Suicide Ideation in Adult Survivors of Childhood Cancer: A Report From the Childhood Cancer Survivor Study

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ABSTRACT

Purpose

To evaluate risk of suicide ideation (SI) after childhood cancer, prevalence of SI in a cohort of adult survivors of pediatric cancers was compared with prevalence in a sibling comparison group. The relationship of SI to cancer treatment and current health was examined, and the hypothesis that poor physical health is significantly associated with suicidality, after adjusting for depression, was specifically tested.

Methods

Nine thousand one hundred twenty-six adult survivors of childhood cancer and 2,968 siblings enrolled onto the Childhood Cancer Survivor Study completed a survey describing their demographics and medical and psychological functioning, including SI in the prior week.

Results

Of survivors, 7.8% reported SI compared with 4.6% of controls (odds ratio = 1.79; 95% CI, 1.4 to 2.4). Suicidality was unrelated to age, age at diagnosis, sex, cancer therapy, recurrence, time since diagnosis, or second malignancy. SI was associated with primary CNS cancer diagnosis, depression, and poor health outcomes including chronic conditions, pain, and poor global health rating. A logistic regression analysis showed that poor current physical health was significantly associated with SI even after adjusting for cancer diagnosis and depression.

Conclusion

Adult survivors of childhood cancers are at increased risk for SI. Risk of SI is related to cancer diagnosis and post-treatment mental and physical health, even many years after completion of therapy. The association of suicidal symptoms with physical health problems is important because these may be treatable conditions for which survivors seek follow-up care and underscores the need for a multidisciplinary approach to survivor care.

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INTRODUCTION

Several studies have shown that cancer patients are at increased risk for suicide compared with the general population.¹⁻⁵ Scandinavian registry studies, for example, have reported standardized mortality ratios for suicide deaths in cancer patients that range from 1.55 to 2.5 for males and 1.35 to 2.9 for females, compared with the general population.²⁻⁴ These studies have focused almost exclusively on patients within 1 to 5 years of first cancer diagnosis and have not examined the risk of suicide in long-term survivors. Additionally, population-based studies have not differentiated between pediatric and adult cancers, making it difficult to know if conclusions could be generalized to survivors of pediatric malignancy.

With the development of intensive treatments, the majority of pediatric cancer patients are cured of

their initial cancer,⁶ but many go on to have late complications of treatment that interfere with later physical,⁷⁻¹¹ psychosocial,^{12,13} and neurocognitive¹⁴ development. An early study of case reports indicated that childhood cancer patients may be at risk for suicide, particularly after therapy completion.¹⁵ More recently, members of our investigator team (C.J.R. and L.R.D.)^{16,17} reported elevated rates of suicide ideation (SI) in adult survivors of childhood cancer seen in a survivor clinic. In one study, using multiple measures of suicidal symptoms, 12.8% of these survivors reported current SI or past suicide attempt, and suicidal symptoms were associated with survivors' physical health, even after accounting for demographic and mental health variables. Identification of a relationship between suicidality and physical health outcomes has important implications for understanding the etiology of the suicide risk and for identifying those most at risk.

To follow-up on these previous findings from single-institution studies, data from the Childhood Cancer Survivor Study (CCSS) were analyzed to determine the prevalence of SI in adult survivors of childhood cancer compared with sibling controls and to identify correlates of SI. In addition to describing the relationship of these variables to SI, the study tested the hypothesis that survivors' physical functioning and health status are associated with increased risk for SI even after adjusting for demographic variables, treatment-related variables, and self-reported depression.

