

The Impact of Preexisting Mental Health Disorders on the Diagnosis, Treatment, and Survival among Lung Cancer Patients in the U.S. Military Health System

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Abstract

Background: Higher cancer-related mortality has been observed among people with mental health disorders than in the general population. Both delay in diagnosis and inadequate treatment due to health care access have been found to explain the higher mortality. The U.S. Military Health System (MHS), in which all beneficiaries have equal access to health care, provides an ideal system to study this disparity where there are no or minimal barriers to health care access. This study assessed preexisting mental health disorders and stage at diagnosis, receipt of cancer treatment, and overall survival among patients with non-small cell lung cancer (NSCLC) in the U.S. MHS.

Methods: The study used data from the linked database from the Department of Defense's Central Cancer Registry and the MHS Data Repository (MDR). The study subjects included 5,054 patients with histologically confirmed primary NSCLC diagnosed between 1998 and 2007.

Results: Patients with a preexisting mental disorder did not present with more advanced disease at diagnosis than those without. There were no significant differences in receiving cancer treatments between the two groups. However, patients with a mental health disorder had a higher mortality than those without [adjusted HR, 1.11; 95% confidence interval (CI), 1.03–1.20].

Conclusions: Poor survival in NSCLC in patients with a preexisting mental health disorder is not necessarily associated with delay in diagnosis and/or inadequate cancer treatment.

Impact: This study contributes to the current understanding that health care access may not be sufficient to explain the poor survival among patients with NSCLC with preexisting mental health disorders. *Cancer Epidemiol Biomarkers Prev*; 25(12); 1564–71. ©2016 AACR.

Introduction

There is mounting evidence of a higher all-cause mortality in people with mental illness than general population (1–9). When the causes of mortality were examined, it was found that except for suicide and other unnatural deaths, people with mental health disorders also experienced a higher mortality than general population, including cancer-related mortality (1, 9–14).

Mental health disorders may influence cancer outcomes through an array of socioeconomic, behavioral, and biologic mechanisms. Socioeconomically, people with mental health dis-

orders may be more likely to be unemployed, have lower education level, and live at or below the poverty level; these factors are associated with less access to healthcare, screening services, inpatient care, and out-patient clinical visits, thereby resulting in delayed diagnosis (15–17), inadequate or less aggressive treatments (16, 18, 19), and poorer survival (14–18, 20–25). Behaviorally, mental health disorders are commonly linked to unhealthy lifestyles such as smoking, alcohol and substance abuse, physical inactivity, poor nutrition, and poor physical health, which contribute to cancer progression and mortality (10, 11, 14, 26, 27). It is also possible that biologically, mental illness could affect biochemical pathways, which include increased cell damaging processes and decreased cell protective or restorative processes (28), dysfunctional immunosurveillance, accumulation of somatic mutations, and genome instability (29). These biologic changes may also facilitate cancer progression.

Lung cancer is the leading cause of cancer-related death worldwide (30). Non-small cell lung cancer (NSCLC) comprises 85% to 90% of all lung cancers (30). Previous studies have found increased mortality among patients with lung cancer with mental illness (1, 10, 11, 13, 14, 31, 32). However, it is not clear what factors may contribute to the increased mortality while it can be reasonably postulated that treatment and treatment adherence may differ between patients with and without a mental health disorder. One recent study showed no association between depression and the receipt of surgery, chemotherapy, or radiation among military veterans with NSCLC (31). Another study that

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was restricted to advanced stage NSCLC veteran patients (stages III and IV) did not find an association between depression and receipt of chemotherapy (33). However, depression was reported to be associated with poor treatment adherence among patients with advanced stage NSCLC (32). To the best of our knowledge, no studies have examined whether mental health disorders overall or specific mental health disorders other than depression could affect stage at diagnosis, cancer treatment, and survival among patients with NSCLC.

