

Incidence of Suicide in Persons With Cancer

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A B S T R A C T

Purpose

The purpose of this study was to characterize suicide rates among patients with cancer in the United States and identify patient and disease characteristics associated with higher suicide rates. Prior studies, mostly in Europe, have suggested that patients with cancer may be at increased risk for suicide, but large cohort studies comparing patients with cancer with the general population have not been performed in the United States.

Methods

Patients in the study were residents of geographic areas served by the Surveillance, Epidemiology, and End Results (SEER) program who were diagnosed with cancer from 1973 to 2002. Comparisons with the general US population were based on mortality data collected by the National Center for Health Statistics. This was a retrospective cohort study of suicide in persons with cancer.

Results

Among 3,594,750 SEER registry patients observed for 18,604,308 person-years, 5,838 suicides were identified, for an age-, sex-, and race-adjusted rate of 31.4/100,000 person-years. In contrast, the suicide rate in the general US population was 16.7/100,000 person-years. Higher suicide rates were associated with male sex, white race, and older age at diagnosis. The highest suicide risks were observed in patients with cancers of the lung and bronchus (standardized mortality ratio [SMR] = 5.74; 95% CI, 5.30 to 6.22), stomach (SMR = 4.68; 95% CI, 3.81 to 5.70), oral cavity and pharynx (SMR = 3.66; 95% CI, 3.16 to 4.22), and larynx (SMR = 2.83; 95% CI, 2.31 to 3.44). SMRs were highest in the first 5 years after diagnosis with cancer.

Conclusion

Patients with cancer in the United States have nearly twice the incidence of suicide of the general population, and suicide rates vary among patients with cancers of different anatomic sites. Further examination of the psychological experience of patients with cancer, particularly that of patients with certain types of cancer, is warranted.

J Clin Oncol 26:4731-4738. © 2008 by American Society of Clinical Oncology

INTRODUCTION

Improved survival after cancer treatment has heightened the need for better insight into issues of cancer survivorship and quality of life.¹ Ten years ago, the National Cancer Institute created the Office of Cancer Survivorship to focus on the needs of cancer survivors.² Numerous institutions, including the US Centers for Disease Control and Prevention, in conjunction with the Lance Armstrong Foundation³ and the Institute of Medicine,^{1,4} have funded initiatives to decrease the substantial psychosocial distress experienced by many cancer survivors.

Several studies have identified increased suicide rates among patients with cancer.⁵⁻¹³ Three Scandinavian studies have been large enough to

compare suicide rates by anatomic cancer site, with inconsistent results among the studies. Particularly high rates were seen in patients with respiratory and breast cancers in Denmark¹⁴; respiratory and oropharyngeal cancers in Norway¹⁵; and esophageal, pancreatic, and respiratory cancers in Sweden.¹¹

With the exception of one study that focused exclusively on women with breast cancer,¹⁶ anatomic site-specific suicide rates have not been examined in a large sample of patients with cancer in the United States. The aims of our study were to characterize suicide rates among persons with cancer in the United States relative to suicide rates in the general population and to identify patient and disease characteristics, such as anatomic site of cancer, that are associated with particularly high suicide rates.

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Submitted August 19, 2007; accepted May 20, 2008; published online ahead of print at www.jco.org on August 11, 2008.

Supported by National Institutes of Health Basic Sciences Training in Otolaryngology Grant No. DC00018 (S.M.) and by Department of Veterans Affairs Health Services Research and Development Service Center of Excellence Grant HFP 83-027 (S.M. and B.Y.).

Presented in part at the Annual Meeting of the American Head and Neck Society, August 17-20, 2006, Chicago, IL.

The views expressed in this article are those of the authors and do not necessarily represent the views of the Department of Veterans Affairs.

Authors' disclosures of potential conflicts of interest and author contributions are found at the end of this article.

