Lifestyle choices among women with breast cancer in the United States

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Abstract

Introduction: Breast Cancer is a common form of cancer for women. The goal of this research was to estimate how a breast cancer diagnosis affects a woman's decisions about smoking, alcohol use, and exercise.
Methods: Using data from the Panel Study of Income Dynamics on breast cancer diagnosis and lifestyle choices, we estimated how being diagnosed influences smoking, drinking, and exercising habits for more than 8,000 women over the period 1999 to 2011.
Results: Controlling for unobserved heterogeneity, persistence in behaviors, and correlation across behaviors, we found that the impact of a diagnosis had a different effect on smoking, drinking, and exercising behavior. Furthermore, the impact depended upon the recency of the diagnosis. Recently diagnosed women exercised and smoked less – an average woman in our sample reduced exercise by 19% and smoking by 1%. However, women with breast cancer did not change their drinking habits relative to healthy women.
Conclusions: A diagnosis of breast cancer impacts lifestyle choices. Women who were diagnosed with breast cancer in the last five years exercised and smoked less but did not change their alcohol consumption after a breast cancer diagnosis regardless of when the diagnosis was made. Our approach provided insight into what extent women who are faced with negative information about life expectancy take this into consideration when deciding to engage in risky behaviors that might further affect their survival. Whether to engage in physical activity, drink alcohol, or smoke are choices associated with how to live.

Keywords: breast cancer, risky health behavior, health economics

1 INTRODUCTION

About 13% of US women will develop breast cancer at some point during their life, and worldwide incidence is rising [1]. There are many genetic and demographic factors linked to breast cancer risk. In addition, several lifestyle habits are associated with incidence including weight gain, fat intake, and level of physical activity, while others have been inconsistently linked with the disease including alcohol consumption and cigarette smoking [2-13]. Whether to engage in physical activity, drink alcohol, or smoke are choices associated with how to live [10-24]. Therefore, understanding lifestyle decisions made by diagnosed women can provide useful information about the tradeoffs women are willing to make between participating in unhealthy habits and increasing one's life expectancy.

Individuals with a breast cancer diagnosis are a particularly informative group to learn about the value of engaging in risky behaviors. As noted earlier, lifestyle habits are associated with breast cancer incidence. Breast cancer is a cancer with one of the highest survival rates - nearly 90% of patients survive the first five years. It is also one of the cancers with the highest recurrence rates. Almost 30% of patients with breast cancer who are free of the disease after initial treatment(s) have a recurrence during follow-up [25]. These facts together suggest that choices made among these individuals can be used to inform us about the value of risky behaviors because (i) behaviors influence incidence, (ii) there is an incentive to change behavior to combat recurrence, and (iii) the sample size is large enough as there are a substantial number diagnosed people who survive more than five years post-diagnosis.

The Panel Study of Income Dynamics contains rich longitudinal information on the timing of breast cancer diagnosis and lifestyle choices that we used to estimate the model. We examined the impact a breast cancer diagnosis had on engaging in (potentially addictive) risky behaviors over time. This approach illustrated to what extent women who are faced with negative information about life expectancy take this into consideration when deciding to engage in risky behaviors that might further affect their survival in a significant way.

2 METHODS

We used data from the Panel Study of Income Dynamics (PSID), a longitudinal study that started in 1968 and now includes more than 22,000 individuals from over 9,000 households in the United States. One person per family, designated as the "head," is interviewed biennially and answers questions about the individuals of the household. The head of the household provides answers for questions related to his or her spouse. The literature has shown that spouses have very precise perceptions of the time spent by the other spouse on different activities [26]. Similarly, it has been shown that spouses provide complete information for various lifestyle behaviors of their spouse such as smoking and drinking behaviors [27, 28]. Every wave contains information about employment, income, education, wealth, marriage, childbearing, and various other topics. We choose to use the PSID data set because of its longitudinal structure which allows us to follow the same individuals and their corresponding behaviors across time. Further, these data are collected not only for breast cancer patients but also for persons without a history of cancer. This allows us to make comparisons between breast cancer patients and healthy individuals.