METHODS

Participants

Participants were adults enrolled onto the CCSS, a multicenter cohort study of individuals treated for childhood cancer. Participating centers are provided in the Appendix. The CCSS design and cohort have been reported in detail,¹⁸ including in a recent special issue of *Journal of Clinical Oncology*,¹⁹ and will be only briefly summarized. Eligibility criteria for the CCSS included the following: diagnosis between January 1, 1970 and December 31, 1986 with a leukemia, CNS tumor, lymphoma, kidney cancer, neuroblastoma, soft tissue sarcoma, or malignant bone tumor; diagnosis and initial therapy at one of 25 CCSS institutions; age less than 21 years at diagnosis; and survival ≥ 5 years from diagnosis. The protocol was approved by the appropriate institutional review boards at each participating institution.

Of 20,720 eligible participants, 85.4% were successfully contacted, and 81.2% of the contacted individuals completed a baseline survey.¹⁹ Only participants $\geq$ age 18 years were administered an item inquiring about SI. Nine thousand one hundred twenty-six participants completed this survey item, and their data were included in this analysis. Participants included 4,814 men (52.8%) and 4,312 women (47.3%). The four largest ethnic groups were white, non-Hispanic (87.8%); black, non-Hispanic (4.5%); hispanic (5.1%); and other (2.6%). Age of the cohort ranged from 18 to 48 years, and time since diagnosis ranged from 6 to 29 years. Cancer diagnoses were classified as follows: leukemias (29.4%), Hodgkin's disease (18.0%), CNS tumors (12.5%), bone tumors (10.9%), soft tissue sarcomas (9.7%), non-Hodgkin's lymphomas (9.2%), Wilms tumors (6.4%), and neuroblastomas (3.9%). A random sample of 50% of participating survivors was asked to identify their nearest-age living sibling. These siblings were recruited to the study as noncancer controls. Data from 2,968 siblings (1,383 men and 1,585 women) with age ≥ 18 years who completed the survey were included in this analysis. Demographic information on participants is listed in Table 1.

Measures

The CCSS collected data on participants' cancer treatment using a standardized medical record review. Patient-reported information was assessed with a 24-page mailed CCSS baseline survey covering sociodemographic information (eg, marital status, education, income, employment in the last year), medical history, functional limitations (eg, disability status), health utilization (eg, physical examination and oncology visit and hospitalizations within the last 2 years), psychological functioning, and current health and illnesses. Copies of the survey are available from the CCSS Web site.²⁰

SI and depression rating. The CCSS baseline survey included items from the Brief Symptom Inventory-18 (BSI-18) an 18-item psychological screening inventory designed for assessing psychological distress in medical patients.²¹ BSI-18 items were presented with standard instructions asking participants to report the extent to which they were "distressed or bothered" in the past week by each symptom. Participants responded on a 5-point Likert scale ranging from "not at all" to "extremely." Information on the BSI-18 items, scoring, and factorial validity in the CCSS cohort have been reported previously.²² Participants who endorsed any suicidal ideation on item 9, "thoughts of ending your life," were considered to have SI. The SI item is part of the Depression scale; however, to allow for a measure of depression excluding SI, an alternative method was used to calculate the Depression score in the study. Specifically, item 9 was treated as missing in the calculation of the BSI-18 Depression score,

Table 1. Demographics and Clinical Characteristics of Adult Survivors of Childhood Cancer and Demographics of Siblings