In the general population, patients with mental health disorders may differ from those without access to medical care due to unemployment, lower education level, and/or poverty. This differential access to care may affect research results in the general population on cancer diagnosis, treatment, and survival because lack of health insurance, limited access to wellness visits, and underutilization of health care service may be related to delayed diagnosis, inadequate treatment and poor survival among patients (16, 17, 22, 23). Research in a health system that provides universal healthcare could reduce the potential effects of unequal access to care. The U.S. military health system (MHS) provides health care to military personnel, retirees, and their family members and all beneficiaries have equal access to health care regardless of military rank, education, or income. A study within the MHS could demonstrate whether mental health disorders increases the mortality of cancer when there are no or minimal barriers to health care access, thus suggesting potential effects of factors other than those related to health care access. In addition, compared with the general population, military personnel are at higher risk of developing mental health problems (34–36) such as posttraumatic stress disorder related to prior combat. Family members of military personnel are also at increased risk of mental stress due to mobile lifestyle and frequent family separations (37, 38). Therefore, it is important to assess whether mental health disorders are related to cancer outcomes in the MHS. To the best of our knowledge, there have been no epidemiologic studies on preexisting mental health disorders in relation to diagnosis, treatment, and survival of cancer including lung cancer among beneficiaries in the MHS. In this study, we investigated whether preexisting mental health disorders are associated with the stage at diagnosis, cancer treatment received, and survival among patients with NSCLC in the MHS.

Materials and Methods

Data sources

This study was based on the MHS, which provides health care to active duty members, retirees, National Guard and Reserve members, and their dependents. The linked database from the Department of Defense (DoD)'s Central Cancer Registry (CCR) and the MHS Data Repository (MDR) was used in this study and described previously (39, 40). The CCR contains information on patients with cancer diagnosed or treated at military treatment facilities (MTF). The CCR data include demographic variables, tumor characteristics, cancer diagnosis, treatment, recurrence, and vital status. Cancer site and histology codes are based on the International Classification of Diseases for Oncology, third edition (ICD-O-3; ref. 41). The CCR registry staff conduct lifetime follow-up on patients. Quality assurance was conducted following the guidelines established by the North America Association of Central Cancer Registries. The MDR contains administrative and medical care information that includes both inpatient and outpatient care

provided at MTFs and civilian facilities paid for by the DoD. The MDR database includes information on clinical diagnoses of all medical conditions, which are coded using the International Classification of Disease, 9th Revision (ICD-9), and diagnostic and treatment procedures, which are coded using ICD-9 or Current Procedural Terminology (CPT) codes. The data linkage project was approved by the Institutional Review Boards of the Walter Reed National Military Medical Center, TRICARE Management Activity, and the NIH Office of Human Subjects Research.

Study subjects

The study subjects were patients diagnosed with histologically confirmed primary NSCLC between 1998 and 2007. NSCLC constitutes about 85% to 90% of all lung cancers (30). The cancer site and histology were classified using the topography (C34.0 to C34.3, C34.8, C34.9) and morphology codes (8050–8078, 8083, 8084, 8250–8260, 8480–8490, 8570–8574, 8140, 8211, 8230, 8231, 8323, 8550, 8551, 8576, 8010–8012, 8014–8031, 8035, 8310, and any other NSCLC codes between 8010 and 8576) of the International Classification of Diseases for Oncology, third edition (ICD-O-3; ref. 41).

Mental health disorder variables

Preexisting mental health disorders were defined as diagnoses of mental health disorders during the 2-year period before NSCLC diagnosis (16, 18). Mental health disorder diagnoses were identified using ICD-9 or CPT codes in the MDR data. The following mental health disorder categories were identified using specific ICD-9 codes: any mental health disorder (codes 29, 30, 31); psychotic disorders (codes 295, 297, 298, 293.81, 293.82; refs. 11, 16, 23, 25, 42–44); dementia and other organic psychosis (codes 290, 294; refs. 11, 16); mood disorders (codes 296, 311, 300.4, 309.1, 309.0, 309.4, 301.1, 301.10, 301.12, 301.13; refs. 7, 11, 16, 18, 23, 25, 42–45); substance abuse and dependence disorders (codes 291, 292, 303, 301, 305; refs. 7, 11, 16, 25, 42, 44, 45); anxiety disorders (codes 300 except 300.4, 308.3, 309.81; refs. 25, 42–44), and all other mental health disorders that falls between codes 29 and 31 but not included in any of the above categories.

Statistical analyses

There were 3 outcomes in this study: cancer stage at diagnosis, receipt of cancer treatments, and all-cause mortality. Cancer stage was defined in accordance of the American Joint Committee on Cancer (AJCC) staging system, the 7th edition (46). Stage was further grouped into early stage (stages I and II; refs. 47, 48), advanced stage (stages III and IV; ref. 49), and unknown stage (missing information in the data). Cancer treatments (lung cancer specific surgery, chemotherapy, and radiation therapy) were identified and consolidated from both CCR and MDR. Vital status was from the CCR data.