Data variables

We used data from seven waves of the PSID from 1999, when cancer outcomes were first recorded, until 2011. We retained respondents who were aged 15 and older and were female because breast cancer almost exclusively affects women. After dropping individuals who had missing information on age, race, education level, income, breast cancer condition, or (lagged) lifestyle behaviors, we had a sample of 8,028 women and 34,109 person-years. Some of these women had missing information on one lifestyle behavior but not another. For our analysis on each behavior, we dropped only those observations with missing values for questions related to those behaviors. So, for smoking habits, this subsample included 8,019 women and 33,947 person-years; for exercise it included 8,009 women and 33,851 person-years, while for drinking it is smaller (for reasons we discuss momentarily) and included 7,175 women and 18,082 person-years.

In our analysis, we aggregated light and heavy physical activities into a variable called "exercise." Heavy exercise refers to "heavy housework, aerobics,

running, swimming, bicycling or similar activity that causes heavy sweating or large increases in breathing or heart rate" [29]. Light exercise includes "walking, dancing, gardening, golfing, bowling or similar activity that causes only light sweating or slight to moderate increases in breathing or heart rate" [29, 30].

Data handling

As the survey questions concerning alcohol consumption were not consistently worded across waves, we reported statistics only for the last four waves (2005, 2007, 2009, and 2011). For the first three waves (1999, 2001, and 2003), people were asked how many drinks they had on average per day: "In the last year, on average, how often did you have any alcohol to drink? Would you say, less than one a month, about once a month, several times a month, about once a week, several times a week, or every day?" For the last four waves, the categories were changed and the questions about daily consumption referred to days when respondents drink: "In the last year, on the days you drank, about how many drinks did you have?" In later regressions, we also used data only from years 2005, 2007, 2009, and 2011 when looking at alcohol behaviors.

With regard to breast cancer diagnosis, the survey asked "Has a doctor ever told you that you have or had cancer or a malignant tumor?" If the respondent answered "yes," follow-up questions were asked regarding the type of cancer and the stage.

Econometric specifications

In our framework, a woman made a lifestyle choice in each period, where the lifestyle behaviors may have been influenced by breast cancer diagnosis. The lifestyle choices concerned how much to smoke, how much to consume alcohol, and how much to engage in physical activity. We specified equations for each latent variable measuring the continuous quantity of each lifestyle activity chosen by the woman in each time period. Specifically, the baseline model specified each latent dependent variable as a function of lagged behavior, a set of explanatory variables shown in Table 1, whether the woman had breast cancer, a person/activity-specific error, and an idiosyncratic error.

There may be heterogeneity that we did not observe in the data that influenced choices and had a persistent nature. Unobserved heterogeneity likely to influence lifestyle choices was included as a person/behavior-specific random

effect which captured things such as taste for alcohol or dislike of exercise, and an idiosyncratic effect.

Whether a woman had been diagnosed with breast cancer may have impacted her decision to engage in risky behaviors, for example, if she felt that those behaviors may have reduced her longevity more severely than prior to the breast cancer diagnosis. To the extent that smoking, drinking, or exercise are risk factors for getting breast cancer, one may be concerned that having breast cancer is a function of prior choices. In effect, causation may run in both directions. We addressed issues of endogeneity and unobserved heterogeneity using fixed effects techniques [31]. Finally, we needed to include an initial value of the risky decisions at time t=0. These are likely to be endogenous, and we followed previous literature [31] to control for endogenous initial conditions.

We began by estimating three models corresponding to the lifestyle activities separately. Then we allowed for correlation across smoking, drinking, and exercise behaviors by estimating all decisions jointly. However, due to data restrictions that we mentioned earlier, some of these behaviors are recorded only for a subset of the data. We estimated the parameters of our model by a dynamic ordered probit estimation methodology. Details are provided in Appendix 1 and Appendix 2.

3 RESULTS

Table 1 reports demographic summary statistics. Our sample consisted of 58% white respondents, 30% black respondents, 8% Latino respondents, and 4% from remaining races. About 9.4% of the sample had been diagnosed with cancer and 2.3% with breast cancer.

Table 2 reports health behaviors summary statistics for our sample. The survey reported the proportion of current drinkers, which referred to adults who had at least 12 drinks in their lifetime and at least one drink in the past year.

