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Psychological distress and the leading cancers among american adults: an evidence from the 2013 national health interview survey

Abstract

The objective of this study is to determine the prevalence of psychological distress (PD) among cancer patients and to investigate the association of PD with various socio-demographic factors. We consider the 2013 National Health Interview Survey, which is a large survey of the US non-institutionalized civilian population. PD is determined with a standardized questionnaire (K6). Cancer diagnoses are determined on the basis of self-report. For the purpose of this study, four different types of cancer are selected based on the leading number of deaths caused by them. We fit three commonly used ordinal regression models to the ordinal response PD for overall cancer patients. According to the goodness of fit criterion, AIC, we select the adjacent category model as best model for PD. All the predictors along with affliction by cancer are found to be significant determinants of PD. Additional analysis shows that the psychological distress does not differ across the four subtypes of cancer, breast, colon, lung and prostate cancer. However, psychological distress differs across the race of the respondents.

Keywords: psychological distress, breast, colon, lung and prostate cancer, K6, ordinal logistic models

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Abbreviations: PD; psychological distress, WHO; world health organization, CHD; chronic heart disease, BC; breast cancer, CC; colon cancer, LC; lung cancer, PC; prostate cancer, K6; kessler 6-qusation screening scale, NHIS; national health interview survey, NCHS; national center for health and statistics, CDC; centers for disease control and prevention, AIC; akai information criterion, CO; cumulative odds model, CR; continuation ratio model, AC; adjacent categories model, SAS; statistical analysis system

Introduction

Cancer is a significant health dilemma in the US and in many countries worldwide. It is one of the leading causes of death around the world. Every year, nearly 10.9 million individuals are diagnosed with cancer worldwide and around 6.7 million individuals die from it. The World Health Organization (WHO) anticipates that death from this disease will continue to rise, with an estimated 11.5 million deaths in 2030.[1] Cancer specialists and medical scientists believe that psychological matters affect the progression of cancer, but the evidence remains unconvincing. Many studies focusing on mental health of cancer patients investigated the psychological impact and stigma of affliction due to cancer.[2-5] Cancer patients naturally experience many kinds of psychological problems due to the physical and mental afflictions caused by the long-term adverse health due to cancer. A number of studies demonstrate a clear link between the affliction from cancer and psychological distress (PD) measured by the symptoms of depression and anxiety.[5-15] PD is a significant problem for patients with cancer at every stage of their disease. Assessment and management of psychological distress are imperative in order to ease the burden on patients and to help them cope with their diagnosis and treatment.[16] A review of the psychological distress literature concludes that there are no simply identifiable characteristics of patients that can readily predict who has the potential need for psychosocial assessment and intervention.[5,6] To explore the impact of PD, many research investigations have been carried out in many countries examining various factors that manipulate the psychological distress among cancer patients. A systematic review on PD among cancer patients conducted by Yeh M et al.,[8] found that the majority of cancer patients face significant psychological and emotional distress at sometime during the course of the illness.

There are various risk factors that have been linked to mental illness. Numerous investigations were conducted to determine the factors that play a significant role on PD among cancer patients.[4-13,17] For example, studies conducted in order to identify the risk factors of PD in females with breast cancer revealed that age, marital status, and education of the patient were the significant factors associated to PD.[11,18,19] Based on prior studies, the socio-demographic and clinical factors of health (i.e., BMI, insurance status, physical activity, smoking, drinking alcohol, etc.) may enhance distress. A common factor that is found to affect PD and cancer was race/ethnicity.[1,3,20] Other studies showed there is correlation between all covariates under consideration and the PD being the response variable. In particular, older women with breast cancer had a significantly higher level of distress Sunderland M et al.,[18] These factors can be used to identify individuals who may be at risk of experiencing PD. In this study, our objectives are to determine the prevalence of psychological distress among cancer patients and to investigate the association of psychological distress with various socio-demographic factors.