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0732-183X/08/2629-4731/\$20.00

DOI: 10.1200/JCO.2007.13.8941

Table 1. Incidence of Suicide Among Patients With Cancer by Demographic and Tumor Characteristics

Characteristic	Patients With Cancer in SEER		Suicides		Suicides per 100,000 Person-Years*	SMR*†	95% CI
	No.	%	No.	%			
Sex							
Male	1,728,990	48.1	4,636	79.4	59.7	2.09	2.03 to 2.15
Female	1,865,760	51.9	1,202	20.6	10.7	1.48	1.40 to 1.57
Race							
White	3,040,111	84.6	5,414	92.7	33.3	1.88	1.83 to 1.93
Black	311,960	8.7	174	3.0	13.5	1.72	1.48 to 2.00
Other	242,679	6.8	250	4.3	23.2	2.23	1.97 to 2.53
Marital status							
Unmarried	1,319,454	36.7	2,129	36.5	37.1	2.18	2.09 to 2.28
Married	1,966,977	54.7	3,300	56.5	31.5	1.84	1.78 to 1.90
Unknown	308,319	8.6	409	7.0	23.1	1.22	1.10 to 1.34
Stage at presentation							
In situ	307,766	8.6	364	6.2	16.1	0.80	0.72 to 0.89
Localized	1,446,700	40.2	2,595	44.5	25.1	1.56	1.50 to 1.62
Regional	733,294	20.4	1,216	20.8	36.1	2.21	2.08 to 2.33
Distant	704,695	19.6	892	15.3	65.3	4.08	3.81 to 4.35
Unstaged/unknown	403,295	11.2	771	13.2	59.4	3.59	3.34 to 3.85
No. of primary tumors‡							
Single	2,815,657	78.3	4,572	78.3	33.5	1.94	1.91 to 2.02
Multiple	778,736	21.7	1,265	21.7	25.2	1.63	1.54 to 1.72
Year of diagnosis							
1973-1982	789,249	22.0	1,885	32.3	32.7	1.83	1.75 to 1.92
1983-1992	1,147,389	31.9	2,407	41.2	31.9	1.94	1.87 to 2.02
1993-2002	1,658,112	46.1	1,546	25.5	29.3	1.83	1.74 to 1.93
All patients with cancer	3,594,750		5,838		31.4	1.88	1.83 to 1.93

Abbreviations: SEER, Surveillance, Epidemiology, and End Results; SMR, standardized mortality ratio.

*Adjusted to the age distribution in the population served by the SEER program.

†For the categories of sex and race, SMR reference population was the specific category in the US subpopulation (eg, the SMR for males is the observed number of suicides in men with cancer divided by the expected number of suicides based on the rate in men in the general population). For marital status, stage at presentation, number of primary tumors, and year of diagnosis, SMR reference population is the entire general US population from 1969 through 2002.

‡A total of 357 persons had an unknown number of primary tumors. There was one suicide in this group.

METHODS

This study was approved by the University of Washington institutional review board (Certificate of Exemption No. 05-8654-X/A) and by the Veterans' Affairs Puget Sound Healthcare System Research Committee (Research and Development Information System approval No. 0030).

Data Sources

Patients with cancer were identified from the Surveillance, Epidemiology, and End Results (SEER) program of the National Cancer Institute. The SEER program is a network of population-based incident tumor registries from geographically distinct regions in the United States. The SEER registries contain data from more than 2,800,000 patients and cover approximately 26% of the US population.¹⁷ The Public Use version of data collected from the SEER13 registries from 1973 to 2002 was used for this study.¹⁸ Comparisons with the general US population were based on mortality data collected by the National Center for Health Statistics spanning 1969 to 2002 and were accessed through the SEER program.¹⁹

Study Population and Inclusion Criteria

For analyses pertaining to all forms of cancer combined, all patients with a cancer diagnosis were included, except those for whom information was obtained solely from death certificate or autopsy and therefore had no survival time data (comprising 1.4% of the total patients in the registries). For organ

site-specific analysis, patients with multiple primary tumors were excluded because suicides in these patients would not be ascribable to a single anatomic site of cancer.

Data are presented only for persons with those forms of cancer in whom 100,000 person-years or more of survival time accrued in the data obtained from the SEER registries. Thus results are not presented for persons with eye and orbital tumors, skeletal tumors, soft tissue tumors, esophageal tumors, pancreatic tumors, liver and biliary tumors, multiple myelomas, mesotheliomas, Kaposi's sarcomas, male breast cancers, and tumors designated as "other" in the SEER registries. The leukemias were analyzed as an aggregate group because no single type of leukemia accumulated sufficient person-years of survival to be analyzed individually.

Study Variables

Available data in the SEER files included sex, age at diagnosis, race, marital status, and year of diagnosis. Data for selected cancer variables such as anatomic site of disease, extent of disease (local, regional, and distant disease), date of last follow-up, and vital status at last follow-up were also available. Data on concomitant illnesses, such as comorbid medical and psychiatric conditions (including depression and substance abuse) were not available.