Table 1: Demographics of individuals included in the Panel Study of Income Dynamics 1999-2011, United States		
Variable	**Mean**	**Standard Deviation**
Age (Years)	46.28	15.59
White	0.58	0.49
Black	0.31	0.46
Married	0.64	0.48
Employed	0.63	0.48
Has Children	0.87	0.34
Highest Education Level		
High School Diploma	0.42	0.49
College Degree	0.33	0.47
Post-graduate Degree	0.09	0.29
Taxable Income (United States dollars)		
< $20,000	0.18	0.39
> $50,000	0.23	0.42
Diagnosed with		
Cancer	0.09	0.29
Breast Cancer	0.02	0.15
Note: Number of Person-Years is 34,109.		

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Table 2: Health behaviors of individuals from the Panel Study of Income Dynamics 1999-2011, United States

Variable	Mean	Standard deviation	Person-years
Smoking Status			33,967
Current Smoker	0.18	0.38	
Cigarette Consumption			5,987
Smokes 1 to 9 cigarettes/day	0.33	0.47	
Smokes 10 to 19 cigarettes/day	0.36	0.48	
Smokes 20 or more cigarettes/day	0.30	0.46	
Alcohol			18,082
Drinks Alcohol	0.54	0.49	
Frequency of Alcohol Consumption			9,814
Less than 1 drink/month	0.29	0.45	
1 drink/month	0.21	0.40	
Several drinks/month	0.16	0.37	
One drink/week	0.17	0.37	
Several drinks/week	0.14	0.34	
Drinks every day	0.04	0.19	
Exercise			33,581
Never	0.17	0.38	
1 or 2 times/week	0.18	0.38	
3 to 6 times/week	0.31	0.46	
7 times/week	0.31	0.46	
8 to 14 times/week	0.02	0.12	
More than 14 times/week	0.02	0.14	

As can be seen in Table 3, the sample average age for a breast cancer diagnosis was approximately 51 years. Most of our respondents were "cured," while approximately 9% were in treatment.

In Table 4, we report prevalence of breast cancer diagnosis by demographic groups. The proportion of respondents having breast cancer was larger among whites than among individuals of other races.

Table 3: Descriptive statistics for individuals with breast cancer from the Panel Study of Income Dynamics 1999-2011, United States

Variable	Mean	Std. Dev.	# Person-Years
Years Since Breast Cancer Diagnosis	11.25	12.20	1,472
Age at Breast Cancer Diagnosis	51.39	14.73	
Currently[1]			
Cured	0.75	0.42	
In Remission	0.14	0.35	
In Treatment	0.09	0.29	

[1] These questions are asked starting only in 2005.

Table 4: Proportion of breast cancer diagnoses by demographics from the Panel Study of Income Dynamics 1999-2011, United States

Variable	Mean	Standard Deviation	Person-Years	p-value[1]
Race				<0.001
White	0.02	0.17	19,838	
Black	0.01	0.13	10,413	
Age				<0.001
Younger than 30	0.00	0.02	5,187	
Between 30 and 59	0.01	0.13	22,657	
60 and older	0.06	0.25	6,265	
Family Composition				<0.001
Have Children	0.03	0.16	28,581	
Childless	0.01	0.12	5,528	
Education				0.045
No High School Diploma	0.02	0.16	5,736	
High School Diploma	0.02	0.15	14,249	
Associate or Bachelor	0.02	0.14	11,069	
More than Bachelor	0.02	0.14	3,055	
Family Income (United States dollar)				<0.001
Income< $20,000	0.03	0.18	6,246	
$20,000<Income<$50,000	0.01	0.14	7,782	

Income>$50,000	0.02	0.15	20,081

[1] The reported p-values are from multivariate tests on equal means.

Table 5 displays breast cancer diagnosis among individuals with differing smoking, drinking, and exercise habits. The bottom panel 5 presents statistics for physical activity. The proportion of breast cancer patients was the largest among people who never exercise.

