survivors.

Aim 3 produced new evidence on depression and cancer. I estimated very high rates of depression. Clinicians must be prepared to integrate mental health care into routine cancer treatment. Depression was associated with increased OOP spending, suggesting that depression exerts comprehensive harm and leads to excess health care resource use. However, while I did find variation in the prevalence of depression by race, I did not find moderation in the effect of depression by race. This suggests that similar interventions might help all patients equally.

This project furthers knowledge in the field via the production of credible estimates examining the effect of cancer on financial outcomes and the prevalence and effect of depression on cancer. Most uniquely, the exploration of the moderating role of race/ethnicity and sex adds to the literature base addressing social determinants of health and the infusing of health equity and health disparity nuances based on group identification. This creates a foundation for addressing these issues in more equitable manner that responds to the diversity of the population of cancer patients and survivors in the U.S.

Future Directions

Although clear evidence was not found for the moderating role of race/ethnicity and sex, it is important that more studies be conducted focused sub-group experiences. Not all patients experience the same objective financial burden;

certain subgroups of the population are at higher risk given structural barriers to wealth and income.

It would be remiss to fail to acknowledge the continual evolution of insurance coverage policy during the years assessed in this dissertation (2000 – 2016). Medicare Part D, covering prescription drugs, was passed in 2003. Additionally, the Affordable Care Act, signed in 2010. These changes have increased access for many, yet there still exist gaps in which individuals may experience underinsurance or financial difficulties.

As cancer technologies continue to advance – coverage of these new treatment options is not always in pace, especially accounting for the higher costs of new therapies. For example, some intravenous therapies cannot be covered via Medicare Part D. Standard care changes that include the use of oral therapies earlier in a treatment process can substantially raise the cost of care for some cancers (Abrams, Durbin, Huang, et al 2021). In conjunction, as the threshold for catastrophic coverage increases, cancer care costs will be frontloaded, disproportionately affecting those without sufficient savings and exacerbating the effect of financial toxicity (Abrams, Durbin, Huang, et al 2021).

While research has described the financial harm associated with cancer treatment, evidence-based solutions and policy interventions are still scarce. Future research should focus on assessing long-term policy changes to address the growing cost of cancer care and promote insurance models that allow for more necessary cost-sharing to shoulder the burden for more individuals and families – otherwise patients

will continue to struggle with increased OOP spending and heightened financial burden.

There exist differences in cost and effect based on cancer type. For example, Tracheal, bronchus, and lung cancer have been shown to be some of the costliest cancers (Chen, Cao, Klaus, et al 2023). Future research should focus on detangling the role of cancer type and treatment to fully understand how these affect cost and ultimately individual financial outcomes. The stage of cancer is also of importance – since the earlier a cancer is found the less costly treatment options may be (McGarvey, Gitlin, Fadli).

The financial toxicity of cancer care is an important policy issue. However, devising appropriate solutions must account for the varied experiences and structural barriers that distinct groups of patients face. In this study I failed to find the significant moderation effects I expected to find. Untangling these effects from improved financial protection or reductions in clinically indicated utilization is a crucial task for on-going work. This research should be built upon by examining the outcomes for other racial/ethnic groups and exploring the intersection of race/ethnicity and sex. There are also nuances within races that may fall along sex lines that if dissected would aid in providing greater nuance to the types of interventions targeting the issue of financial toxicity.

Lastly, given the high cost of cancer treatment, this study creates a research base for future assessment of healthcare spending and saving attributable to the detection and treatment of depression within cancer patients. Further research should similarly examine sociodemographic characteristics are needed to evaluate this

economic impact. Additionally, the prevalence of depression in cancer patients necessitates more research focused on interdisciplinary care models which can concurrently address cancer and mental health.

Conclusion

This research joins a growing body of evidence supporting the existence of financial toxicity resulting from a cancer diagnosis and the relationship between depression and cancer. Additional work is needed to further explain the relationship between financial distress, sociodemographic factors, and depression with efforts to determine which factors contribute most to distress. This research is crucial in addressing these issues in that it builds the foundation for necessary policy intervention that are concurrently needed to effectuate change in the impact of financial toxicity amongst older Americans.