Although a number of studies investigate PD among cancer patients, the risk factors of PD among the leading sub-types of cancers are not well studied. In this study, we selected sub-types of cancer according to the estimates of the leading new cancer cases and death since 2013 in the US. The most frequently diagnosed cancers that occurred in both males and females in 2013 were breast cancer (BC), colon cancer (CC), lung cancer (LC), and prostate cancer (PC).[4] In

particular, this study explores and compares the prevalence of overall cancer and that off our leading cancer subtypes namely, BC, CC, LC, and PC and the association with psychological distress among the black and white American adults.

Data and research methods

Data are obtained from the 2013 National Health Interview Survey(NHIS), which is a large annual survey conducted on a random sample of individuals living in the United States.[21,22] This survey is across-sectional household survey of the US population conducted annually by the National Center for Health Statistics (NCHS), Center for Disease Control and Prevention (CDC). Face-to-face interviews were carried out at respondents' houses. But, for those who were not home a follow-up was performed over the telephone. This survey employed a randomly selected, stratified, and multistage area design that produced nationally representative sample of households. Data from the NHIS are organized into a number of different types of files. We consider the sample adult module, which contains health-related information on randomly selected adults in the households. According to National Center for Health Statistics during the data collection period in 2013, there were 42, 294 eligible individuals, of which 34, 557 (81.7%) were interviewed.

We consider Kessler6 (K6)[23-26] to measure psychological distress (PD) among cancer patients. This measure K6 contains a six-item instrument, for each part the respondents were asked how frequently they experienced symptoms of psychological distress (sad, nervous, restless, hopeless, everything was an effort, and worthless) during the past 30 days. Each question has a 5-point scale with ranges from 0= 'none of the time' to5='all of the time' in the NHIS. Since K6 scores lie between 0 and 4 on the Likert scale, the total of the responses scores is ranged between 0 and 24. We collapsed these scores into three categories as: 0-7 indicating a low level of PD, 8-12 indicating a moderate level of PD, and 13-24 indicating high PD. The predictor variables are selected as those found to be relevant according to the literature review.

Statistical models for ordinal response PD

We consider the three ordinal regression models: cumulative odds (CO), continuation ratio (CR), and adjacent categories (AC) models for psychological distress (PD).[25-27,30] The best-fit model among these three is used to report the statistically significant determinants of PD among cancer patients. The cumulative odds (CO) or the proportional odds (PO) model is appropriate when the response categories are based on one or more latent continuous response variable. A CO model with J categories is divided to J-1 logit equations. We use the category ordering by forming logit s of cumulative probabilities,

$$P\left(Y \le j \middle/ x\right) = \pi_1(x) + \ldots + \pi_j(x), j = 1, \ldots, J.$$

The cumulative logit s are defined as:

$$logit\left[P\left(Y \le j \middle/ x\right)\right] = \log \frac{P\left(Y \le j \middle/ x\right)}{1 - P\left(Y \le j \middle/ x\right)} = \log \frac{\pi_1(x) + \ldots + \pi_j(x)}{\pi_{j+1}(x) + \ldots + \pi_{J-1}(x)}, j = 1, \ldots, J-1 \quad \ldots.(1)$$

$$logit\left[P\left(Y \le j \middle/ x\right)\right] = \alpha_j + \beta^T x. \quad \ldots\ldots\ldots\ldots(2)$$

Each cumulative logit has its intercept $t\alpha_j$ but the same slope coefficient β^T. The $\{\alpha_j\}$ are increasing j in because $P\left(Y \le j \middle/ x\right)$ increases in j for fixed x. For illustration, in our study a three-category outcome will have two binary log it equations based on the following comparisons: 1 vs. 2&3, 1&2 vs. 3. The CO is used to predict the odds of a person being at or below any particular level of Psychological Distress (PD). The following CO model is fitted to our data using the equation form (2):

a. Low vs. (Moderate & High):

$$logit\left[P\left(Y \le 1 \middle/ x\right)\right] = \log\left(\frac{\pi_1}{\pi_2 + \pi_3}\right) = \alpha_1 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5 + \beta_6 x_6 + \beta_7 x_7 + \beta_8 x_8 + \beta_9 x_9 + \beta_{10} x_{10} + \beta_{11} x_{11} + \beta_{12} x_{12} + \beta_{13} x_{13} + \beta_{14} x_{14} + \beta_{15} x_{15} + \beta_{16} x_{16} + \beta_{17} x_{17} \quad ..(3)$$

