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Research Article

Associations of Anxiety and Psychological Distress with Cancer in US Adults: Results from the 2012 National Health Interview Survey

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Abstract

Background: Little is known about age differences in the associations of anxiety, depression, and psychological distress (PD) with cancer.

Objectives: We estimated the prevalence of cancer in the United States (US) adults and examined the associations between mental health problems and cancer, and tested the related age differences.

Materials and Methods: This was a cross-sectional study (n=34,505, 3,118 had cancer) from the 2012 National Health Interview Survey (NHIS) data. Weighted univariate and multiple logistic regression analyses were used to estimate the odds ratios (ORs) with 95% confidence intervals (CIs).

Results: The overall prevalence of cancer is 8.6% (7.6% for males and 9.4 % for females). The prevalence increased with age (2.0%, 9.3% and 24.3% for age groups 18-49, 50-64 and 65+ years, respectively). The prevalence of anxiety, depression, and PD was significantly higher in cancer patients than in non-cancers (26% vs. 18%, 20% vs.13%, and 13% vs. 9%, respectively). Multiple logistic regression analyses showed that being female, aging, anxiety, and PD were positively associated with cancer ($p<0.05$). Age group revealed significant interactions with anxiety and PD, in relation to cancer. Stratified by age groups, PD was positively associated with cancer just in young adults (18-49 years) while anxiety showed a stronger association with cancer in young adults and elderly (65+ years).

Conclusions: The prevalence of mental health problems was higher among US adults who had cancer. The associations between mental health problems and cancer varied across ages. Effective strategies may be needed to manage these mental health conditions among patients with cancer at each age.

Keywords: Cancer; Prevalence; Anxiety; Depression; Psychological distress; Ageing

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Introduction

In the United States (US), about 1,638,910 new cancer cases were diagnosed in 2012 and the 5-year relative survival rate for all cancers diagnosed between 2001 and 2007 was 67% (Cancer Facts & Figures 2012, American Cancer Society). It has been shown that many survivors experience symptoms (such as pain, fatigue, mood changes, and sleep disturbance) that can impact function and well-being for years [1-4]. Nevertheless, only 10% of patients with cancers were referred to specialist despite potential negative impacts on patients' quality of life if those symptoms left untreated or unmanaged [5]. For example, about 30%-50% of cancer patients may suffer from depression or anxiety [6, 7], and 20%-35% had psychological distress (PD) [8, 9]. It has been reported that PD, in the form of past life events and stress at work, was associated with the development of breast cancer [10]; while diagnostic delay may cause more PD in female than in male cancer patients [11]. It has been suggested that it is essential to develop effective strategies to manage these conditions among patients with cancer [12].

The Kessler 6 (K6) scale has been used to screen at the population level for individuals with possible severe mental illness; while serious psychological distress (SPD), defined as the K6 scale (a validated screening tool for mental illness) score of 13 or more, has been associated with presence of chronic medical conditions, and arthritis [13, 14]. However, few studies have focused on the association of SPD with cancer [1]. Age may also play a role in the association between mental health and cancer. Previous studies have reported that the majority of cancer patients in the US were 65 years or older [15, 16]. In addition, the incidence of cancer increased with age in both human samples and animal models [17]. It has been predicted that from 2010 to 2030, the total projected cancer incidence in the US population will increase by approximately 45%, from 1.6 million in 2010 to 2.3 million in 2030 while the percentage of all cancers diagnosed in older adults will increase from 61% to 70% [18]. More recently, it has been reviewed that the ageing of populations worldwide is leading to an unprecedented increase in cancer cases and fatalities [19]. Therefore, risk factors of cancer may vary across ages and it may be important to understand age differences in the associations of risk factors with cancer that however has not been thoroughly studied to date.

In the present study, we analyzed data on mental health problems and cancer from The 2012 National Health Interview Survey (NHIS). We aimed to estimate the prevalence of cancer in US adults and mental health variables (including anxiety and depression and PD), and to identify associated factors of cancer, and to test whether these associations differ by age.