Appendix

Table A1. Out-of-Pocket Spending Coefficient Results			
	Coefficient	*SE*	*P-Value*
Cancer Timing			
-3	-2592.33	371.77	0
-2	-2539.3	346.89	0
-1	-2076.57	318.95	0
0	REF	REF	REF
1	-1685.71	272.46	0
2	-1158.26	338.4	0.001
3	-729.04	393.32	0.064
Age			
	-35.12	34.45	0.308
Married			
	-232.04	428.66	0.588
Labor Force Status			
Part-time	352.548	492.311	0.474
Unemployed	947.78	507.642	0.062
Partly Retired	443.47	354.696	0.211
Retired	312.77	272.594	0.251
Disabled	917.45	664.4	0.167
Not in Labor Force	6.74	476.89	0.989
Government Insurance			
	675.9303	330.11	0.041
Source: Health and Retirement Study			

Table A2. Financial Burden Coefficient Results			
	Coefficient	*SE*	*P-Value*
Cancer Timing			
-3	0.002	0.026	0.921
-2	-0.061	0.022	0.007
-1	-0.066	0.02	0.001
0	REF	REF	REF
1	-0.061	0.018	0.001
2	-0.024	0.021	0.26
3	-0.005	0.026	0.834
Age			
	-0.012	0.002	0
Married			
	-0.102	0.026	0
Labor Force Status			
Part-time	0.014	0.03	0.58
Unemployed	0.048	0.04	0.26
Partly Retired	0.046	0.02	0.06
Retired	0.076	0.02	0
Disabled	0.132	0.03	0
Not in Labor Force	0.085	0.04	0.03
Government Insurance			
	0.009	0.02	0.657
Source: Health and Retirement Study			

Table A3. Respondent Earnings Coefficient Results			
	Coefficient	*SE*	*P-Value*
Cancer Timing			
-3	1670.97	2300.12	0.468
-2	4632.47	2178.24	0.03
-1	2494.81	1680.38	0.138
0	REF	REF	REF
1	2505.17	1966.15	0.203
2	1867.02	1825.62	0.306
3	2427.79	2574.16	0.346
Age			
	-0.01	-452.28	0.058
Married			
	0.1	-3350.1	0.346
Labor Force Status			
Part-time	-13351.96	2343.83	0
Unemployed	-13569.08	2584.45	0
Partly Retired	-22673.76	2209.5052584.452	0
Retired	-29273.96	1955.91	0
Disabled	-28704.73	1926.44	0
Not in Labor Force	-28293.93	2196.38	0
Government Insurance			
	-7850.1	1947.61	0
Source: Health and Retirement Study			

Table A4 Debt-to-Asset Ratio Coefficient Results			
	Coefficient	*SE*	*P-Value*
Cancer Timing			
-3	-0.003	0.023	0.876
-2	-0.016	0.022	0.473
-1	-0.013	0.019	0.464
0	REF	REF	REF
1	-0.043	0.017	0.012
2	-0.044	0.019	0.017
3	-0.036	0.023	0.119
Age			
	0.001	0.002	0.49
Married			
	0.01	0.026	0
Labor Force Status			
Part-time	-0.013	0.023	0.573
Unemployed	-0.006	0.039	0.878
Partly Retired	-0.033	0.019	0.1
Retired	-0.02	0.016	0.226
Disabled	0.02	0.035	0.555
Not in Labor Force	0.018	0.029	0.547
Government Insurance			
	0.019	0.018	0.291
Source: Health and Retirement Study			