b. (Low & Moderate) vs. High:

$$logit\left[P\left(Y \le 2 \middle/ x\right)\right] = \log\left(\frac{\pi_1 + \pi_2}{\pi_3}\right) = \alpha_2 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5 + \beta_6 x_6 + \beta_7 x_7 + \beta_8 x_8 + \beta_9 x_9 + \beta_{10} x_{10} + \beta_{11} x_{11} + \beta_{12} x_{12} + \beta_{13} x_{13} + \beta_{14} x_{14} + \beta_{15} x_{15} + \beta_{16} x_{16} + \beta_{17} x_{17} \quad ..(4)$$

Where π_1, π_2, π_3 are the probability of being in low, moderate, and high levels, respectively. $\beta_1, \cdots, \beta_{17}$ are the regression coefficients and $x_1, \cdots, x_{17}$ are the covariate factors.

In a continuation ratio (CR) model, the ratio of probabilities as follows,

$$\frac{\pi_1}{\pi_2}, \frac{\pi_1 + \pi_2}{\pi_3}, \ldots, \frac{\pi_1 + \ldots + \pi_{J-1}}{\pi_J}$$

OR

$$\frac{\pi_1}{\pi_2 + \ldots + \pi_J}, \frac{\pi_2}{\pi_3 + \ldots + \pi_J}, \ldots, \frac{\pi_{J-1}}{\pi_J}$$

are modeled through "continuation–ratio logit s". Thus, the model can be written as:

$$\log\left(\frac{\pi_j}{\pi_{j+1} + \ldots + \pi_J}\right) = x_j^T \beta_j \quad \ldots\ldots\ldots\ldots(5)$$

The continuation ratio model provides the log odds of the response being in the category j. For our study, J=3, we can estimate the odds of the respondents PD as "Low" vs. "Moderate" and the odds of these levels are in "Low" and "Moderate" versus "High" using:

$$\log\left(\frac{\pi_1}{\pi_2}\right) \text{ and } \log\left(\frac{\pi_1 + \pi_2}{\pi_3}\right)$$

The CR may be easier than CO in terms of interpretation if we are interested in finding the probability for individual categories .

Finally the adjacent categories (AC) model considers the ratios of probabilities for successive categories:

$$\frac{\pi_1}{\pi_2}, \frac{\pi_2}{\pi_3}, \ldots, \frac{\pi_{J-1}}{\pi_J}$$

The AC model can be written as:

$$\log\left(\frac{\pi_j}{\pi_{j+1}}\right) = x_j^T \beta_j$$

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Which is equivalent to ,

$$\log\left(\frac{P(y_i = j)}{P(y_i = j+1)}\right) = \log\left(\frac{\pi_j}{\pi_{j+1}}\right) = \beta_{0j} + \beta_1 x_1 + \ldots + \beta_{p-1} x_{p-1}$$

This model assumes that the effect of each independent variable to be the same for all adjacent pairs of categories. All computations are conducted using SAS version 9.3 (SAS Institute, Cary, NC,[31]) and the R computing environment (Version3.11, TheRProject). SAS isused to manage the data and create analysis variables. In R, we used the VIGAM package to fit all of the three models.

Results

The summary statistics and the prevalence of psychological distress cross classified by all the predictor variables are presented in Table 1. About 90% of the respondents fall in the low distress category, followed by 7%and3%in the moderate and high categories, respectively. About 36% of respondents is from the South region while 16%, 21% and 27% is from the Northeast, the Midwest, and the West respectively. Most of the participants (76%) are white American. There are 12086 (68%) respondents in the age range of 31-64 years old. More than 65% of the sample has a high school education or above. About 38% of the respondents are smokers while 71% of them are alcoholic. Approximately, 20% of the respondents do not have insurance. More than half of them have an annual income in the range of $0-$34,999. About 4% of the respondents with cancer have low distress level. The number of cancer patients in the high distress level is 44. More singles are found to be in high distress level (2%) compared to married people (0.73%). About 73% of the respondents with insurance have low distress level while 17% of people without insurance have low distress level. In terms of the income, people who have low income tend to have high distress compared to high-income people. Pre valence of four sub-types of cancer cases by gender are shown in Table 2.