In data analysis, we first presented the distributions of demographic, diagnostic, treatment, and other variables by mental health disorder status. We then used multivariate logistic regression to estimate ORs and 95% confidence intervals (95% CI) of preexisting mental health disorders (any and specific disorders) in relation to tumor stage at NSCLC diagnosis. ORs of mental health disorders were estimated for late stage versus early stage and unknown stage versus early stage, respectively. In regard to cancer treatment (yes or no) related to preexisting mental health disorders, we used multivariate Cox proportional hazards models to estimate HRs and 95% CI. Time to treatment was used in the

Table 1. Characteristics of patients with NSCLC by preexisting mental health disorder status in the Military Health System (1998–2007)

Variables	No mental health disorder n (%)	Any mental health disorder n (%)	P
Age, y			<0.001
<50	245 (7.67)	140 (7.53)	
50–59	549 (17.18)	362 (19.48)	
60–69	1,181 (36.95)	756 (40.69)	
70–79	920 (28.79)	483 (26.00)	
80 and older	301 (9.42)	117 (6.30)	
Sex			0.007
Male	2,104 (65.83)	1,153 (62.06)	
Female	1,092 (34.17)	705 (37.94)	
Race			<0.001
White	2,519 (78.82)	1,526 (82.13)	
Black	382 (11.95)	210 (11.30)	
Asian	198 (6.20)	62 (3.34)	
Other	79 (2.47)	47 (2.53)	
Unknown or missing	18 (0.56)	13 (0.70)	
Marital status			0.148
Never married	111 (3.47)	48 (2.58)	
Married	2,386 (74.66)	1,389 (74.76)	
Separated or divorced	177 (5.54)	123 (6.62)	
Widowed	396 (12.39)	237 (12.76)	
Unknown or missing	126 (3.94)	61 (3.28)	
Sponsor service branch			<0.001
Army	1,080 (33.79)	740 (39.83)	
Navy	621 (19.43)	349 (18.78)	
Air Force	1,086 (33.98)	589 (31.70)	
Marines	116 (3.63)	67 (3.61)	
Coast Guard	24 (0.75)	12 (0.65)	
Other, unknown, or missing	269 (8.42)	101 (5.44)	
Active duty status			0.204
No	3,057 (95.60)	1,795 (96.61)	
Yes	107 (3.35)	51 (2.74)	
Unknown or missing	32 (1.00)	12 (0.65)	
Tobacco use			<0.001
Never used	319 (9.98)	89 (4.79)	
Previous use	1,768 (55.32)	792 (42.63)	
Current use	888 (27.78)	853 (45.91)	
Unknown or missing	221 (6.91)	124 (6.67)	
Comorbidity index			<0.001
0	1,616 (50.56)	504 (27.13)	
1	611 (19.12)	448 (24.11)	
2 or more	969 (30.32)	906 (48.76)	
Tumor stage			0.002
Stage I	1,002 (31.35)	635 (34.18)	
Stage II	270 (8.45)	161 (8.67)	
Stage III	734 (22.97)	433 (23.30)	
Stage IV	979 (30.63)	554 (29.82)	
Unknown	211 (6.60)	75 (4.04)	
Tumor grade			0.015
Well-differentiated	271 (8.48)	135 (7.27)	
Moderately differentiated	689 (21.56)	437 (23.52)	
Poorly differentiated	1,033 (32.32)	617 (33.21)	
Undifferentiated	53 (1.66)	49 (2.64)	
Unknown or missing	1,150 (35.98)	620 (33.37)	
Histology			<0.001
Squamous cell carcinoma	785 (24.56)	469 (25.24)	
Adenocarcinoma	1,437 (44.96)	811 (43.65)	
Large cell carcinoma	349 (10.9)	150 (8.07)	
Other	625 (19.56)	428 (23.04)	
Surgery			0.845
No	1,582 (49.50)	925 (49.78)	
Yes	1,614 (50.50)	933 (50.22)	
Chemotherapy			0.706
No	1,562 (48.87)	910 (48.98)	
Yes	1,610 (50.38)	930 (50.05)	
Unknown	24 (0.75)	18 (0.97)	

(Continued on the following column)

Table 1. Characteristics of patients with NSCLC by preexisting mental health disorder status in the Military Health System (1998–2007) (Cont'd)