Patients were considered to have committed suicide if the cause of death variable was coded as "Suicide and Self-inflicted Injury (50220)." Patients with other cause of death values, including "Accidents and Adverse Effects (50210)," "Homicide and Legal Intervention (50230)," and "Other Cause of Death (50300)," were not classified as deaths due to suicide.

Because survival duration after cancer diagnosis was measured in months, the smallest nonzero value of survival duration was 1 month. Patients included in the analyses who did not survive a full month after diagnosis were therefore coded in the SEER data set as having a survival time of zero. For our analyses, these patients were assigned a survival time of one-half month according to standard epidemiologic convention.²⁰

Statistical Analyses

Contingency tables of suicide rates (number of suicides divided by person-years of survival) were created to facilitate a comparison between the cancer population and the general population, as well as to compare rates by different anatomic sites. Analyses addressing the relation of suicide to demographic characteristics were adjusted to the distribution of the age at diagnosis in persons with cancer in the SEER registries. Suicide rates were standardized to the sex, race, and age (at diagnosis) distribution of the persons with cancer in the SEER registries. Five-year age categories were used for standardization. Staging for prostate tumors that were coded as locoregional in the SEER registries was analyzed as part of the localized group. Standardized mortality ratios (SMR) and 95% CIs were calculated as previously described.²⁰⁻²² Analysis for relative suicide risk over time since diagnosis was adjusted for the sex and age distribution of persons with a single primary tumor in the SEER registries. Statistical analyses were performed with SEER*Stat 6.2.3 (Surveillance Research Program, National Cancer Institute, Bethesda, MD) and STATA 9.1 (STATA Corp, College Station, TX).

RESULTS

A total of 5,838 suicides were identified among 3,594,750 persons with cancer observed for 18,604,308 person-years, giving an age-, sex-, and race-adjusted suicide rate of 31.4/100,000 person-years. The corresponding suicide rate in the general US population was 16.7/100,000 person-years. This gave an SMR of 1.88 (95% CI, 1.83 to 1.93). The range of survival time was 0 to 29.92 years, with mean survival time 5.10 years, which was calculated for all persons in the SEER registries regardless of cause of death.

Characteristics Associated With Higher Suicide Rates

Higher suicide rates among patients with cancer were associated with male sex, white race, and being unmarried. Suicide rates were also higher among patients with advanced disease at diagnosis, but not among patients with multiple primary tumors. For the population as a whole, suicide rates remained stable over the 30 years covered in the SEER data (Table 1). Higher suicide rates were noted with increasing age at diagnosis among men (Table 2).

Anatomic Sites of Tumor Associated With Higher Suicide Rates

Among 2,815,657 patients with a single primary tumor, who accumulated 14,094,889 person-years, 4,572 suicides occurred. Though suicide rates among patients with most types of cancer were higher than those of the general US population, rates were highest in patients with cancers of the lung and bronchus (81.7/100,000 person-years; SMR = 5.74; 95% CI, 5.30 to 6.22), followed by stomach cancers (71.7/100,000 person-years; SMR = 4.68; 95% CI, 3.81 to 5.70), cancers of the oral cavity and pharynx (53.1/100,000 person-years; SMR = 3.66; 95% CI, 3.16 to 4.22), and cancers of the larynx (46.8/100,000 person-years; SMR = 2.83; 95% CI, 2.31 to 3.44; Table 3). Cancers of the lung and bronchus, stomach, and oral cavity and pharynx remained associated with the highest suicide rates in both men and women (Table 3).

Suicide Risk Over Time After Diagnosis

The relative increase in suicide risk among persons with cancer was highest in the first 5 years after diagnosis with cancer and declined gradually thereafter, but remained elevated compared with that of the general US population 15 years after diagnosis. The highest relative suicide risks persisted over time in patients with cancers of the lung and bronchus, oral cavity and pharynx, larynx, nervous system, prostate, and cervix (Table 4).