Table A5. Full Coefficient Results for White, Non-Hispanics						
	Out-of-Pocket			Financial Burden		
	Coefficient	*SE*	*P-Value*	*Coefficient*	*SE*	*P-Value*
Cancer Timing						
-3	-2547.76	372.79	0	0	0.03	0.92
-2	-2518.13	350.39	0	-0.06	0.02	0
-1	-2086.33	322/93	0	-0.07	0.02	0
0	REF	REF	REF	REF	REF	REF
1	-1628.05	269.5	0	-0.06	0.02	0
2	-1114.62	341.29	0	-0.02	0	0.26
3	-685.29	394.7	0.08	0	0.03	0.83
Age						
	-26.16	34.77	0.45	-0.01	0	0
Married						
	-119.622	439.486	0	-0.098	0.265	0
Labor Force Status						
Part-time	367.42	498.47	0.46	0.03	0.03	0.58
Unemployed	747.62	479.4	0.12	0.05	0.04	0.26
Partly Retired	415.62	356.81	0.24	0.05	0.02	0.06
Retired	282.08	274.87	0.31	0.08	0.02	0
Disabled	975.76	692.36	0.16	0.13	0.03	0
Not in Labor Force	72.64	493.21692.36	0.88	0.08	0.04	0.03
Government Insurance						
	-768.08	332.07	0.02	0	0.02	0.66
Source: Health and Retirement Study						

Table A6. Full Coefficient Results for Black, Non-Hispanics						
	Out-of-Pocket			**Financial Burden**		
	Coefficient	*SE*	*P-Value*	*Coefficient*	*SE*	*P-Value*
Cancer Timing						
-3	508.2	687.95	0.46	-0.45	0.05	0.39
-2	382.55	655.08	0.56	0.02	0.05	0.66
-1	1653.67	825.14	0.05	0.02	0.05	0.7
0	CG	CG	CG	CG	CG	CG
1	426.78	517.08	0.41	0.03	0.04	0.51
2	-34.8	515.02	0.95	-0.02	0.05	0.66
3	1.08	509.59	0.1	-0.04	0.04	0.33
Age						
	-26.42	34.83	0.45	-0.01	0	0
Married						
	-372.29	431.95	0.39	-0.1	0.03	0
Labor Force Status					0.03	
Part-time	382.83	498.12	0.44	0.02	0.04	0.56
Unemployed	768.49	480.87	0.11	0.05	0.34	0.27
Partly Retired	422.64	356.71	0.24	0.05	0.02	0.06
Retired	283.74	274.73	0.3	0.08	0.02	0
Disabled	978.1	694.99	0.16	0.13	0.03	0
Not in Labor Force	64.74	493.45	0.9	0.09	0.04	0.03
Government Insurance						
	-769.43	332.84	0.02	0	0.02	0.69
Source: Health and Retirement Study						

Table A7. Full Coefficient Results for Hispanics						
	Out-of-Pocket			**Financial Burden**		
	Coefficient	SE	P-Value	Coefficient	SE	P-Value
Cancer Timing						
-3	901.46	1433.91	0.53	-0.15	0.15	0.34
-2	491.94	1491.63	0.74	0.1	0.18	0.59
-1	1115.08	1528.1	0.47	0.22	0.11	0.04
0	CG	CG	CG	CG	CG	CG
1	-2540.13	2808.15	0.3	0.07	0.11	0.52
2	-3193.4	247.5	0.2	-0.02	0.09	0.83
3	-3928.66	3287.73	0.23	0.11	0.08	0.17
Age	-33.68	34.37	0.33	-0.01	0	0
Married	-277.7	428.96	0.52	-0.102	0.03	0
Labor Force Status						
Part-time	371.07	493.66	0.452	0.01	0.03	0.06
Unemployed	926.79	503.2	0.07	0.05	0.04	0.25
Partly Retired	429.35	354.92	0.23	0.05	0.02	0.05
Retired	321.95	273.25	0.24	0.08	0.02	0
Disabled	890.79	666.62	0.18	0.13	0.03	0
Not in Labor Force	8.32	477.98	0.99	0.09	0.04	0.03
Government Insurance	-713.44	329.16	0.03	0	0.02	0.658
Source: Health and Retirement Study						