Table 5: Proportion of breast cancer diagnoses by health behaviors from the Panel Study of Income Dynamics 1999-2011, United States

Variable	Proportion	Person-Years	p-value[1]
Smoking Status			<0.001
Smoker	0.02	5,987	
Non-Smoker	0.03	27,980	
Cigarette Consumption			0.037
Smokes 1 to 9 cigarettes/day	0.01	1,998	
Smokes 10 to 19 cigarettes/day	0.01	2,174	
Smokes 20 or more cigarettes/day	0.02	1,815	
Alcohol			<0.001
Drinks Alcohol	0.02	9,814	
Never Drinks Alcohol	0.03	8,268	
Frequency of Alcohol Consumption[2]			0.058
Less than 1 drink/month	0.02	2,853	
One drink/month	0.02	2,009	
Several drinks/month	0.02	1,563	
One drink/week	0.02	1,640	
Several drinks/week	0.03	1,346	
Drinks every day	0.03	403	
Exercise			<0.001
Never	0.04	5,817	
1 or 2 times/week	0.02	6,070	
3 to 6 times/week	0.02	10,318	
7 times/week	0.02	10,423	
8 to 14 times/week	0.01	546	
More than 14 times/week	0.02	677	

[1] The reported p-values are from multivariate tests on equal means.

[2] Used waves 2005-2011.

Table 6 presents random-effects ordered probit estimates where the explanatory variables included smoking behavior in the previous year, demographics, as well as breast cancer variables.

Table 6: Random-effects ordered probit regressions for smoking

Dependent Variable: Ordered Variable for Number of Cigarettes Smoked

	1		2		3		4	
Lagged Behavior								
Smoker Last Period	2.43	***	1.64	***	2.43	***	1.64	***
	(0.03)		(0.04)		(0.03)		(0.04)	
Breast Cancer Variables								
Diagnosed with Breast Cancer	-0.010		-0.15					
	(0.09)		(0.14)					
Recent Breast Cancer Diagnosis					-0.28	**	-0.32	***
					(0.14)		(0.17)	
Other Controls								
Aged in 30s, 40s, or 50s	-0.02		0.17	**	-0.02		0.17	***
	(0.03)		(0.05)		(0.03)		(0.05)	
Aged 60s or Older	-0.51	***	-0.16		-0.52	***	-0.16	
	(0.05)		(0.10)		(0.05)		(0.10)	
White	0.47	**	0.70	**	0.47	**	0.70	***
	(0.05)		(0.08)		(0.05)		(0.08)	
Black	0.08		0.19	**	0.08		0.19	**
	(0.05)		(0.08)		(0.05)		(0.08)	
Married	-0.22	***	-0.25	***	-0.22	***	-0.25	***
	(0.03)		(0.03)		(0.03)		(0.03)	
Have Children	0.00		-0.03		0.00		-0.03	
	(0.04)		(0.06)		(0.04)		(0.06)	
Highest Education is High School	-0.24	***	-0.35	***	-0.24	***	-0.35	***
	(0.03)		(0.05)		(0.03)		(0.05)	
Highest Education is University Degree	-0.50	***	-0.70	***	-0.50	***	-0.70	***
	(0.04)		(0.06)		(0.04)		(0.06)	
Highest Education is Post Graduate	-0.89	***	-1.26	***	-0.89	***	-1.26	***
	(0.07)		(0.10)		(0.07)		(0.10)	
Income Less than 20K	0.10	***	0.10	***	0.10	***	0.10	***
	(0.03)		(0.04)		(0.03)		(0.04)	
Income Between 20K and 50K	0.09	***	0.10	***	0.09	***	0.10	***
	(0.03)		(0.03)		(0.03)		(0.04)	
Initial Conditions Included	No		yes		no		Yes	
Number of Observations	33,967		33,942		33,967		33,942	
Number of Individuals	8,019		8,010		8,019		8,010	

Notes:

1) Standard errors are in parentheses.

2) * p-value<.10, ** p-value<.05, *** p-value<.01

3) All regressions include cutoff points, individual heterogeneity variance, and fixed effects.

4) The initial conditions specifications include the mean over time of all time-varying regressors.

Table 7 presents the results of a random-effects ordered probit regression for number of alcoholic drinks, where the dependent variable is ordered according to: (i) a non-drinker, (ii) a woman who drinks at most once a week on average, and (iii) a woman who drinks more than once a week on average.