Variable	Survivors (n = 9,126)		Siblings (n = 2,986)	
	No.	%	No.	%
Age at interview, years	9,126		2,968	
18-24	3,566	39.1	861	29.0
25-29	2,501	27.4	696	23.5
30-34	1,859	20.4	647	21.8
≥ 35	1,200	13.2	764	25.7
Sex	9,126		2,968	
Female	4,312	47.3	1,585	53.4
Male	1,383	46.6	4,814	52.8
Race/ethnicity	9,101		2,869	
White, NH	7,993	87.8	2,463	92.1
Black, NH	408	4.5	71	2.5
Hispanic	467	5.1	96	3.4
Other	233	2.6	59	2.1
Education	8,645		2,843	
< 12 years (some high school)	784	9.1	157	5.5
Completed high school	1,882	21.8	517	18.2
High school + some college*	3,213	37.2	1,041	36.6
College/postgraduate†	2,766	32.0	1,128	39.7
Household income	8,039		2,701	
< \$9,999	706	8.8	125	4.6
\$10,000-\$19,000	1,080	13.4	224	8.3
\$20,000-\$39,999	2,440	30.4	666	24.7
\$40,000-\$59,999	1,787	22.2	666	24.7
> \$60,000	2,026	25.2	1,020	37.8
Cancer diagnosis	9,126			
Leukemia	2,681	29.4		
Hodgkin's disease	1,645	18.0		
CNS	1,136	12.5		
Bone	997	10.9		
Sarcoma	881	9.7		
NHL	842	9.2		
Wilms tumor	584	6.4		
Neuroblastoma	360	3.9		
Cancer treatment	7,903			
Surgery only	578	7.3		
RT only	23	0.3		
Chemo only	307	3.9		
Chemo + RT	910	11.5		
Chemo + surgery	1,310	16.6		
RT + surgery	1,143	14.5		
Chemo + RT + surgery	3,632	46.0		
Age at cancer diagnosis, years	9,126			
< 3	820	9.0		
3-6	2,043	22.4		
7-10	1,764	19.3		
11-17	3,509	38.5		
≥ 18	990	10.9		
Time since cancer diagnosis, years	9,126			
6-10	662	7.3		
11-15	2,633	28.9		
16-20	3,267	35.8		
≥ 21	2,564	28.1		

NOTE. Results are adjusted for age and sex. Percentages are based on the total No. of patients with available data for each variable.

Abbreviations: NH, non-Hispanic; NHL, Non-Hodgkin's lymphoma; RT, radiation therapy; Chemo, chemotherapy.

*High school + some college = high school graduate with either some college courses or other training.

†College/postgraduate = college graduate with or without postgraduate training.

Table 2. Cancer Treatment and SI in Survivors of Childhood Cancer

Variable	Total No. of Survivors (N = 9,126)	SI in Survivors		OR	95% CI
		No.	%		
Diagnosis	9,126				
Leukemia	2,681	200	7.5	1.0	Reference
Hodgkin's disease	1,645	131	8.0	1.2	0.9 to 1.5
CNS	1,136	120	10.6	1.5*	1.2 to 1.9
Bone	997	76	7.6	1.1	0.8 to 1.4
Sarcoma	881	64	7.3	1.0	0.8 to 1.4
NHL	842	56	6.7	0.9	0.7 to 1.3
Wilms tumor	584	40	6.9	0.9	0.6 to 1.3
Neuroblastoma	360	26	7.2	0.9	0.6 to 1.4
Time since diagnosis, years	9,126				
6-10	662	54	8.2	1.0	Reference
11-15	2,633	207	7.9	1.0	0.7 to 1.3
16-20	3,267	255	7.8	1.0	0.7 to 1.3
≥ 21	2,564	197	7.7	1.0	0.7 to 1.4
Age at diagnosis, years	9,126				
≥ 18	990	59	6.0	1.0	Reference
11-17	3,509	283	8.1	1.4	1.0 to 1.8
7-10	1,764	151	8.6	1.4	1.0 to 2.0
3-6	2,043	154	7.5	1.2	0.8 to 1.8
< 3	820	66	8.1	1.3	0.9 to 2.0
Cancer treatment	7,903				
Chemo only	307	20	6.5	1.0	Reference
RT only	23	0	0.0	—	—
Chemo + RT	910	75	8.2	1.3	0.8 to 2.2
Chemo + surgery	1,310	105	8.0	1.3	0.8 to 2.1
Chemo + surgery + RT	3,632	309	8.5	1.4	0.9 to 2.2
Surgery only	578	54	9.3	1.6	0.9 to 2.7
Surgery + RT	1,143	94	8.2	1.4	0.8 to 2.3
RT	7,921				
None	2,198	179	8.1	1.0	Reference
Abdomen/Pelvis	618	48	7.8	0.9	0.7 to 1.3
Chest	193	12	6.2	0.8	0.4 to 1.4
Head/brain	1,829	170	9.3	1.1	0.9 to 1.4
Other	3,083	248	8.0	1.0	0.8 to 1.2
Chemo	7,926				
None	1,749	148	8.5	1.0	Reference
Alkylators	1,786	159	8.9	1.0	0.8 to 1.3
Alkylators + anthracyclines	2,467	209	8.5	1.0	0.8 to 1.2
Anthracyclines	555	44	7.9	0.9	0.6 to 1.3
Other	1,369	99	7.2	0.8	0.6 to 1.0
Surgery	7,918				
No	1,244	95	7.6	1.0	Reference
Yes	6,674	564	8.5	1.2	0.9 to 1.5
Recurrences	9,126				
No	8,214	634	7.7	1.0	Reference
Yes	912	79	8.7	1.1	0.9 to 1.5
SMN	9,126				
No	8,834	690	7.8	1.0	Reference
Yes	292	23	7.9	1.0	0.7 to 1.6