Materials and Methods

Data source The NHIS is a multi-purpose health survey conducted by the National Center for Health Statistics (NCHS), Centers for Disease Control and Prevention (CDC), and is the principal source of information on the health of the civilian noninstitutionalized household population of the US. The NHIS has been conducted continuously since its beginning in 1957. Public use data files are released on an annual basis. From each family in the NHIS, one sample adult aged 18 years or older is randomly selected, and information is collected with sample adult core questionnaires. In 2012, the NHIS sample size augmentation that began in 2011 continued in 32 states and the District of Columbia, with some increases in the level of augmentation. The main goal of the augmentation was to increase the number of states for which reliable estimates can be made. The 2012 NHIS sample size is the largest sample size since the current sample design was implemented in 2006. The interviewed sample for 2012 consisted of 42,366 households, which yielded 108,131 persons in 43,345 families. The interviewed sample for the sample adult component, which required self-response to all questions unless the sample adult was physically or mentally unable to do so, was 34,525 persons aged 18

years of age and older. The conditional response rate the sample adult component was 79.7%, which was calculated by dividing the number of completed adult interviews (34,525) by the total number of sample adults (43,323). The unconditional or final response rate for the sample adult component was calculated by multiplying the conditional rate by the final family response rate 76.8%, yielding a rate of 61.2%. Detailed methods of this survey have been published elsewhere [20]. This study was approved by the Institutional Review Board of East Tennessee State University.

Outcome variable Subjects were considered to had cancer if they responded "yes" to the question "Have you ever been told by a doctor or other health professional that you had Cancer?" Anyone who answered "yes" was shown a flashcard that lists sites and was asked, "What kind of cancer was that?" Respondents could report cancers, and analysts could calculate the time since diagnosis from questions about the respondent's age at diagnosis. A total of 34,505 adults (3,118 had cancer) were included for the analysis.

Social factors Social factors included age group classified as young (18-49 years), middle aged (50-64 years), and elderly (65 years or older), gender, and race/ethnicity (White, African American, Asian and other). Other demographic characteristics included born in US (yes, no), insurance (yes, no) and education (≤ high school, > high school). Adult obesity was defined as a body mass index (BMI) of 30.0 kg/m^2 or above, and BMI was calculated as weight in kilograms divided by height in meters squared.

Mental health We used three variables for mental health problems, including anxiety, depression, and PD. Anxiety was determined as a positive response to the question "have you had been frequently anxious, past 12 months?" while depression was determined by a positive response to the question "Ever told you had depression". The K6 scale comprised 6 questions asking how often during the past 30 days a person felt "so sad that nothing could cheer them up," "nervous," "restless," "hopeless," "worthless," or "everything was an effort." Responses were scored from 0 (none of time) to 4 (all the time) and summed to produce a total score (0 to 24), with a score of 13 or above used to define SPD [21]. SPD is a nonspecific measure of psychological distress that has been psychometrically validated and shown to be able to discriminate community Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV) cases from noncases [21,22]. It is intended to characterize having at least 1 mental disorder, such as major depressive disorder, generalized anxiety disorder, or schizophrenia, as well as having serious impairment of body function. The K6 has been used widely to screen for DSM-IV mood and anxiety disorders in the general population [23, 24]. PD was defined as a K6 score of 8 or above.