Table 2. Suicide Rate in Persons With Cancer by Age at Diagnosis

Age at Diagnosis (years)*	Suicide Rate in United States General Population†‡	Suicide Rate in SEER Cancer Population†	Survival Time (person-years)§	No. of Suicides§	SMR‡	95% CI	Suicide Rate Among Male Patients in SEER Cancer Population†	Suicide Rate Among Female Patients in SEER Cancer Population†
15-19	8.7	15.5	148,370	23	1.78	1.13 to 2.66	28.2	8.4
20-24	14.7	15.8	429,339	68	1.08	0.84 to 1.37	29.9	12.1
25-29	15.0	14.8	754,665	112	0.99	0.81 to 1.19	33.0	10.9
30-34	14.7	16.5	847,484	140	1.12	0.95 to 1.33	47.8	8.8
35-39	15.1	18.6	888,357	165	1.23	1.05 to 1.43	54.7	8.4
40-44	15.6	18.3	1,042,682	191	1.17	1.01 to 1.35	45.0	10.2
45-49	16.2	20.2	1,283,883	259	1.25	1.10 to 1.41	45.6	11.1
50-54	16.3	22.2	1,573,521	349	1.36	1.22 to 1.51	44.6	11.2
55-59	16.7	27.7	1,893,017	525	1.66	1.52 to 1.81	51.4	11.9
60-64	15.9	32.5	2,223,345	723	2.05	1.90 to 2.20	57.4	11.1
65-69	16.4	39.7	2,394,511	950	2.42	2.27 to 2.58	67.0	11.6
70-74	18.1	44.9	2,128,697	956	2.48	2.33 to 2.64	76.2	10.1
75-79	20.4	46.6	1,527,301	711	2.28	2.12 to 2.46	80.7	11.2
80-84	22.0	52.3	827,459	433	2.38	2.16 to 2.61	100.3	9.8
85+	20.1	50.4	438,872	221	2.51	2.19 to 2.86	108.4	10.0

Abbreviations: SEER, Surveillance, Epidemiology, and End Results; SMR, standardized mortality ratio.

*Analysis was limited to age groups for which at least 100,000 person years were accrued.

†Per 100,000 person-years.

‡Reference population: general US population, 1969 to 2002.

§Among persons with cancer in the populations served by the SEER program.

Table 3. Suicide Rates by Anatomic Site of Cancer

Site*	No. of Suicides	No. of Patients	Survival Time (person-years)	Overall (male and female)			Male Patients			Female Patients		
				Suicide Rate††	SMR‡§	95% CI‡§	Suicide Rate††	SMR‡§	95% CI‡§	Suicide Rate††	SMR‡§	95% CI‡§
Lung and bronchus	610	362,163	541,310	81.7	5.74	5.30 to 6.22	171.4	6.04	5.54 to 6.57	24.8	4.18	3.27 to 5.27
Stomach	100	58,954	113,485	71.7	4.68	3.81 to 5.70	147.1	4.85	3.89 to 5.98	23.9	3.74	1.94 to 6.48
Oral cavity and pharynx	191	51,807	242,481	53.1	3.66	3.16 to 4.22	103.1	3.71	3.18 to 4.31	21.4	3.23	1.95 to 5.03
Larynx	100	24,524	147,142	46.8	2.83	2.31 to 3.44	88.4	2.83	2.29 to 3.46	20.3	2.84	1.04 to 6.06
Hodgkin's lymphoma	50	20,497	165,809	40.6	2.07	1.54 to 2.72	97.2	2.35	1.73 to 3.13	4.6	0.71	0.14 to 1.99
Kidney	90	52,699	237,446	39.7	2.05	1.65 to 2.52	68.7	2.06	1.63 to 2.58	21.2	2.00	1.07 to 3.39
Thyroid	39	38,446	330,246	38.7	1.08	0.77 to 1.47	81.5	1.26	0.80 to 1.88	11.5	0.89	0.51 to 1.44
Nervous system	38	44,151	135,497	35.8	2.33	1.65 to 3.20	63.3	2.13	1.42 to 3.08	18.3	3.17	1.52 to 5.76
Non-Hodgkin's lymphoma	156	98,475	406,503	35.1	2.24	1.90 to 2.62	65.8	2.26	1.88 to 2.69	15.7	2.16	1.47 to 3.06
Leukemias	77	75,438	271,126	30.1	1.86	1.47 to 2.32	52.1	1.75	1.34 to 2.25	16.1	2.45	1.40 to 3.96
Colorectal	524	317,951	1,529,946	29.1	1.90	1.74 to 2.07	60.2	2.03	1.85 to 2.23	9.4	1.39	1.10 to 1.74
Bladder	256	97,441	591,281	25.2	1.73	1.52 to 1.95	49.5	1.74	1.53 to 1.98	9.8	1.55	0.92 to 2.44
Skin, nonbasal	157	114,591	780,825	19.5	1.16	0.98 to 1.35	40.4	1.24	1.03 to 1.47	6.2	0.88	0.58 to 1.28
Testis	53	18,744	175,272	NA			89.7	1.29	0.97 to 1.68	NA		
Prostate	976	364,460	1,946,650	NA			40.7	1.56	1.47 to 1.66	NA		
Ovary	44	53,434	238,961	NA			NA			18.9	2.47	1.79 to 3.31
Breast	294	417,821	2,837,667	NA			NA			9.7	1.35	1.20 to 1.52
Cervix	198	158,969	1,777,803	NA			NA			9.1	1.70	1.47 to 1.95
Uterus	63	85,350	756,290	NA			NA			6.8	1.05	0.81 to 1.35
All cancer patients with single primary tumor	4,572	2,815,657	14,094,889	32.4	2.06	2.00 to 2.12	65.3	2.23	2.16 to 2.31	11.6	1.61	1.51 to 1.71
General US population				15.8	1	Reference	29.2	1	Reference	7.2	1	Reference