NOTE. Percentages are based on the total with available data for each variable. ORs are adjusted for age and sex.

Abbreviations: SI, suicidal ideation; OR, odds ratio; NHL, Non-Hodgkin's lymphoma; Chemo, chemotherapy; RT, radiation therapy; SMN, second malignant neoplasm.

*OR differs significantly from 1.0.

Current medical conditions. Using participants' responses to the CCSS baseline survey, the number and severity of participants' conditions were quantified using a coding system based on the National Cancer Institute Common Terminology Criteria for Adverse Events (version 3), a scoring system developed to rate chronic and acute conditions associated with cancer therapies. The Common Terminology Criteria for Adverse Events were previously applied to the CCSS data, and details of the coding system are available in that report.²⁴ For the study reported here, each participant was rated on the number and severity of their medical conditions by grade as follows: grade 1 = mild, grade 2 = moderate, grade 3 = severe, or grade 4 = life threatening or disabling.

Statistical Analyses

Prevalence of SI in survivors and siblings was compared using generalized estimating equations to account for family relationship and was adjusted for age and sex. The associations of SI with demographic, cancer diagnosis and treatment, and health outcome variables were evaluated individually using logistic analyses adjusting for age and sex. Responses of "Unsure" on participant-reported variables were treated as missing. Odds ratios (ORs) and 95% CIs were determined separately for survivors and controls.

To test the hypothesis that survivors' health and physical functioning are associated with SI, hierarchical logistic regression was used with independent variables organized in conceptual blocks. Block 1 included the demographic variables of age and sex because these have previously been reported to be suicide correlates.²⁵ Male sex and the 18- to 24-year-old age group served as reference groups for these variables. Block 2 included cancer-related variables. The group of patients diagnosed at age ≥ 18 years served as the reference group for age at diagnosis. Cancer diagnosis was recoded into the following three groups: CNS disease, hematologic malignancies (leukemias and lymphomas), and other solid tumor (which served as the reference group). Block 3 consisted of the depression rating. Block 4 included the health outcome variables (global health rating, number of medical conditions, number of hospital admissions, and cancer-related pain). Blocks were added in successive steps. At each step, improvement in model fit was evaluated using a likelihood ratio test. All tests were conducted at a $P = .05$ significance level.

RESULTS

A significantly larger proportion of survivors (7.8%; 95% CI, 7.3% to 8.4%; 713 of 9,126 survivors) reported SI compared with controls (4.5%; 95% CI, 3.9% to 5.4%; 135 of 2,968 controls; OR = 1.79; 95% CI, 1.4 to 2.4). Table 2 shows the relationship of SI to cancer diagnosis and cancer treatment variables. Survivors of CNS cancers had the highest prevalence of SI (10.6%) and were significantly more likely to report SI than the leukemia survivors (OR = 1.5; 95% CI, 1.2 to 1.9). SI was not associated with age at diagnosis, time since diagnosis, type of cancer therapy, recurrence, or second malignancy.