Figure 1 shows the distribution of prevalence of cancer across the levels of psychological distress. In the high distress level proportion prevalence of cancer is higher. Figure 2 shows that the distribution of PD levels across gender. Females are prone to be susceptible to belong higher distress level. Figure 3 shows the distribution of PD levels across the sub-types of cancer. Breast and 'other' types have more prevalence of moderate and high distress levels.

Association between psychological distress and each predictor variable is determined using a chi-squared test. Results of the bi-variant analysis are presented in Table 3. It shows most of the predictors, except region and alcohol consumption, are significantly associated with the response variable PD. All the significant predictors are then included in the CO, CR and AC model. All three models are implemented to estimate the regression parameters (β) and p-values based on World statistics. The statistical computing software R issued to fit these three models. Based on the goodness of fit criterion as Information Criteria (AIC) (Table 4) we selected AC model as the best-fit model for PD and the included predictor variables.

Table 5 presents the results of AC model. All the predictors are found significant 5% level of significant. Male are 1.23 times more likely to have low or moderated stress level than female. In other words, females tend to be in high distress level. White Americans are more likely to have low or moderate distress level compare to other groups. Inexact, they are 28% more relaxed than other group where as Black/African American and Asians 42% and 26% more likely to have low or moderate distress level, respectively. Respondents of aged 18-30 years are 36% less likely to have low or moderate distress level compare to the respondents of aged 65+years. People who are at the age of 31-64 years are 46% less likely to have low or moderated stress level compare to the aged 65+. It is to be noted that older people are more relaxed than the younger people. If a person has a cancer, then he/she is more likely to be in high distress level. In fact, a person with cancer is 35% less likely to have low or moderate distress level. Married people are 42% more likely to have low or moderated I stress level than singles. Smokers are less likely to have lower distress level than nonsmokers. If a person does some physical activity at least once a week, then he/she is 1.17 times higher chance to have low or moderated I stress level. Obese people are more likely to have high distress level. People with insurance are more likely to have low or moderate distress than people without insurance. In other words, covered respondents tend to be 28% times higher to be in low or moderated I stress level. Persons having at least high school diploma are more likely to be in low or moderated I stress level. Low-income group is less likely to be in lower distress level.

The risk factors for psychological distress obtained in Table 5 are based on the entire population. We found that respondents with cancer are more likely to be in the high distress level. Figure 3 shows the distribution of psychological distress levels over all the types of cancer. In order to test is there is any heterogeneity in PD across different sub-types of cancer, that if the distress levels are same for all types of cancer, we perform a chi-squared homogeneity test. Out of 923 people who have at least one type of cancer, 148 have breast cancer, 24 have colon cancer, 11 have lung cancer, 82 have prostate cancer and rest of them have other types of cancer or they won't disclose it. Based on the test (p-value = 0.4323), we fail to reject the hypothesis of homogeneity of the distress level among the different types of cancer. So we can conclude that there is no difference in distress level among different types of cancer.

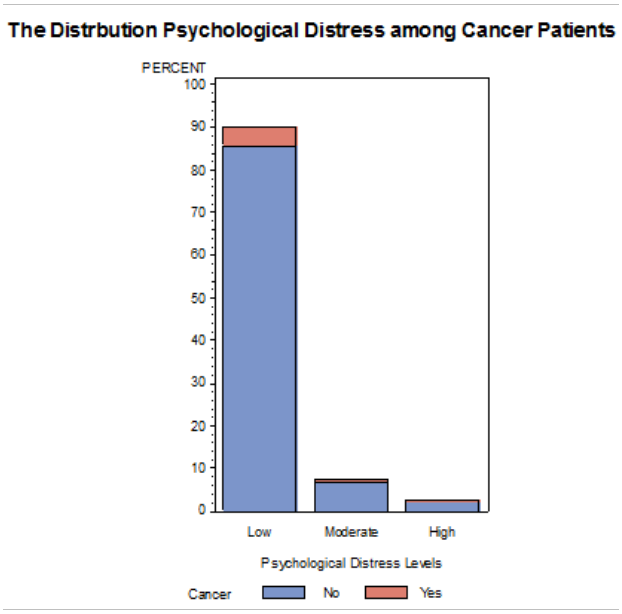

Figure 1 The distribution of PD among Cancer patients.