Table 7: Random-effects ordered probit regressions for alcohol consumption

Dependent Variable: Ordered Variable for Number of Alcoholic Drinks

	1		2		3		4	
Lagged Behavior								
Number of Drinks Last Period	0.22	***	0.05	***	0.22	***	0.05	***
	(0.01)		(0.01)		(0.01)		(0.01)	
Breast Cancer Variables								
Diagnosed with Breast Cancer	-0.07		-0.10					
	(0.13)		(0.14)					
Recent Breast Cancer Diagnosis					-0.01		-0.08	
					(0.18)		(0.18)	
Other Controls								
Aged in 30s, 40s, or 50s	0.01		0.10	**	0.01		0.10	
	(0.04)		(0.05)		(0.04)		(0.05)	
Aged 60s or Older	-0.39	***	-0.16	**	-0.39	***	-0.16	**
	(0.06)		(0.07)		(0.06)		(0.07)	
White	0.84	***	0.71	***	0.84	***	0.71	***
	(0.0)		(0.07)		(0.07)		(0.07)	
Black	0.13	*	0.14	*	0.13	*	0.14	*
	(0.07)		(0.08)		(0.07)		(0.08)	
Married	-0.19	***	-0.15	***	-0.19	***	-0.15	***
	(0.04)		(0.04)		(0.04)		(0.04)	
Have Children	-0.47	***	-0.39	***	-0.47	***	-0.39	***
	(0.05)		(0.06)		(0.05)		(0.06)	
Highest Education is High School	0.46	***	0.46	***	0.46	***	0.46	***
	(0.06)		(0.06)		(0.06)		(0.06)	
Highest Education is University Degree	0.80	***	0.80	***	0.80	***	0.80	***
	(0.06)		(0.06)		(0.06)		(0.06)	
Highest Education is Post Graduate	1.00	***	1.01	***	1.00	***	1.01	***
	(0.08)		(0.08)		(0.08)		(0.08)	
Income Less than 20K	-0.07		-0.05		-0.07		-0.05	
	(0.04)		(0.04)		(0.04)		(0.04)	
Income Between 20K and 50K	-0.06		-0.06		-0.06		-0.06	
	(0.03)		(0.04)		(0.03)		(0.04)	
Initial Conditions Included	No		yes		No		Yes	
Number of Observations	18,082		18,036		18,082		18,036	
Number of Individuals	7,175		7,147		7,175		7,147	

Notes:
1) Standard errors are in parentheses.
2) * p-value<.10, ** p-value<.05, *** p-value<.01
3) All regressions include cutoff points, individual heterogeneity variance, and fixed effects.
4) The initial conditions specifications include the mean over time of all time-varying regressors.

We present the results of the random-effects ordered probit for exercise frequency in Table 8. Exercise frequency was based on the number of exercise sessions per week.

We re-estimated the specifications from Tables 6-8 with additional covariates measuring changes. These results are presented in Appendix 4, Table 10. The results show no significant changes in the impact of a breast cancer diagnosis and the impact of a recent diagnosis on income.

Table 8: Random-effects ordered probit regressions for exercising

Dependent Variable: Ordered Variable for Number of Exercising

	1		2		3		4	
Lagged Behavior								
Exercise Frequency Last Period	0.17	***	0.12	***	0.17	***	0.12	***
	(0.01)		(0.00)		(0.01)		(0.01)	
Breast Cancer Variables								
Diagnosed with Breast Cancer	-0.14	***	-0.16	***				
	(0.05)		(0.05)					
Recent Breast Cancer Diagnosis					-0.13	**	-0.15	**
					(0.07)		(0.07)	
Other Controls								
Aged in 30s, 40s, or 50s	-0.13	***	-0.14	***	-0.13	***	0.14	***
	(0.01)		(0.02)		(0.01)		(0.02)	
Aged 60s or Older	-0.38	***	-0.39	***	-0.38	***	-0.39	***
	(0.02)		(0.02)		(0.02)		(0.02)	
White	0.15	***	0.13	***	0.15	***	0.13	***
	(0.02)		(0.02)		(0.02)		(0.02)	
Black	-0.06	**	-0.06	**	-0.06	**	-0.06	**
	(0.02)		(0.02)		(0.02)		(0.02)	
Married	0.05	***	0.05	***	0.05	***	0.05	***
	(0.01)		(0.01)		(0.01)		(0.01)	
Have Children	0.01		0.01		0.01		0.01	
	(0.02)		(0.02)		(0.02)		(0.02)	
Highest Education is High School	0.11	***	0.10	***	0.11	***	0.10	***
	(0.02)		(0.02)		(0.02)		(0.02)	
Highest Education is University Degree	0.16	***	0.15	***	0.16	***	0.15	***
	(0.02)		(0.02)		(0.02)		(0.02)	
Highest Education is Post Graduate	0.19	***	0.19	***	0.19	***	0.19	***
	(0.03)		(0.03)		(0.03)		(0.03)	
Income Less than 20K	0.04	**	0.03	*	0.04	**	0.03	*
	(0.02)		(0.02)		(0.02)		(0.02)	
Income Between 20K and 50K	0.06	***	0.05	***	0.06	***	0.05	***
	(0.01)		(0.01)		(0.01)		(0.01)	
Initial Conditions Included	No		yes		no		yes	
Number of Observations	33,851		33,851		33,851		33,851	
Number of Individuals	8,009		8,009		8,009		8,009	