Statistical Analysis The SAS PROC SURVEYFREQ procedure was used to weight and estimate population proportions in cancer patients and non-cancers of mental health variables (anxiety, depression and PD), obesity, and social factors (age, gender, race, born in US, education, and insurance). SAS PROC SURVEYMEANS was used to estimate the overall prevalence of cancer while SAS PROC SURVEYFREQ determined the prevalence in demographic factors. The Chi-square test was used to compare the prevalence of cancer across gender, age and races. Then, SAS PROC SURVEYLOGISTIC was used to estimate the odds ratios (ORs) and 95% confidence intervals (CIs) for the relation between potential factors and cancer. Three models were used. In model one, simple logistic regression was used to examine the role of each potential factor in cancer; multiple logistic regression models were then used to simultaneously adjust for all potential risk factors of cancer (full model). In model two, to test effects of demographic factors such as sex, age and race, an interaction term between each demographic factor and each mental health variable was added in the multiple logistic regression models. In model three, to examine the risk factors for cancer stratified by age, multiple logistic regression models were applied to adjust for all these factors (full model). All the analyses were

conducted with SAS statistical software, version 9.2 (SAS Institute, Cary, NC, USA).

Results

Subjects characteristics and prevalence. The basic characteristics of the cancer patients and non-cancers are shown in Table 1. The percentage of anxiety and depression was higher in cancer patients than in non-cancers (26% vs. 18%, 20% vs. 13%, respectively). The prevalence of PD in cancer patients and non-cancers was 13% and 9%, respectively. The prevalence of cancer by gender, age and race is presented in Table 2. The overall prevalence of cancer was 8.6% (7.6% for males and 9.4% for females). The prevalence increased with age (2.0%, 9.3% and 24.3% for age groups 18-49, 50-64 and 65+ years, respectively). The prevalence in Whites (10.0%) was higher than African Americans (AAs) (4.4%) and Asians (4.3%). The prevalence for major cancer types was 2.0% in skin cancer (non-melanoma), 1.4% in breast cancer, 1.0% in prostate cancer, 0.8% in melanoma, 0.6% in cervix cancer, and 0.4% in colon cancer.

The relationship between all potential risk factors and cancer. Univariate logistic regression showed that all the potential risk factors except for obesity were significantly associated with cancer ($p < 0.05$) (Table 3). Multiple logistic regression showed being female was associated with an increased likelihood of having cancer (OR = 1.14, 95% CI = 1.02-1.28). Compared with young adults, middle-aged adults were more than four times more likely to have cancer (OR = 4.34, 95% CI = 3.65-5.16), and elderly were more than 13 times more likely to have cancer (OR = 13.78, 95% CI = 11.6-16.4). Compared with Whites, AAs were less likely to have cancer (OR = 0.52, 95% CI = 0.44-0.61). PD and anxiety were positively associated with cancer (OR = 1.35, 95% CI = 1.12-1.63; OR = 1.45, 95% CI = 1.25-1.69, respectively).

Interactions with social factors. After adjusting for potential risk factors in the multiple logistic regression models, we found significant interactions between age and anxiety and PD, in relation to cancer. Comparing with young adults, middle-aged adults and elderly revealed significant interactions with anxiety ($p = 0.001$ and 0.002, respectively) and PD ($p < 0.001$ and $p < 0.001$, respectively). No significant interactions were found for gender and race with mental health variables.

Age differences in the associations of mental health variables with cancer. Age differences in risk factors for cancer are presented in Table 4. Stratified by age groups, PD was positively associated with cancer just in young adults (OR = 2.18, 95% CI = 1.38-3.4) while anxiety showed stronger associations with cancer in young adults (OR = 1.88, 95% CI = 1.21-2.90) and elderly (OR = 1.48, 95% CI = 1.18-1.85).

Table 1 Characteristics of cancer patients and non-cancers

Variable	Cancers (percentage %) N=3,118	Non-cancers (percentage %) N=31,387	p
Gender			
Male	1230(43%)	14037(49%)	<0.001
Female	1888(57%)	17350(51%)	
Age group			