Variables	No mental health disorder n (%)	Any mental health disorder n (%)	P
Radiation			0.269
No	1,442 (45.12)	871 (46.88)	
Yes	1,740 (54.44)	975 (52.48)	
Unknown	14 (0.44)	12 (0.65)	
Recurrence			0.066
No	2,647 (82.82)	1,585 (85.31)	
Yes	524 (16.40)	259 (13.94)	
Unknown	25 (0.78)	14 (0.75)	

models and calculated as the interval between NSCLC diagnosis date and first cancer treatment date. Subjects who did not receive any cancer treatment before study end date were censored. For surgery, chemotherapy, and radiation treatments, time to treatment was calculated as the interval between NSCLC diagnosis date and the date of receiving surgery, chemotherapy, and radiation therapy, respectively. Considering recommended treatment guidelines (50, 51), receipt of surgery was assessed among stages I and II patients only and receipt of chemotherapy and radiation therapy was analyzed among stages III and IV patients only. In terms of cancer survival, we first analyzed overall survival by preexisting mental health disorder status using Kaplan–Meier curve and log-rank test. Multivariate Cox proportional hazards models were then used to estimate HRs and 95% CI of mortality associated with preexisting mental health disorders. Survival time was calculated as the interval from the date of diagnosis until death, date of last contact, or the study end date. Subjects who did not die during follow-up were censored. Cox analysis was further stratified by tobacco use (never, former, and current) and by comorbidity index group. Comorbidities were identified from the MDR data. A comorbid condition was considered to be present if at least 1 inpatient record or 3 outpatient records (52, 53) showed the diagnosis prior to the NSCLC diagnosis. The level of comorbidity was categorized according to the Charlson comorbidity index (54). The index score was further grouped into three groups with index score of 0, 1, and 2 or more, respectively. In all logistic and Cox regression analyses, the potential confounders, variables related to both mental health disorders and outcomes, were controlled in the models.

Results

A total of 5,054 patients with NSCLC were identified from the data. Of them, 1,858 had a history of preexisting mental health disorder. The distributions of patient characteristics by mental health disorder are shown in Table 1. Compared with individuals without any mental health disorder, patients with a diagnosis of preexisting mental health disorder were more likely to be in the age groups of 50–59 and 60–69 years ($P < 0.001$), female ($P = 0.007$), and White ($P < 0.001$). There was a higher percentage of Army beneficiaries with a mental health disorder than other military branches ($P < 0.001$). Patients with a mental health disorder were more likely to be current smokers ($P < 0.001$) and have more comorbidities than those without ($P < 0.001$). Compared with those without mental health disorders, patients with a mental health disorder were more likely to have stage I and less likely to have unknown information on tumor stage ($P = 0.002$). They were more likely to be diagnosed with moderately

Table 2. The association between preexisting mental health disorders and stage at diagnosis among patients with NSCLC in the Military Health System (1998–2007)

Mental disorder variables	Late stage vs. early stage		Unknown stage vs. early stage	
	No. (Early/Late)	Adjusted OR (95% CI) ^a	No. (Early/Unknown)	Adjusted OR (95% CI) ^a
Any mental health disorder				
No	1,272/1,713	1.00 (ref)	1,272/211	1.00 (ref)
Yes	796/987	0.95 (0.83–1.08)	796/75	0.58 (0.41–0.80)
Number of mental health disorders				
None	1,272/1,713	1.00 (ref)	1,272/211	1.00 (ref)
One	553/731	1.00 (0.86–1.16)	553/47	0.66 (0.40–1.07)
Two or more	243/256	0.81 (0.66–1.00)	243/28	0.54 (0.37–0.79)
Psychotic disorder				
No	2,046/2,684	1.00 (ref)	2,046/284	1.00 (ref)
Yes	22/16	0.60 (0.30–1.21)	22/2	0.75 (0.15–3.87)
Dementia				
No	2,034/2,658	1.00 (ref)	2,034/282	1.00 (ref)
Yes	34/42	0.98 (0.60–1.60)	34/4	0.96 (0.30–3.01)
Mood disorder				
No	1,847/2,442	1.00 (ref)	1,847/257	1.00 (ref)
Yes	221/258	0.97 (0.77–1.21)	221/29	1.03 (0.60–1.78)
Substance abuse disorder				
No	1,515/2,031	1.00 (ref)	1,518/237	1.00 (ref)
Yes	550/669	0.90 (0.77–1.04)	550/49	0.64 (0.43–0.94)
Anxiety disorder				
No	1,913/2,524	1.00 (ref)	1,913/263	1.00 (ref)
Yes	155/176	0.97 (0.75–1.26)	155/23	1.02 (0.56–1.86)
Other mental health disorders				
No	1,928/2,527	1.00 (ref)	1,928/277	1.00 (ref)
Yes	140/173	1.03 (0.80–1.33)	140/9	0.51 (0.24–1.10)

^aAdjusted for age, sex, race, marital status, sponsor service branch, active duty status, tobacco use, comorbidity index, tumor grade, and histology. Specific mental disorders were also mutually adjusted.

differentiated, poorly differentiated, and undifferentiated tumors ($P = 0.015$) and with large cell histology ($P < 0.001$; Table 1). Differences between the two groups in cancer treatment, recurrence, and marital status were not significant (Table 1).