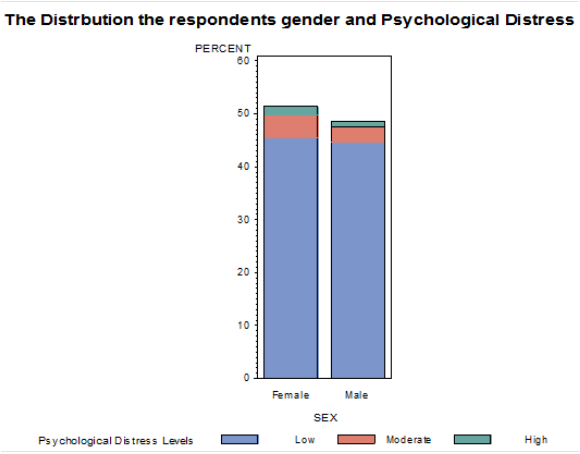

Figure 2 The distribution of respondents' gender and PD.

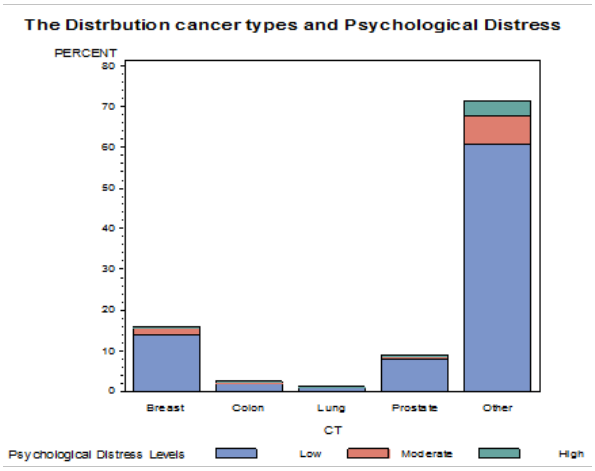

Figure 3 The Distribution of Cancer Types and PD.

Table 1 Psychological distress across predictor variables (cancer in general), N=17765

The Variables	Category	The psychological distress level			Total N=17765 100%
		Low n=16018 90.17%	Moderate n= 1288 7.25%	High n= 459 2.58%	
Region	Northeast	2556 (14.39%)	205(1.15%)	77 (0.43%)	2838 (15.98%)
	Midwest	3341(18.81%)	265(1.49%)	87) 0.49%)	3693 (20.79%)
	South	5830(32.82%)	449(2.53%)	171(0.96%)	6450(36.31%)
	West	4291(24.15%)	369(2.08%)	124(0.70%)	4784(26.93%)
Sex	Male	7933(44.66%)	526(2.96%)	175(0.99%)	8634(48.60%)
	Female	8085 (45.51%)	762(4.29%)	284(1.60%)	9131 (51.40%)
Race	White	12212(68.74%)	976(5.49%)	339(1.91%)	13527(76.14%)
	Black/African	2284(12.86%)	199(1.12%)	65(0.37%)	2548(14.34%)
	Asian	1022(5.75%)	62(0.35%)	23(0.13%)	1107(6.23%)
	Others	500(2.81%)	51(0.29%)	32(0.18%)	583(3.28%)
Age	(18-30)	4114(23.16%)	363(2.04%)	103(0.58%)	4580(25.78%)
	(31-64)	10870(61.19%)	876(4.93%)	340(1.91%)	12086(68.03%)
	65+	1034(5.82%)	49(0.28%)	16(0.09%)	1099(6.19%)
Marital Status	Married	7344(41.34%)	439(2.47%)	129(0.73%)	7912(44.54%)
	Unmarried	8674(48.83%)	849(4.78%)	330(1.86%)	9853(55.46%)
Cancer	Yes	792(4.46%)	87(0.49%)	44(0.25%)	923 (5.20%)
	No	15226(85.71%)	1201(6.76%)	415(2.34%)	16842(94.80%)
Smoke	Yes	5840(32.87%)	593(3.34%)	251(1.41%)	6684(37.62%)
	No	10178(57.29%)	695(3.91%)	208(1.17%)	11081(62.38%)
Activity	Yes	8899(50.09%)	618(3.48%)	183(1.03%)	9700(54.60%)
	No	7119(40.07%)	670(3.77%)	276(1.55%)	8065(45.40%)
BMI	Underweight	215(1.21%)	18(0.10%)	7(0.04%)	240(1.35%)