Notes:

1) Standard errors are in parentheses.

2) * p-value<.10, ** p-value<.05, *** p-value<.01

3) All regressions include cutoff points, individual heterogeneity variance, and fixed effects.

4) The initial conditions specifications include the mean over time of all time-varying regressors.

It may be the case that decisions to smoke, drink, or exercise are correlated with each other even after controlling for observed covariates. Table 9 presents the estimates from dynamic multivariate ordered probit regressions which allowed for this correlation. These regressions use information on all behaviors over all periods during which they are available, hence the sample size is somewhat smaller. The first specification included information on whether an individual was diagnosed with breast cancer and the second included only a recent diagnosis.

Table 9: Multivariate o probit regressions

	1						2					
	Smoking		Drinking		Exercise		Smoking		Drinking		Exercise	
Lagged Behavior	2.53	***	0.43	***	0.29	***	2.53	***	0.43	***	0.29	***
	(0.02)		(0.01)		(0.01)		(0.02)		(0.01		(0.00)	
Diagnosed with Breast Cancer	-0.06		-0.02		-0.10	***						
	(0.07)		(0.05)		(0.03)							
Recent Breast Cancer Diagnosis							-0.27	**	0.01		-0.10	*
							(0.11)		(0.08)		(0.06)	
Aged in 30s, 40s, or 50s	0.02		0.03		-0.12	***	0.03		0.03		-0.12	***
	(0.02)		(0.02)		(0.01)		(0.03)		(0.03)		(0.01)	
Aged 60 or Older	-0.27	***	-0.12	***	-0.32	***	-0.27	***	-0.12	***	-0.33	***
	(0.03)		(0.02)		(0.02)		(0.03)		(0.02)		(0.02)	
White	0.31	***	0.36	***	0.11	***	0.31	***	0.36	***	0.11	***
	(0.03)		(0.02)		(0.01)		(0.03)		(0.02)		(0.01)	
Black	-0.03		0.09	***	-0.04	**	-0.03		0.09	***	-0.04	**
	(0.03)		(0.02)		(0.02)		(0.03)		(0.02)		(0.02)	
Married	-0.13	***	-0.04	**	0.04	***	-0.13	***	-0.04	**	0.04	***
	(0.02)		(0.01)		(0.01)		(0.02)		(0.01)		(0.01)	
Have Children	0.05	*	-0.17	***	0.01		0.05	*	-0.17	***	0.01	
	(0.03)		(0.02)		(0.01)		(0.03)		(0.02)		(0.01)	
Highest Education is High School	-0.16	***	0.31	***	0.08	***	-0.16	***	0.31	***	0.08	***
	(0.02)		(0.02)		(0.01)		(0.02)		(0.02)		(0.01)	
Highest Education is College Degree	-0.36	***	0.57	***	0.10	***	-0.36	***	0.57	***	0.10	***
	(0.03)		(0.02)		(0.01)		(0.03)		(0.02)		(0.01)	
Highest Education is Post Graduate	-0.60	***	0.73	***	0.13	***	-0.60	***	0.73	***	0.13	***
	(0.05)		(0.03)		(0.02)		(0.05)		(0.03)		(0.02)	
Income Less than 20K	0.07	***	0.07	***	-0.01		0.07	***	0.07	***	-0.01	
	(0.02)		(0.02)		(0.01)		(0.02)		(0.02)		(0.01)	
Income Between 20K and 50K	0.06	**	-0.00		0.00		0.06	**	-0.01		0.01	
	(0.02)		(0.02)		(0.01)		(0.02)		(0.02)		(0.01)	