Variable	Cancers (percentage %) N=3,118	Non-cancers (percentage %) N=31,387	p
18-49 years	326(11)	14960(51)	<0.001
50-64 years	1098(38)	10742(35)	
65 +	1694(51)	5685(15)	
Race			
White	2657(89)	21673(75)	<0.001
AA	290(6)	5040(12)	
Asian	46(2)	1305(4)	
Other	116(3)	3369(9)	
Education			
≤HS	1379(44)	14380(48)	<0.001
>HS	1690(56)	15162(52)	
Born in US			
No	225(7)	5011(14)	<0.001
Yes	2891(93)	26360(86)	
Insurance			
No	131(4)	3100(8)	<0.001
Yes	2984(96)	28236(92)	
Obesity			
No	2077(70)	21511(72)	0.056
Yes	913(30)	8657(28)	
PD			
No	2677(87)	28190(91)	<0.001
Yes	441(13)	3197(9)	
Anxiety			
No	2273(74)	25278(82)	<0.001
Yes	842(26)	6096(18)	
Depression			
No	2434(80)	26696(87)	<0.001
Yes	679(20)	4688(13)	

Abbreviations: AA = African American; HS= High school; PD= Psychological distress. p-value is based on x^2 test
*Data Source: CDC/NCHS, National Health Interview Survey, 2012

Table 2 Cancer prevalence of demographic characteristics (%)

Variable	Total (N)	Cancers (N)	Prevalence (%)	95%CI	p
Gender					
Male	15267	1230	7.6	7.1-8.2	<0.001
Female	19238	1888	9.4	8.8-9.9	
Age group					
18-49	15286	326	2.0	1.7-2.3	<0.001
50-64	11840	1098	9.3	8.6-10.0	
65 +	7379	1694	24.3	22.9-25.7	
Race					
White	24330	2657	10.0	9.5-10.5	<0.001
AA	5339	299	4.4	3.7-4.9	
Asian	1351	46	4.3	2.4-6.2	
Other	3485	116	3.1	2.4-3.9	
Cancer type					
Breast	34505	572	1.4	1.3-1.6	
Cervix	34505	226	0.6	0.5-0.7	
Colon	34505	184	0.4	0.3-0.5	
Prostate	34505	362	1.0	0.9-1.2	
Melanoma	34505	245	0.8	0.6-0.9	
Non-melanoma	34505	640	2.0	1.8-2.2	
Overall	34505	3118	8.6	8.1-9.0	

Abbreviations: AA = African American; CI= Confidence interval, p-value is based on $\chi 2$ test, *Data Source: CDC/NCHS, National Health Interview Survey, 2012

Table 3 Univariate and multiple logistic regression analyses for the relationship between potential factors and cancer

Variable	Crude OR	95% CI	p-value	Adjusted OR	95% CI	p-value
Gender						
Male	1			1		
Male	1			1		
Female	1.28	1.15-1.41	<0.001	1.14	1.02-1.28	0.02
Age group						
28-49 years	1			1		

Variable	Crude OR	95% CI	p-value	Adjusted OR	95% CI	p-value
50-65 years	4.64	3.90-5.52	<0.001	4.34	3.65-5.16	<0.001
65 +	14.5	12.1-17.3	<0.001	13.78	11.6-16.4	<0.001
Race						
White	1			1		
AA	0.43	0.36-0.49	<0.001	0.52	0.44-0.61	<0.001
Asian	0.40	0.26-0.65	<0.001	0.75	0.46-1.21	0.237
Other	0.29	0.23-0.37	<0.001	0.53	0.41-0.70	<0.001
Education						
No	1			1		
Yes	1.19	1.08-1.30	<0.001	1.21	1.10-1.33	<0.001
Born in US						
No	1			1		
Yes	2.39	1.98-2.90	<0.001	1.83	1.49-2.26	<0.001
Insurance						
No	1			1		
Yes	2.48	1.94-3.18	<0.001	1.27	0.98-1.65	0.07
Obesity						
No	1			1		
Yes	1.09	0.98-1.21	0.12	1.09	0.98-1.22	0.126
PD						
No	1			1		
Yes	1.45	1.25-1.69	<0.001	1.35	1.12-1.63	0.002
Anxiety						
No	1			1		
Yes	1.54	1.37-1.72	<0.001	1.45	1.25-1.69	<0.001
Depression						
No	1			1		
Yes	1.56	1.38-1.76	<0.001	1.12	0.95-1.30	0.171

Abbreviations: AA = African American; HS= High school; PD= Psychological distress; OR= Odds ratio; CI= Confidence interval.