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Table Continued

The Variables	Category	The psychological distress level			Total N=17765 100%
		Low n=16018 90.17%	Moderate n= 1288 7.25%	High n= 459 2.58%	
	Normal	5429(30.56%)	403(2.27%)	131(0.74%)	5963(33.57%)
	Overweight	5590(31.47%)	426(2.40%)	126(0.71%)	6142(34.57%)
	Obese	4784(26.93%)	441(2.48%)	195(1.10%)	5420(30.51%)
Insurance	Covered	13036(73.38%)	921(5.18%)	282(1.59%)	14239(80.15%)
	Uncovered	2982(16.79%)	367(2.07%)	177(1.00%)	3526(19.85%)
Education	High School or less	5009(28.20%)	513(2.89%)	201(1.13%)	5723(32.22%)
	> High School	11009(61.97%)	775(4.36%)	258(1.45%)	12042(67.78%)
Income	($0-$34,999)	8285(46.64%)	894(5.03%)	371(2.09%)	9550(53.76%)
	($35,000-$74,999)	5375(30.26%)	320(1.80%)	69(0.39%)	5764(32.45%)
	$75,000+	2358(13.27%)	74(0.42%)	19(0.11%)	2451(13.80%)

Body Mass Index (BMI) is a simple index of weight-for-height that is commonly used to classify underweight, overweight and obesity in adults. It is defined as the weight in kilograms divided by the square of the height in meters (kg/m^2).

Table 2 Sub-type of cancer cases by gender.

Types of Cancer	Categories	Gender		N=17765
		Male	Female	
Breast cancer	Yes	4	144	148
	No	357	413	769
Colon cancer	Yes	13	11	24
	No	347	547	894
Lung cancer	Yes	6	5	11
	No	353	554	907
prostate cancer	Yes	82	0	82
	No	278	0	278
Other types	Yes	256	402	658
	No	105	160	265

Table 3 The association between PD of the respondents and predictors for (the cancer sample)

	d.f	Chi-square	p-value
Region	6	3.4235	0.7541
SEX	2	56.7093	<.0001
Race	6	29.4704	<.0001
Age (Group in years)	4	26.5571	<.0001
Marital Status	2	118.3031	<.0001
Cancer	2	26.3698	<.0001
Smoking status	2	105.0631	<.0001
Physical Activity	2	68.8511	<.0001
Alcohol consumption	2	0.1908	0.9090

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Table Continued

	d.f	Chi-square	p-value
BMI	6	43.7622	<.0001
Insurance	2	176.8340	<.0001
Education	2	68.8976	<.0001
Income	4	306.9797	<.0001

Table 4 The adequacy tool for model selection

	Ordinal logistic regression model		
	Cumulative Odds (CO)	**Adjacent category log it model (AC)**	**Continuation ratio model (CR)**
AIC	12800.63	12765.06	12806.01

Table 5A The results of the ordinal logistic regression model (AC)