Abbreviations: SMR, standardized mortality ratio; NA, not applicable.

*Analysis was limited to tumor sites for which at least 100,000 person years were accrued.

†Per 100,000 person-years.

‡Adjusted to the age, race, and sex distributions of patients with a single primary tumor.

§Reference population: general US population, 1969 to 2002.

||Sex-specific analysis, adjusted for age and race distributions of patients with single primary tumor.

DISCUSSION

The incidence of suicide in patients with cancer in the United States is approximately twice that of the general US population. European studies also have observed increased suicide rates in persons with cancer. Using a Danish cancer registry, Yousaf et al¹⁴ found SMRs of 1.7 and 1.4 for suicide among men and women, respectively, as compared with those of the general Danish population. In Norway, Hem et al¹⁵ reported SMRs of 1.55 and 1.35. In Sweden, Björkenstam et al¹¹ observed an SMR of 2.5 (men and women combined) for the period from 1965 to 1974 and 1.5 for the period from 1985 to 1994. Smaller studies from the United States and Australia have also noted that a history of cancer is associated with increased risk of death by suicide.^{16,23,24}

Using data from the United States similar to those in the present analysis, Kendal²⁵ documented that suicides occurred in 19 per 10,000 men with cancer and four per 10,000 women with cancer. However, because no account was taken of the person-time at risk after a cancer diagnosis, no meaningful comparison could be made to the incidence of suicide in the population as a whole or across patients with different forms of cancer.

We found that lung, stomach, and head and neck cancers were associated with the highest suicide rates. Several studies have observed that cancers at certain anatomic sites are associated with particularly

increased suicide rates. However, the sites associated with the greatest risk vary depending on the report.^{5,7-9,11,12,14,15} The European studies have shown similarly elevated suicide rates in patients with lung cancer, but have not been unanimous in identifying high rates of suicide among those with stomach and head and neck cancers.^{5,14,15} Although the reasons for particular types of cancers to be associated with increased suicide rates are unknown, it is possible that patients with lung cancer may struggle with their grave prognoses. One study found a 25% prevalence of depression among patients with lung cancer,²⁶ and other work has suggested that lower quality of life in patients with lung cancer is related to emotional distress.²⁷ Examination of psychological reactions in newly diagnosed patients with gastric cancer showed high levels of psychological distress.²⁸ Patients with head and neck cancers have a high prevalence of depression as well.²⁹ Head and neck cancers could have a particularly devastating effect on quality of life through their impact on appearance and essential functions such as speech, swallowing, and breathing.³⁰

Characteristics associated with suicide in the cancer population, such as older age and male sex, were similar to those in the general population.³¹ Suicide risk among patients with cancer as a group was highest in the years immediately after diagnosis, but remained increased for more than 15 years as compared with the suicide rates in the general population. This is similar to the elevation in suicide risk