*Data Source: CDC/NCHS, National Health Interview Survey, 2012

Table 4 Age differences in the associations of behavioral and mental health variables with cancer

Variable	OR[1]	95% CI	p-value	OR[2]	95% CI	p-value	OR[3]	95% CI	p-value
Gender									
Male	1			1			1		
Female	2.46	1.79-3.38	<0.001	1.33	1.12-1.60	0.001	0.81	0.69-0.94	0.007
Race									
White	1			1			1		
AA	0.36	0.21-0.63	<0.001	0.51	0.39-0.66	<0.001	0.59	0.47-0.74	<0.001
Other	0.64	0.34-1.18	0.15	0.49	0.33-0.73	<0.001	0.69	0.48-0.98	0.04
Education									
No	1			1			1		
Yes	1.19	0.89-1.59	0.241	1.31	1.12-1.53	<0.001	1.12	0.98-1.29	0.096
Born in US									
No	1			1			1		
Yes	2.17	1.06-4.47	0.035	1.76	1.27-2.44	<0.001	1.75	1.36-2.25	<0.001
Obesity									
No	1			1			1		
Yes	1.38	0.99-1.92	0.057	1.11	0.95-1.29	0.193	1.00	0.84-1.20	0.968
PD									
No	1			1			1		
Yes	2.18	1.38-3.43	<0.001	1.27	0.98-1.63	0.068	1.05	0.76-1.46	0.76
Anxiety									
No	1			1			1		
Yes	1.88	1.21-2.90	0.005	1.32	1.04-1.66	0.02	1.48	1.18-1.85	<0.001
Depression									
No	1			1			1		
Yes	0.91	0.60-1.39	0.67	1.20	0.95-1.51	0.125	1.09	0.86-1.38	0.482

Abbreviations: AA = African American; HS= High school; PD= Psychological distress; CI= Confidence interval. OR[1] = Adjusted odds ratio for age group 1 (18-49 years) , OR[2] = Adjusted odds ratio for age group 2 (50-64 years), OR[3] = Adjusted odds ratio for age group 3 (≥65 years), *Data Source: CDC/NCHS, National Health Interview Survey, 2012

Discussion

In this study, we found the prevalence of mental health problems (anxiety, depression and PD) in the nation to be significantly higher in adults with cancer than in those without cancer. After adjusting for covariates, anxiety and PD were significantly associated with cancer. Age showed significant interactions with anxiety and PD in influencing cancer.

Our results showed that cancer patients reported significantly higher prevalence rate of PD compared with non-cancers. This is consistent with the report by

Hoffman *et al.* [1] where they reported the prevalence of SPD was significantly higher among long-term cancer survivors than among respondents who were never diagnosed as having cancer. However, the prevalence of PD in cancer patients was lower than previous reports ranging from 20% to 35% [8, 9]. In the present study, PD was positively associated with cancer. Hoffman *et al.* [1] reported that survivors remained to be more likely to experience SPD (OR = 1.4; 95% CI = 1.2-1.7). However, Hoffman *et al.* [1] used SPD as the primary outcome in a population-based study and examined whether social factors were associated with SPD, which was different from our study. Furthermore, the prevalence of anxiety and depression was significantly higher in adults with cancer than those without it, which is consistent with previous studies [6, 7]. Univariate logistic regression showed that anxiety and depression were significantly associated with cancer. However, multiple logistic regression showed that the association of depression with cancer disappeared, which may be due to the strong association between depression and anxiety (OR = 10.43, $p < 0.001$) and PD (OR = 11.27, $p < 0.001$). Our results further showed that age had significant interactions with anxiety and PD, in relation to cancer. PD was positively associated with cancer just in young adults while anxiety showed stronger associations with cancer in young adults and elderly. It has been reported that younger people were more likely to experience SPD [1].