Compared with those without a preexisting mental health disorder, patients with any preexisting mental health disorders were 42% less likely to be diagnosed with an unknown stage tumor (OR, 0.58; 95% CI, 0.41–0.80; Table 2). Further analysis showed that compared with patients without any preexisting mental health disorders, the OR of unknown tumor stage was 0.66 (95% CI, 0.40–1.07) for those with one mental health disorder and 0.54 (95% CI, 0.37–0.79) for those with two or more mental health disorders (Table 2). The ORs were not significant in late tumor stage at diagnosis relative to early stage for patients with a mental health disorder compared with those without. In terms of specific mental health disorders, patients with substance abuse disorder were less likely to have an unknown tumor stage (OR, 0.64; 95% CI, 0.43–0.94; Table 2). No significant ORs were observed between other specific mental health disorders and unknown tumor stage or late stage (Table 2).

There were no significant differences in receiving any cancer treatment between the groups by mental health disorder status (Table 3). However, subjects with dementia were less likely to receive treatment than subjects without (HR, 0.74; 95% CI, 0.57–0.97; Table 3). No association was observed between other specific mental health disorders and receipt of any cancer treatment (Table 3). Further analyses on receipt of surgery (stages I and II patients only), chemotherapy (stages III and IV patients only), and radiation therapy (stages III and IV patients only) did not reveal differences between patients with and without mental health disorders (Table 4).

Kaplan–Meier survival curves showed better survival for patients without any mental health disorder than patients with a diagnosis of a mental health disorder (Supplementary Fig. S1;

log-rank: $P = 0.048$). In the multivariate Cox regression model adjusting for confounders, preexisting mental health disorder remained an independent risk factor for mortality (HR, 1.11; 95% CI, 1.03–1.20; Table 5). Furthermore, the HR was 1.08 for those with one mental health disorder (95% CI, 1.00–1.17) and increased to 1.22 (95% CI, 1.08–1.37) for those with two or more mental health disorders. When data were analyzed on a specific mental health disorder, the increased mortality was observed for dementia (HR, 1.43; 95% CI, 1.10–1.86) and anxiety disorder (HR, 1.20; 95% CI, 1.03–1.39; Table 5).

The analysis stratified by tobacco use or comorbidity index is shown in Table 6. Significantly increased mortality associated with mental health disorders was observed among current tobacco users (HR, 1.18; 95% CI, 1.04–1.33) but not among previous users (HR, 1.01; 95% CI, 0.91–1.13) or never users (HR, 1.29; 95% CI, 0.89–1.88). The higher mortality associated with mental health disorders was also observed among patients who did not have comorbidity (HR, 1.15; 95% CI, 1.01–1.31) and those with low comorbidity index (HR, 1.18; 95% CI, 1.01–1.39) but not among those with high comorbidity index (HR, 1.07; 95% CI, 0.95–1.20; Table 6). However, in these stratified analyses, the 95% CIs were overlapped.

Discussion

Our results showed that in MHS, a system providing universal care to all beneficiaries, compared with patients with NSCLC without any mental health disorder, patients with a diagnosis of mental health disorder did not present with more advanced disease at diagnosis and were less likely to have unknown information on staging. There were no differences in receipt of cancer treatment between those with and without mental health disorders. However, patients with pre-cancer mental health disorders experienced higher mortality than those without.