Incidence of Suicide in Persons With Cancer

Table 4. Suicide in Patients With Cancer by Site and Years Since Diagnosis

Cancer Site*	Time Since Diagnosis			
	0 to 5 Years	5 to 10 Years	10 to 15 Years	15 to 30 Years
All				
No. of suicides	3,202	858	313	199
Person-years accrued	7,657,131	3,546,942	1,665,199	1,225,617
SMR†‡	2.38	1.58	1.43	1.43
95% CI	2.30 to 2.46	1.47 to 1.69	1.28 to 1.60	1.24 to 1.64
Lung and bronchus				
No. of suicides	565	30	8	7
Person-years accrued	410,217	81,196	31,885	18,012
SMR†‡	6.60	2.00	1.42	2.31
95% CI	6.07 to 7.17	1.35 to 2.86	0.61 to 2.75	0.93 to 4.67
Stomach				
No. of suicides	89	10	1	0
Person-years accrued	78,953	20,269	8,886	5,378
SMR†‡	5.16	2.57	0.62	NA
95% CI	4.15 to 6.35	1.24 to 4.68	0.02 to 3.07	
Oral cavity and pharynx				
No. of suicides	142	27	10	12
Person-years accrued	138,201	58,162	27,669	18,449
SMR†‡	4.65	2.23	1.81	3.38
95% CI	3.92 to 5.48	1.47 to 3.23	0.87 to 3.29	1.75 to 5.85
Larynx				
No. of suicides	64	19	11	6
Person-years accrued	77,607	37,869	19,039	12,628
SMR†‡	3.27	2.10	2.53	2.17
95% CI	2.52 to 4.17	1.27 to 3.26	1.26 to 4.48	0.80 to 4.64
Hodgkin's lymphoma				
No. of suicides	25	15	7	3
Person-years accrued	74,138	44,024	25,765	21,882
SMR†‡	2.27	2.39	1.96	1.02
95% CI	1.47 to 3.33	1.34 to 3.92	0.79 to 3.96	0.21 to 2.85
Kidney				
No. of suicides	60	19	8	3
Person-years accrued	135,349	58,227	26,327	17,542
SMR†‡	2.25	1.81	1.84	1.14
95% CI	1.72 to 2.90	1.09 to 2.82	0.79 to 3.57	0.23 to 3.18
Thyroid				
No. of suicides	21	12	4	2
Person-years accrued	144,650	86,983	50,786	47,828
SMR†‡	1.29	1.26	0.74	0.40
95% CI	0.80 to 1.96	0.65 to 2.18	0.20 to 1.83	0.05 to 1.34
Nervous system				
No. of suicides	27	5	3	3
Person-years accrued	78,245	30,561	15,298	11,394
SMR†‡	2.59	1.53	2.08	3.25
95% CI	1.71 to 3.76	0.49 to 3.48	0.42 to 5.83	0.65 to 9.08
Non-Hodgkin's lymphoma				
No. of suicides	116	26	11	3
Person-years accrued	247,260	96,071	39,611	23,560
SMR†‡	2.62	1.66	1.81	0.89
95% CI	2.17 to 3.15	1.08 to 2.42	0.91 to 3.21	0.18 to 2.48
Leukemias				
No. of suicides	56	14	2	5
Person-years accrued	166,683	62,505	25,581	16,356
SMR†‡	2.01	1.60	0.68	3.50
95% CI	1.52 to 2.61	0.88 to 2.67	0.08 to 2.29	1.13 to 7.96
Colorectal				
No. of suicides	367	103	34	20
Person-years accrued	869,291	371,158	176,756	112,740
SMR†‡	2.19	1.56	1.16	1.15
95% CI	1.97 to 2.43	1.27 to 1.89	0.80 to 1.61	0.71 to 1.78

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Table 4. Suicide in Patients With Cancer by Site and Years Since Diagnosis (continued)