Table 9: (continued)

	1		2	
Covariance Terms				
Smoking and Drinking	0.0478	***	0.0479	***
	(0.014)		(0.014)	
Smoking and Exercise	0.0227	**	0.0227	***
	(0.010)		(0.010)	
Drinking and Exercise	0.0549	***	0.0549	***
	(0.009)		(0.009)	

Notes:

1) Standard errors are in parentheses.

2) * p-value<.10, ** p-value<.05, *** p-value<.01

3) All regressions include cutoff points, individual heterogeneity variance, and fixed effects.

4) The initial conditions specifications include the mean over time of all time-varying regressors.

To put these results in perspective, we evaluated the marginal impact of having a new breast cancer diagnosis on health behaviors for an average woman in our sample. On average the women in our sample were middle-aged, white, with a high-school education, a household income between $20,000 and $50,000, and married with a child. When the average person in our sample was recently diagnosed with breast cancer, that resulted in an increase in exercising of 19%, a decline in smoking of 1%, and an increase in drinking of 0.2% (but the drinking estimate was not significantly different than zero).

4 DISCUSSION

There are numerous studies in the economics and medical literatures that examine issues associated with breast cancer. These include studies on cancer mortality [32], investment in research [33], mammography screening [24-36], costs of treatment [37], and insurance coverage [26]. However, there are relatively few that consider the relationship with lifestyle choices. Those that do include some focus on smoking [3, 5, 6, 8, 10, 12, 13, 15, 37, 38], some on physical activity [14-19, 21, 41], and some on alcohol consumption [4, 10, 11, 15]. To the

best of our knowledge, ours is the first paper to examine changes in behavior while controlling for persistence in lifestyle choices. Among those papers that examine lifestyle choices among breast cancer survivors, Bellizi et. al. (2005) [41] conduct a descriptive analysis of the prevalence of health behaviors (smoking, alcohol use, physical activity, and cancer screening) of cancer survivors by age, time since diagnosis, and cancer site using data from the National Health Interview Survey. They find that cancer survivors are more likely to meet the recommendations for physical activity and cancer screening compared with noncancer controls. (also, see [19]). However, they do not find any evidence of different behavior among survivors with respect to smoking and alcohol consumption. We complement and add to previous studies in many ways. First, we use a large, nationally representative sample that includes women diagnosed with breast cancer. Second, we examine changes in lifestyle behaviors over time where we allow for persistence in behavior.

As can be seen in Table 1, 9.4% of the sample were diagnosed with cancer and 2.3% with breast cancer. Incidence of breast cancer was not high: we observed 2.3% of the white respondents with breast cancer, 1.8% of the black respondents, and only 0.8% of the Latino respondents. Unfortunately, the sample sizes of Latino respondents and individuals of races other than black and white were too small to allow us to separately identify an effect of being Latino or of another race on behavior. However, individuals of all races are included in our analysis. Our results are interpreted as the impact of being white or black on behavior relative to the impact of being non-white and non-black.

As can be seen in Table 2, approximately 54% of our respondents ever drank alcoholic beverages for the period 2005-2007. Looking at these numbers disaggregated by race, we found in our sample that 61% of the white respondents and 43% of the black respondents ever drink alcoholic beverages.

Table 5 shows that, among smokers, breast cancer prevalence was the highest for respondents who smoked more than 19 cigarettes per day. Regarding alcohol consumption behaviors, prevalence was lower in the group of respondents who drank alcohol. Among those who drank, breast cancer prevalence was highest among those women who drank more than one drink per week. The main point that emerged from Table 5 was that breast cancer incidence differed with the degree that an individual engaged in lifestyle behaviors.