In the survivor cohort, ideation was not significantly associated with age or sex but was associated with low levels of educational attainment, lower household income, and lack of recent employment (Table 3). Among survivors with less than a 12th grade education, 14.0% reported SI compared with only 6.3% of survivors with a college or graduate education (OR = 2.4; 95% CI, 1.9 to 3.1). Marital status was associated with SI, with both the never married (OR = 1.5; 95% CI, 1.2 to 1.8) and previously married groups (OR = 2.1; 95% CI, 1.7 to 2.8) more likely to report SI than the currently married survivors. In the siblings, the associations of SI with demographic variables followed a similar pattern, although many did not reach statistical significance (Table 3). Of note, age was associated with SI in the siblings, with older groups being less likely to report SI than the reference group (age 18 to 24 years).

and the scale was scored using the published missing data rules.²¹ Individuals with Depression scores at or above the recommended 90th percentile (T-scores ≥ 63)^{21,23} were considered to have clinically significant depression symptoms.

Table 3. Demographic Variables and SI in Survivors of Childhood Cancer and Siblings

Variable	Survivors (n = 9,126)					Siblings (n = 2,968)				
	Total No.	Survivors With SI		OR	95% CI	Total No.	Siblings With SI		OR	95% CI
		No.	%				No.	%		
Age at interview, years	9,126					2,968				
18-24	3,566	296	8.3	1.0	Reference	861	57	6.6	1.0	Reference
25-29	2,501	184	7.4	0.9	0.7 to 1.1	696	28	4.0	0.6*	0.4 to 0.9
30-34	1,859	143	7.7	0.9	0.7 to 1.1	647	22	3.4	0.5*	0.3 to 0.8
≥ 35	1,200	90	7.5	0.9	0.7 to 1.1	764	28	3.7	0.5*	0.3 to 0.9
Sex	9,126					2,968				
Male	4,814	367	7.6	1.0	Reference	1,383	61	4.4	1.0	Reference
Female	4,312	346	8.0	1.1	0.9 to 1.2	1,585	74	4.7	1.1	0.8 to 1.5
Education	8,645					2,843				
College/postgraduate	2,766	175	6.3	1.0	Reference	1,128	42	3.7	1.0	Reference
High school + some college	3,213	258	8.0	1.3*	1.0 to 1.6	1,041	52	5.0	1.2	0.8 to 1.8
Completed high school	1,882	126	6.7	1.1	0.8 to 1.3	517	20	3.9	0.9	0.5 to 1.6
< 12 years (some high school)	784	110	14.0	2.4*	1.9 to 3.1	157	15	9.6	2.2*	1.2 to 4.2
Household income	8,039					2,701				
≥ \$60,000	2,026	110	5.4	1.0	Reference	1,020	36	3.5	1.0	Reference
\$40,000-\$59,999	1,787	122	6.8	1.3	1.0 to 1.7	666	33	5.0	1.4	0.9 to 2.2
\$20,000-\$39,999	2,440	187	7.7	1.4*	1.1 to 1.8	666	40	6.0	1.6*	1.0 to 2.6
\$10,000-\$19,999	1,080	105	9.7	1.9*	1.4 to 2.5	224	14	6.3	1.5	0.8 to 2.9
< \$9,999	706	118	16.7	3.5*	2.6 to 4.6	125	10	8.0	2.0	0.9 to 4.1
Worked in last year	8,743					2,914				
Yes	7,838	571	7.3	1.0	Reference	2,713	122	4.5	1.0	Reference
No	905	109	12.0	1.8*	1.4 to 2.2	201	11	5.5	1.3	0.7 to 2.4
Marital status	8,909					2,914				
Married	3,758	222	5.9	1.0	Reference	1,665	47	2.8	1.0	Reference
Single/never married	4,372	369	8.4	1.5*	1.2 to 1.8	971	62	6.4	2.0*	1.2 to 3.1
Formerly married	779	92	11.8	2.1*	1.7 to 2.8	278	24	8.6	3.3*	2.0 to 5.6

NOTE. Percentages are based on the total available data for each variable. ORs are adjusted for age and sex.