Table 3. The association between preexisting mental health disorders and receipt of cancer treatment among patients with NSCLC in the Military Health System (1998–2007)

Mental disorder variables	No. (No treatment/ Any treatment)	Adjusted HR (95% CI) ^a
Any mental health disorder		
No	270/2,910	1.00 (ref)
Yes	166/1,686	1.00 (0.94–1.07)
Number of mental health disorders		
None	270/2,910	1.00 (ref)
One	122/1,206	0.99 (0.93–1.07)
Two or more	44/480	1.03 (0.93–1.14)
Psychotic disorder		
No	430/4,562	1.00 (ref)
Yes	6/34	0.99 (0.70–1.39)
Dementia		
No	412/4,540	1.00 (ref)
Yes	24/56	0.74 (0.57–0.97)
Mood disorder		
No	393/4,132	1.00 (ref)
Yes	43/464	1.02 (0.91–1.13)
Substance abuse disorder		
No	319/3,448	1.00 (ref)
Yes	117/1,148	0.99 (0.92–1.06)
Anxiety disorder		
No	410/4,270	1.00 (ref)
Yes	26/326	1.03 (0.91–1.17)
Other mental health disorders		
No	415/4,298	1.00 (ref)
Yes	21/298	1.07 (0.95–1.21)

^aAdjusted for age, sex, race, marital status, sponsor service branch, active duty status, tobacco use, comorbidity index, tumor stage, grade, histology, and recurrence. Specific mental disorders were also mutually adjusted.

Higher mortality of cancer among people with mental health disorders has been reported. Kisely and colleagues (10) studied all-cause mortality of 135,442 patients with cancer, including patients with lung cancer, from 1988 to 2007 using Western Australian Cancer Registry and national morbidity data systems and reported increased mortality rates for major cancers in psychiatric patients as compared with sex- and age-matched general population. The rate ratio for lung cancer was 1.24 (95% CI, 1.11–1.40). Two other studies in the same area observed similar excess lung cancer mortality in people with psychiatric illnesses (1, 11). In another study based on the linked data from death certificates and the mental health system in Ohio, Musuuza and colleagues (14) reported higher standardized mortality rates (SMR) of lung cancer among people with mental illness than the general population, with SMRs ranging from 3 to 5 times higher stratified by race and gender, respectively (14). With respect to specific mental health disorders, a French study observed a more than 2-fold increase in the mortality of lung cancer among men with schizophrenia compared with the general population (13). Two other cohort studies identified psychologic stress (12) and schizophrenia (21) as significant may exist for the observed associations in these studies. A recent study in veterans reported increased mortality among patients with lung cancer with preexisting depression (31) and depression was associated with poor survival in a small Mexican study (32). It is not clear what underlying factors might be for the observed associations in these studies.

One of the possible factors related to the poor survival of patients with cancer with mental illness may be socioeconomic disadvantages, which may limit their access to health care and services, resulting in delayed diagnosis or later cancer stage at diagnosis (15–17, 22), insufficient treatment (16, 18, 23), and therefore poor

survival (15, 16, 18, 23). In lung cancer, however, there are few studies examining these possible factors. Sullivan and colleagues (31) found no association between depression and receipt of surgery, chemotherapy, or radiation in a veteran population. Another study restricted to advanced stage veteran patients did not find an association between depression and receipt of chemotherapy (33). The authors concluded that other factors not included in their analysis may have contributed to the poor survival among patients with depression. Nevertheless, in other cancers, multiple large-scale studies have demonstrated that patients with mental health disorders tended to present with later stage tumors and were less likely to receive cancer treatments (16, 18, 23). In a study in Taiwan, Chang and colleagues (23) found that patients with oral cancer with mental illness were less likely to undergo surgery with or without adjuvant therapy than those without mental illness. In the study by Kisely and colleagues (10), psychiatric patients had a higher proportion of cancer with metastases than the general population. They were also less likely to receive surgery of colorectal, breast, and cervical cancers; radiotherapy for breast, colorectal, and uterine cancers; and chemotherapy sessions (10). A SEER-Medicare-based study (16) found that old patients with colon cancer with preexisting mental health disorders were more likely to be diagnosed at an unknown stage and less likely to have received any treatment (surgery, chemotherapy, or radiation therapy) and less likely to receive chemotherapy (stage III patients), suggesting that individuals with mental health disorders may not be able to complete the diagnostic procedures for cancer staging and treatments, likely due to psychosocial and economic barriers to medical care (16).