The present study demonstrated that females, elderly , and education were significantly associated with cancer. Previous studies have reported that the majority of cancer patients in the US were 65 years old or older [15, 16, 18]. In the present study, we found that the prevalence of cancer increased with age (2.0%, 9.3% and 24.3% for age groups 18-49, 50-64 and 65 +, respectively), while age showed significant interactions with anxiety and PD in influencing cancer. Therefore, continued efforts are needed to improve cancer care for older adults. Furthermore, in consistent with previous studies, we found that gender was associated with cancer. It has been recognized that there is gender difference in the prevalence of some cancers such as lung cancer [25, 26], colon cancer [27, 28], and bladder cancer [29]. This difference may be partly due to genetic male-female differences [25]. Moreover, the current study found that education level was positively associated with cancer. Previous studies have shown that some cancers may be related to education level. For example, cancers of the colon and rectum were associated with higher levels of education, but cancers of the esophagus and stomach with lower classes [30]. These associations are most likely to be mediated by dietary habits [30]. There are five cancer sites inversely related to education level: colon, pancreas, breast, kidney, and thyroid cancers; however, no consistent gradient in risk with education was observed for the six other neoplasms considered, including rectum, prostate, bladder, Hodgkin disease, and multiple myeloma [31]. However, women with primary education or less were found to have almost twice the cervical cancer incidence of those with secondary or higher education [32]. Education was associated with colon cancer but no significant association was found between education and risk of rectal cancer [33], while higher education was found to be associated with slightly increased incidence of prostate cancer [34]. A significant association between educational level and cancer risk was observed in Iceland population. For example, males with academic education had higher risk for prostate cancer and melanoma, but lower risk for cancers of the lung and stomach. Women with academic education had an increased risk of breast cancer and a decreased risk of lung cancer, whereas increasing educational level was associated with a lowered risk of cervical cancer [35]. Recently, one longitudinal study showed the position association between education and risk of developing cancers of the esophagus, head and neck, stomach, colon, rectum, liver, lung, pleura, bladder and combined smoking-related cancers. In contrast, lower education level was associated with a decreased risk of melanoma of the skin and local prostate cancers. Women with the least education had increased risks of colon, lung, kidney and combined smoking-related cancers but a lower risk of melanoma of the skin, endometrial and invasive breast cancers [36]. However,

one more recent study did not find association between education level and risk of invasive breast cancer [37].

This study has several important strengths. The sample size was relative large. We provided the national prevalence estimates for anxiety, depression and PD in persons with cancer, using a nationally representative sample of US adults. Also, we examined interactions between mental health variables and demographic factors and found age differences in the associations of anxiety and PD with cancer. Future research need focus on longitudinal studies of specific types of mental health problems, including depression and anxiety and PD, in adults with different types of cancer, specifically looking at the effect of age.

There are several limitations in this study. First, the present study is a cross-sectional study design, which limited the ability to establish causality. Further limitations include possible recall and differential misclassification biases, as well as the effects of differences in how respondents interpreted survey questions. Another limitation is possible self-reported misclassification of cancer type that would increase or reduce reported rates [38].

Conclusions

The national prevalence of anxiety, depression and PD was significantly higher in adults with cancer than in those without cancer. Mental health problems affect persons with cancer and should be addressed in their treatment. As more cancer cases are diagnosed in the coming decades and increasing financial pressure is placed on health-care systems, proposals for psychological interventions in routine clinical care will need to demonstrate cost effectiveness to service providers. There were age differences in the associations of mental health problems with cancer. It is important to develop effective strategies to manage these mental health conditions among patients with cancer separately at each age. Gender and education differences should be taken into account when programs for health promotion are planned.

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