Abbreviations: SI, suicidal ideation; OR, odds ratio.

*OR differs significantly from 1.0.

Among survivors, indicators of poor health were consistently associated with higher prevalence of SI (Table 4). For example, survivors reporting poor health status had the highest prevalence of SI at 28.8%, which is in sharp contrast to those reporting excellent health, of whom only 3.3% reported SI. Disabled status was associated with SI (OR = 2.7; 95% CI, 2.2 to 3.3), as were number and severity of medical conditions. Cancer-related pain was also significantly associated with SI in the survivor group. Only 5.8% of survivors with no cancer-related pain reported SI compared with 21.4% of those reporting the highest level of pain (OR = 4.5; 95% CI, 3.3 to 6.0). In siblings, the relationships between SI and health status variables were similar, although the relationships with chronic conditions did not consistently reach statistical significance (Table 4). As expected, depression was strongly associated with SI in survivors (OR = 20.4; 95% CI, 17.2 to 24.3) and siblings (OR = 28.0; 95% CI, 19.0 to 41.4). Of those reporting SI, 63.9% of survivors and 62.2% of siblings scored above the clinical cutoff on the depression measure.

Examining the health utilization information, only 20% of survivors reported a recent oncology visit, and there was no significant association with SI. Survivors reporting no routine physical examination within the last 5 years were somewhat more likely to report SI than those who reported a recent examination (OR = 1.2; 95% CI, 1.0 to 1.5). SI was more prevalent among survivors reporting a greater number of recent hospital admissions, suggesting a psychological burden

associated with medical morbidity. In siblings, the relationships between SI and recent physical examination and hospitalization variables were of similar magnitude but not statistically significant.

To test the hypothesis that SI in survivors is independently associated with physical health status after adjusting for demographic, disease, and depression variables, a hierarchical logistic regression analysis was performed (Table 5). Demographic variables entered in step 1 were not significantly associated with SI. The entry of disease and treatment variables at step 2 did significantly improve the fit of the model ($P < .01$), as did the addition of the depression variable at step 3 ($P < .001$). In the last step, the entry of the physical health variables added significantly to the model ($P < .001$), indicating that even after the variance caused by demographic, cancer treatment, and depression variables was accounted for, physical health is significantly associated with SI. In the final model adjusting for all covariates, SI was significantly associated with a CNS cancer diagnosis, earlier ages of diagnosis, higher level of depression, poor health ratings, and cancer pain.

DISCUSSION

Adult survivors of childhood cancer were found to be significantly more likely to have SI than a group of noncancer controls. SI was

Table 4. Health Status, Health Behaviors, and SI in Survivors of Childhood Cancer and Siblings