Cancer Site*	Time Since Diagnosis			
	0 to 5 Years	5 to 10 Years	10 to 15 Years	15 to 30 Years
Bladder				
No. of suicides	163	56	26	11
Person-years accrued	315,809	154,763	73,444	47,266
SMR†‡	1.99	1.53	1.62	1.15
95% CI	1.69 to 2.32	1.15 to 1.98	1.06 to 2.37	0.58 to 2.05
Skin, nonbasal				
No. of suicides	90	44	13	10
Person-years accrued	405,177	202,785	100,902	71,961
SMR†‡	1.25	1.33	0.84	0.96
95% CI	1.01 to 1.54	0.97 to 1.78	0.45 to 1.43	0.46 to 1.74
Testis§				
No. of suicides	23	17	8	5
Person-years accrued	74,154	48,068	28,778	24,272
SMR†‡	1.35	1.54	1.22	0.91
95% CI	0.86 to 2.02	0.90 to 2.46	0.53 to 2.36	0.29 to 2.07
Prostate§				
No. of suicides	612	259	80	25
Person-years accrued	1,260,950	511,800	131,582	42,318
SMR†‡	1.43	1.55	1.97	2.09
95% CI	1.31 to 1.54	1.37 to 1.75	1.56 to 2.45	1.35 to 3.08
Ovary§				
No. of suicides	34	7	1	2
Person-years accrued	134,690	54,942	27,156	22,173
SMR†‡	3.45	1.74	0.5	1.23
95% CI	2.39 to 4.81	0.70 to 3.53	0.02 to 2.50	0.14 to 4.17
Breast§				
No. of suicides	178	67	32	17
Person-years accrued	1,521,683	744,074	343,563	228,346
SMR†‡	1.57	1.19	1.20	0.92
95% CI	1.34 to 1.81	0.92 to 1.51	0.82 to 1.69	0.54 to 1.47
Cervix§				
No. of suicides	69	60	29	40
Person-years accrued	662,264	510,507	308,014	297,018
SMR†‡	1.56	1.76	1.41	2.00
95% CI	1.21 to 1.97	1.35 to 2.27	0.94 to 2.01	1.43 to 2.71
Uterus§				
No. of suicides	28	19	8	8
Person-years accrued	313,013	194,311	122,842	126,120
SMR†‡	1.20	1.29	0.84	0.79
95% CI	0.80 to 1.74	0.78 to 2.00	0.36 to 1.63	0.34 to 1.53

Abbreviations: SMR, standardized mortality ratio; NA, not applicable.

*Analysis was limited to tumor sites for which at least 100,000 person years were accrued.

†Adjusted to the age and sex distributions of patients with single primary tumor.

‡Reference population: general US population, 1969 to 2002.

§Sex-specific analysis, adjusted to the age distribution of patients with single primary tumor.

seen in breast cancer survivors in the SEER program, some of whom were included in this study, which lasted more than 25 years after diagnosis even after definitive treatment of their cancers.¹⁶ Interpretation of results from patients who survived 15 or more years after their cancer diagnosis was limited by small numbers of suicides associated with some cancer sites. However, in addition to lung and head and neck cancers, cancers of the nervous system, prostate, and cervix seemed to be associated with long-term increases in suicide risk. This is consistent with prior work that observed a high prevalence of depression and distress in patients with brain cancer.³² Other work demonstrated elevated suicide rates among men with prostate cancer in South Florida and suggested that depression was a significant risk

factor.³³ Similarly, a study in southern New England described depressive symptoms in long-term survivors of cervical cancer.³⁴

Our findings should be interpreted in light of several limitations. First, cause of death may be subject to misclassification bias. Suicide is often difficult to distinguish from homicide or accidental injury and could potentially also be classified as an unexplained death. The literature is not conclusive as to the magnitude of such an effect,³⁵⁻³⁸ although some work has suggested that suicide codes are generally quite accurate.³⁹

Second, we were unable to evaluate the potential confounding role of comorbid medical and psychiatric conditions, including characteristics that could bear on the incidence of cancer (such as tobacco

and alcohol use) that may also be associated with an increased risk of suicide. Tobacco^{40,41} and alcohol use^{42,43} have been associated with increased suicide risk, although the strengths of these associations vary widely (ranging from relative risk of 1.4 to 4.3) depending on the study. Because tobacco and alcohol use can be common in patients with lung and head and neck cancer,^{44,45} this may account for some of the increased suicide rates in these groups of patients.

Third, we were unable to censor patients with cancer who died of suicide from the general US population mortality data collected by the National Center for Health Statistics. Given the vastly larger number of patients who commit suicide in the general population, the impact of suicides among patients with cancer on the suicide rate of the overall US population can be expected to be negligible. In addition, any bias introduced in this manner would likely be conservative.

Our data suggest that the psychological experience of cancer survivors deserves further attention, as urged by the Institute of Medicine,^{1,4} particularly because appropriate use of psychosocial interventions in patients with cancer can make a positive impact on quality of life.⁴⁶ The role of lifestyle factors and comorbidity in

determining suicide risk among patients with cancer invites further investigation, and future analyses may be augmented by the SEER-Medicare data set,⁴⁷ which may help elucidate important relationships with comorbid medical and psychiatric illnesses.

AUTHORS' DISCLOSURES OF POTENTIAL CONFLICTS OF INTEREST

The author(s) indicated no potential conflicts of interest.

AUTHOR CONTRIBUTIONS

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