Predictors	**Adjacent category log it model**		
	Estimate (SE)	**OR (95% CI)**	**P-value**
$Intercept_1(\alpha_1)$	2.87 (0.17)		
$Intercept_2(\alpha_2)$	1.64 (0.185)		
Sex			
Male	0.21 (0.04)	1.23 (1.14,1.34)	<.0001
Female		1	
Race			
White	0.24 (0.08)	1.28 (1.07,1.52)	0.0004
Black	0.35 (0.09)	1.42 (1.17,1.72)	<.0001
Asian	0.23 (0.12)	1.26 (0.99,1.60)	0.005
Other		1	
Age (in years)			
(18-30)	-0.44 (0.11)	0.64 (0.51,0.8)	<.0001
(31-64)	-0.60 (0.10)	0.54 (0.44,0.67)	<.0001
65+		1	
Marital Status			
Married	0.35 (0.04)	1.42 (1.30,1.54)	<.0001
Unmarried		1	
Cancer			
Yes	-0.42 (0.07)	0.65 (0.56,0.75)	<.0001
No		1	
Smoke			
Yes	-0.32 (0.03)	0.72 (0.66,0.78)	<.0001
No		1	
Activity			
Yes	0.16 (0.04a)	1.17 (1.08,1.27)	<.0001
No		1	

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Table 5B The results of the ordinal logistic regression model (AC) (Can't)

Predictors	Adjacent category log it model		
	Estimate (SE)	OR (95% CI)	P-value
BMI			
Underweight	0.23 (0.16)	1.26 (0.92,1.7)	0.01
Normal	0.21 (0.04)	1.23 (1.12,1.3)	<.0001
Overweight	0.17 (0.04)	1.18 (1.08,1.3)	<.0001
Obese		1	
Insurance			
Covered	0.24 (0.04)	1.28 (1.17,1.39)	<.0001
Uncovered		1	
Education			
High school or less		1	
>high school	0.06 (0.04)	1.06 (0.98,1.15)	0.01
Income			
($0-$34,999)	-0.84 (0.09)	0.42 (0.35,0.51)	<.0001
($35,000-$74,999)	-0.32 (0.09)	0.72 (0.59,0.87)	<.0001
$75,000+		1	

SE=Standard Error of the estimate; OR=odds ratio; CI=Confidence interval

We also conducted a heterogeneity test for the distress level across race. Most of the respondents in the study are white American (76%) followed by African American (14%). To test if the distress level is same for all people who have different race, we employ a contingency analysis and use chi-square statistic to investigate the homogeneity of the distress level. We reject (p-value <0.0001) the hypothesis of homogeneity of the distress level overall people who have different race at 5% significance level. So we conclude that there is difference in distress level for different race, which is supported by the findings in the literature.[3,4]

Discussion

This study is conducted to determine the prevalence of psychological distress among cancer patients and to investigate the association of psychological distress with various socio-demo graphic factors. Clearly, in terms of mental health, this study has found that cancer patients suffer from higher level of psychological distress than the general population. That is, individuals with cancer diagnostics are more likely to experience higher psychological distress than those without cancer.

In general, the results suggest that psychological distress (PD) is a burden among participants with the cancer, however particular types of cancer is not associated with the level of PD. The results from the ordinal logistic regression models suggest that individuals with self-reported cancer are more likely to experience PD when compared with those without cancer. We found a number of socio-demographic factors that contribute PD other than cancer. These include age, sex, race, marital status, physical activity, BMI, insurance, education level and income. Thus our findings confirm those by the previous findings in the literature. Sub group analysis of PD among the sub types of cancer (breast, colon, lung, and prostate) does not demonstrate any significant determinants of PD.

Psychological distress among cancer patients adds extra burden on them. An important finding is that differential psychological distress level exists a cross different race of overall cancer patients. However, among the different sub types of cancer (breast, colon, lung, and prostate) PD is not found to be different across race.

The psychological distress of cancer patients is not a straight forward subject to study. Numerous factors must be taken into account. However, the main advantage of this study is the availability of all representative population based sample. The NHIS has been conducted every year since1957. However, there are some limitations of this study. One limitation is that the self-reported nature of the data. Another limitation is that a bulk of missing information. There is not enough data to assess the association between the risk factors and the PD across different subtypes of the cancer.

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Conflict of interest

None.

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