From Table 6, we found, not surprisingly, that past smokers were more likely to be current smokers, and the significant positive effect persisted after controlling for unobserved heterogeneity (in columns labeled 2 and 4). Our results indicated that white women smoked more than non-white women. We also found that married women smoked less than those who were not married as did women with a higher education relative to other education categories. Finally, we found that individuals with lower incomes (under $50,000) smoked more than women with higher incomes.

The first two labeled columns indicated that whether an individual was diagnosed with breast cancer had no significant impact on smoking behavior conditional on past behavior and demographic variables. However, as labeled columns (3) and (4) show, if a woman had a diagnosis of breast cancer less than five years ago, she would significantly decrease her smoking behavior with this effect being robust to including initial conditions (labeled column 4).

This is quite different than the results in [8]. The differential impact of the time of diagnosis on smoking behavior could arise from a few sources. First, the individual may react to a diagnosis by curbing unhealthy habits such as smoking, but this effect may deteriorate over time as the individual survives past the initial stages. Second, the woman may be undergoing treatment which makes smoking more difficult in the short term due to lack of energy, for example.

As with smoking, our results from Table 7 indicated that past drinking behavior was a positive significant indicator of current drinking behavior, and this effect remained after controlling for initial conditions in labeled columns (2) and (4). The other control variables implied that women aged 60 or older drank less than younger women and that white women drank more than black women. In addition, we found that married women drank less often as do those with children. Drinking more often was more likely among those with higher education relative to other groups and among those with a larger income. In contrast to smoking behaviors, women did not change their alcohol consumption after a breast cancer diagnosis regardless of when the diagnosis was made.

Regarding exercise (Table 8), the control variables indicated that, the older the woman is, the less physical activity she participated in. The results also showed that being white was associated with higher levels of physical activity. Our findings also indicated that married women engaged in more physical activity relative to non-married women. Furthermore, the higher the level of education

the woman has, the more she engaged in weekly physical activity. Finally, individuals with income less than $20,000 engaged in less exercise relative to individuals with income between $20,000 and $50,000. As the results in labeled columns (1) and (2) show, a diagnosis of breast cancer significantly impacted the amount of exercise in a negative way. Perhaps this result is not so surprising given that women often undergo treatment after a breast cancer diagnosis that can weaken them and make it more difficult to engage in extra physical activity.

In addition, we find that the impact of breast cancer diagnosis for each risky behavior remained after we controlled for other changes in a woman's life in the last year. Specifically, we included changes in marital status (i.e., got married or divorced), changes in health status (i.e., moved into a state of poorer (self-reported) health), and changes in employment status (i.e., became employed or lost a job)(Appendix 4).

The results in Table 9 indicated that, indeed, there was correlation across behaviors (as evidenced by the significant covariance terms). However, the estimates of the impact of a breast cancer diagnosis remained and were consistent with those from Tables 6-8. Namely, a recent breast cancer diagnosis resulted in less smoking and exercise but did not impact alcohol consumption.

In summary, we found a consistent picture of how a breast cancer diagnosis influences a woman's decision to engage in risky lifestyle choices.

5 CONCLUSIONS

A diagnosis of breast cancer impacts lifestyle choices. However, the impact of diagnosis has a different effect on smoking, drinking, and exercising behavior, and the impact also depends upon the recency of the diagnosis. Women who were diagnosed with breast cancer in the last five years smoked less but did not change their alcohol consumption after a breast cancer diagnosis regardless of when the diagnosis was made relative to healthy women. A diagnosis of breast cancer significantly impacted the amount of exercise in a negative way. Perhaps this latter result is not so surprising given that women often undergo treatment after a breast cancer diagnosis that can weaken them and make it more difficult to engage in extra physical activity.

These changes in behavior are not always consistent with information provided to the public on breast cancer risk factors. However, these choices may

be rationalized when one considers the overall value of life where lifestyle choices increase the utility from living.

Our approach provided insight into what extent women who are faced with negative information about life expectancy take this into consideration when deciding to engage in risky behaviors that might further affect their survival in a significant way. Whether to engage in physical activity, drink alcohol, or smoke are choices associated with how to live.

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CONFLICT OF INTEREST

We have no conflicts of interest to disclose.

DATA AVAILABILITY STATEMENT

Panel Study of Income Dynamics data are publicly available, for example, through the Inter-university Consortium for Political and Social Research (ICPSR).

ETHICS STATEMENT: None

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