In contrast to the above previous studies that found patients with mental health disorders were more likely to be diagnosed at an advanced stage or unknown stage and less likely to receive recommended treatment, our study showed that there was no difference in the stage at diagnosis between patients with mental health disorders and those without. Similarly, patients with mental health disorders were less likely to have unknown information on tumor stage. Regarding cancer treatment, with the exception of patients with dementia who received less treatment which was largely driven by less surgery, there was no overall difference between those with and without a mental health disorder. The lower likelihood of having unknown stage and the absence of differences in receiving cancer treatments may be attributed to a high accessibility to health care for beneficiaries in MHS, in which there are no or minimum cost barriers to laboratory tests, radiology workup, and cancer prevention and surveillance services (55). Moreover, in early 2000, the MHS launched the initiative of integration behavioral health services into primary care services (56), which have facilitated the care and follow up of beneficiaries with mental health disorders in the system. The integration of mental healthcare into primary care services in MHS may have reduced the treatment disparity generally found in the general population. Consistent with our results, two studies in the Veteran Affairs (VA) system, a system providing care to all beneficiaries, did not observe an association between depression and treatment. A recent study in the VA system also did not find differences in the stage at diagnosis or delay in care for colorectal, urothelial, and head and neck cancer between patients with and without mental health problems (57). The authors concluded that mental health is not a barrier to cancer staging or treatment in the VA system that integrated mental health care and routine health care (57).

Table 4. The association between preexisting mental health disorders and receipt of surgery, chemotherapy, and radiation treatments among patients with NSCLC in the Military Health System (1998–2007)

Mental health disorder variables	Surgery (stages I and II)		Chemotherapy (stages III and IV)		Radiation (stages III and IV)	
	No. (Surgery/No surgery)	Adjusted HR (95% CI) ^a	No. (Chemo/No chemo)	Adjusted HR (95% CI) ^a	No. (Radiation/No radiation)	Adjusted HR (95% CI) ^a
Any mental health disorder						
No	176/1,096	1.00 (ref)	603/1,102	1.00 (ref)	512/1,191	1.00 (ref)
Yes	127/669	1.01 (0.91–1.12)	350/629	1.01 (0.91–1.12)	323/658	1.00 (0.93–1.11)
Number of mental health disorders						
None	176/1,096	1.00 (ref)	603/1,102	1.00 (ref)	512/1,191	1.00 (ref)
One	86/467	1.03 (0.92–1.16)	254/473	1.04 (0.93–1.17)	239/488	0.98 (0.87–1.09)
Two or more	41/202	0.96 (0.82–1.13)	96/156	0.92 (0.78–1.10)	84/170	1.08 (0.91–1.28)
Psychotic disorder						
No	297/1,749	1.00 (ref)	943/1,725	1.00 (ref)	829/1,839	1.00 (ref)
Yes	6/16	0.84 (0.51–1.40)	10/6	1.93 (0.86–4.33)	6/10	1.25 (0.66–2.35)
Dementia						
No	290/1,744	1.00 (ref)	923/1,719	1.00 (ref)	814/1,828	1.00 (ref)
Yes	13/21	0.65 (0.42–1.00)	30/12	1.89 (1.07–3.35)	21/21	1.12 (0.72–1.74)
Mood disorder						
No	260/1,587	1.00 (ref)	862/1,567	1.00 (ref)	746/1,684	1.00 (ref)
Yes	43/178	0.88 (0.74–1.05)	91/164	0.97 (0.81–1.16)	89/165	0.94 (0.79–1.13)
Substance abuse disorder						
No	223/1,295	1.00 (ref)	718/1,301	1.00 (ref)	613/1,403	1.00 (ref)
Yes	80/470	1.02 (0.81–1.15)	235/430	0.98 (0.87–1.10)	222/446	0.95 (0.85–1.07)
Anxiety disorder						
No	278/1,635	1.00 (ref)	886/1,626	1.00 (ref)	776/1,734	1.00 (ref)
Yes	25/130	1.09 (0.89–1.33)	67/105	1.01 (0.82–1.26)	59/115	1.08 (0.87–1.33)
Other mental health disorders						
No	286/1,642	1.00 (ref)	901/1,613	1.00 (ref)	784/1,729	1.00 (ref)
Yes	17/123	1.13 (0.93–1.38)	52/118	0.98 (0.81–1.19)	51/120	1.09 (0.90–1.32)

^aAdjusted for age, sex, race, marital status, sponsor service branch, active duty status, tobacco use, comorbidity index, tumor stage, grade, histology, and recurrence. Specific mental disorders were also mutually adjusted.