Table A8. Full Coefficient Results for Males						
	Out-of-Pocket			**Financial Burden**		
	Coefficient	*SE*	*P-Value*	*Coefficient*	*SE*	*P-Value*
Cancer Timing						
-3	-321.33	604.79	.6	0.08757	0.04	0.027
-2	-451.6	659.8	0.5	0.038	0.041	0.355
-1	-118.49	638.38	0.85	0.021	0.038	0.584
0	CG	CG	CG	REF	REF	REF
1	185.92	522.89	0.72	-0.017	0.036	0.636
2	985.23	642.07	0.13	0.019	0.038	0.629
3	187.37	513.64	0.72	0	0.033	0.992
Age	-35.37	34.47	0.31	-0.011	0.003	0
Married	-242.8	423.8	0.57	-0.1	0.026	0
Labor Force Status					26	
Part-time	314.94	489.41	0.52	0.017	0.026	0.488
Unemployed	918.09	509.72	0.07	0.051	0.043	0.23
Partly Retired	430.36	354.69	0.23	0.048	0.025	0.049
Retired	318.6	270.31	0.24	0.078	0.019	0
Disabled	923.48	665.21	0.17	0.132	0.034	0
Not in Labor Force	-3.68	479.7	0.99	0.089	0.04	0.026
Government Insurance	-687.18	327.27	0.04	0.009	0.021	0.67
Source: RAND Health and Retirement Study						

Table A9. Full Coefficient Results for Females						
	Out-of-Pocket			**Financial Burden**		
	Coefficient	*SE*	*P-Value*	*Coefficient*	*SE*	*P-Value*
Cancer Timing						
-3	-321.328	604.797	0.595	0.088	0.027	0.027
-2	-451.596	659.798	0.494	0.038	0.355	0.355
-1	-118.492	638.378	0.853	0.021	0.584	0.584
0	REF	REF	REF	REF	REF	REF
1	185.918	522.889	0.722	-0.017	0.636	0.636
2	985.232	642.073	0.125	0.018	0.629	0.629
3	187.371	513.644	0.715	0	0.992	0.992
Age	-35.374	34.473	0.305	-0.011	0.002	0
Married	-242.796	42.804	0.567	-0.1	0.026	0
Labor Force Status						
Part-time	314.94	489.411	0.52	0.018	0.026	0.488
Unemployed	918.086	509.724	0.072	0.052	0.043	0.232
Partly Retired	430.362	354.687	0.225	0.048	0.025	0.049
Retired	318.601	270.311	0.239	0.078	0.019	0
Disabled	923.484	665.211	0.165	0.132	0.034	0
Not in Labor Force	-3.677	479.701	0.994	0.089	0.04	0.026
Government Insurance	-687.184	327.272	0.036	0.009	0.021	0.67
Source: RAND Health and Retirement Study						

Table A10. Full Coefficient Results for OOP Spending among Depressed (Race/Ethnicity Moderation)			
	Out-of-Pocket		
	Coefficient	*SE*	*P-Value*
CESD			
Not Depressed	REF	REF	REF
Depressed	.204	.127	.107
Race/Ethnicity			
White	REF	REF	REF
Black	-.594	.160	.000
Hispanic	-1.431	.368	.000
CESD*Race/Ethnicity			
White	REF	REF	REF
Black	.061	.281	.830
Hispanic	.144	.613	.814
Sex			
Male	REF	REF	REF
Female	.083	.098	.394
Age	-.007	.009	.468
Year of Interview	-.037	.011	.001
Marital Status			
Not Married	REF	REF	REF
Married	.087	.106	.412
Education			
None	REF	REF	REF
GED	.493	.229	.031
High School	.655	.192	.001
Some College	.580	.181	.001
College and beyond	.706	.182	.000
Labor Force Status			
Full-time	REF	REF	REF
Part-time	-.005	.248	.984
Unemployed	.169	.342	.621
Partly Retired	-.045	.172	.788
Retired	.283	.132	.033
Disabled	.320	.339	.344
Not in Labor Force	.993	.543	.068
Government Insurance			
Private	REF	REF	REF
Public	-.432	.147	.003
Mean of Y: 3689.03 (SE:195.399)			
Sample Size: 1612			
Source: Health and Retirement Study			

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