While cancer diagnosis and treatment related to health care access and socioeconomic barrier might not account for the survival disadvantage among those with mental health disorder in MHS, unhealthy lifestyles and poor physical health commonly found in patients with mental health disorder may affect survival indirectly (10, 11, 14, 26, 27). In our study population, there were higher percentages of tobacco users and higher percentages of people with comorbidities in the mental health disorder group. However, the decrease in survival among patients with mental health disorders was still observed after adjusting for tobacco use and comorbidity in survival analysis in our study. In addition, we stratified the survival analysis by tobacco use and comorbidity, and the results remained similar between the subgroups, suggesting the effects of factors other than smoking and comorbidity. The second factor is that patients with mental illness may be more likely to commit suicide, which contributes to overall mortality. However, the rate of suicide might not be high enough to account for the difference in survival. Another factor may be the time interval between treatments and treatment frequency. This difference between patients with and without mental health disorders warrants future study. This study only evaluated receipt of treatment, but adherence to treatment recommendations may differ between patients with versus without mental health disorders, which may contribute to the overall survival difference. Finally, mental health disorders may affect interactions and communications between patients and their providers, and patient–provider communications have been shown to influence clinical outcomes in patients with lung cancer (21, 58, 59)

Our study was based on the existing cancer registry and medical claims data and thus there are limitations due to the

Table 5. The association between preexisting mental health disorders and mortality among patients with NSCLC in the Military Health System (1998–2007)

Mental health disorder variables	No. (Alive/Dead)	Adjusted HR (95% CI) ^a
Any mental health disorder		
No	953/2,243	1.00 (ref)
Yes	597/1,261	1.11 (1.03–1.20)
Number of mental health disorders		
None	953/2,243	1.00 (ref)
One	423/908	1.08 (1.00–1.17)
Two or more	174/353	1.22 (1.08–1.37)
Psychotic disorder		
No	1,542/3,472	1.00 (ref)
Yes	8/32	1.18 (0.83–1.69)
Dementia		
No	1,531/3,443	1.00 (ref)
Yes	19/61	1.43 (1.10–1.86)
Mood disorder		
No	1,387/3,159	1.00 (ref)
Yes	163/345	1.03 (0.91–1.17)
Substance abuse disorder		
No	1,135/2,651	1.00 (ref)
Yes	415/853	1.03 (0.95–1.12)
Anxiety disorder		
No	1,436/3,264	1.00 (ref)
Yes	114/240	1.20 (1.03–1.39)
Other mental health disorders		
No	1,436/3,296	1.00 (ref)
Yes	114/208	1.04 (0.90–1.20)

^aAdjusted for age, sex, race, sponsor service branch, active duty status, tobacco use, comorbidity index, tumor stage, grade, histology, recurrence, surgery, chemotherapy, and radiation treatments. Specific mental disorders were also mutually adjusted.

Table 6. Stratified analysis of preexisting mental health disorders and mortality among patients with NSCLC in the Military Health System (1998–2007)

Stratified variables	Any mental health disorder	No. (Alive/Dead)	Adjusted HR (95% CI) ^a
Tobacco use			
Never use	No	160/159	1.00 (ref)
	Yes	38/51	1.29 (0.89–1.88)
Previous use	No	519/1,249	1.00 (ref)
	Yes	274/518	1.01 (0.91–1.13)
Current use	No	212/676	1.00 (ref)
	Yes	254/599	1.18 (1.04–1.33)
Comorbidity index group			
0	No	485/1,131	1.00 (ref)
	Yes	175/329	1.15 (1.01–1.31)
1	No	187/424	1.00 (ref)
	Yes	136/312	1.18 (1.01–1.39)
2 or more	No	281/688	1.00 (ref)
	Yes	286/620	1.07 (0.95–1.20)

^aAdjusted for age, sex, race, sponsor service branch, active duty status, tobacco use, comorbidity index, tumor stage, grade, histology, recurrence, surgery, chemotherapy, and radiation except for the stratified variable itself.

use of such data for research, such as lack of detailed information and inaccurate records found in secondary data sources. Also, the numbers in specific mental health disorder groups were small and thus further research with a larger number of patients is warranted.

In conclusion, our study suggests that health care access and socioeconomic barriers commonly found to be responsible for the poor survival in the studies conducted within the general population may not explain the worse survival among patients with mental health disorders. There may be other factors at play and additional research is warranted to further examine the increased mortality of lung cancer among patients with mental health disorders.

Disclosure of Potential Conflicts of Interest

No potential conflicts of interest were disclosed.

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Disclaimers

The views expressed in this article are those of the author and do not necessarily reflect the official policy or position of the Departments of the Navy and Army, the Uniformed Services University of the Health Sciences, the Department of Defense, National Cancer Institute, or the U.S. Government. Nothing in the presentation implies any Federal/DoD endorsement.

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