Variable	Survivors (n = 9,126)					Siblings (n = 2,968)				
	Total No.	Survivors With SI		OR	95% CI	Total No.	Siblings With SI		OR	95% CI
		No.	%				No.	%		
Health status	9,039					2,940				
Excellent	1,812	59	3.3	1.0	Reference	717	23	3.2	1.0	Reference
Very good	3,457	182	5.3	1.7*	1.2 to 2.3	1,285	42	3.3	1.1	0.6 to 1.8
Good	2,781	278	10.0	3.4*	2.5 to 4.5	785	48	6.1	2.0*	1.2 to 3.4
Fair	843	146	17.3	6.4*	4.7 to 8.8	141	18	12.8	4.7*	2.4 to 9.0
Poor	146	42	28.8	12.5*	8.0 to 19.5	12	2	16.7	6.7*	1.4 to 32.9
Disabled	8,782					2,955				
No	7,916	535	6.8	1.0	Reference	2,906	127	4.4	1.0	Reference
Yes	866	143	16.5	2.7*	2.2 to 3.3	49	8	16.3	4.7*	2.1 to 10.3
Chronic condition/grade	9,126					2,968				
None	3,449	208	6.0	1.0	Reference	1,832	72	3.9	1.0	Reference
Grade 1 or 2	3,211	275	8.6	1.5*	1.2 to 1.8	958	53	5.5	1.6*	1.1 to 2.3
Grade 3 or 4	2,466	230	9.3	1.7*	1.4 to 2.0	178	10	5.6	1.7	0.9 to 3.4
No. of chronic conditions	9,126					2,968				
0	3,449	208	6.0	1.0	Reference	1,832	72	3.9	1.0	Reference
1	2,307	164	7.1	1.2	1.0 to 1.5	710	29	4.1	1.1	0.7 to 1.7
2	1,272	92	7.2	1.3	1.0 to 1.6	249	18	7.2	2.2*	1.3 to 3.7
≥ 3	2,098	249	11.9	2.2*	1.8 to 2.7	177	16	9.0	3.1*	1.8 to 5.7
Pain medications	8,556					2,896				
No	7,040	458	6.5	1.0	Reference	2,527	92	3.6	1.0	Reference
Yes	1,516	205	13.5	2.3*	1.9 to 2.7	369	32	8.7	2.5*	1.6 to 3.8
Last physical examinations	8,239					2,636				
Within 2 years	5,746	421	7.3	1.0	Reference	1,496	68	4.6	1.0	Reference
Within 3 to 4 years	941	81	8.6	1.2	0.9 to 1.5	390	19	4.9	1.0	0.6 to 1.8
≥ 5 years/never	1,552	136	8.8	1.2*	1.0 to 1.5	750	40	5.3	1.2	0.8 to 1.8
No. of hospital admissions	8,970					2,950				
0	7,081	503	7.1	1.0	Reference	2,471	112	4.5	1.0	Reference
1-5	1,798	176	9.8	1.4*	1.2 to 1.7	472	20	4.2	0.9	0.6 to 1.5
> 5	91	16	17.6	2.8*	1.6 to 4.8	7	1	14.3	3.2	0.4 to 27.2
Depression	9,104					2,965				
Low	8,027	269	3.4	1.0	Reference	2,739	53	1.9	1.0	Reference
High	1,077	443	41.1	20.4*	17.2 to 24.3	226	81	35.8	28.0*	19.0 to 41.4
Cancer pain	8,762									
None	6,899	403	5.8	1.0	Reference					
Small amount	965	117	12.1	2.3*	1.8 to 2.8					
Medium amount	599	86	14.4	2.7*	2.1 to 3.5					
Very bad, excruciating	299	64	21.4	4.5*	3.3 to 6.0					
Visit oncology clinic	9,103									
Yes	1,749	136	7.8	1.0	Reference					
No	7,354	576	7.8	1.0	0.8 to 1.2					

NOTE. Percentages are based on the total with available data for each variable. ORs are adjusted for age and sex.

Abbreviations: SI, suicidal ideation; OR, odds ratio.

*OR differs significantly from 1.0.

strongly associated with survivors' physical health, even many years after the completion of therapy and when effects of cancer diagnosis, treatment, and depression had been taken into account. Although previous publications, based largely on case reports or small selected groups of survivors, have found survivors to report SI,¹⁵⁻¹⁷ the current study provides, to our knowledge, the first large-scale investigation of this topic. With the larger and more representative sample provided by CCSS, findings of increased SI can be more confidently accepted as reflecting a true difference between childhood cancer survivors and their same-age peers. The majority of survivors reported no SI, but the significant minority of those experiencing thoughts of ending their lives is a serious concern. SI, although only one aspect of a spectrum of

suicidal symptoms, is important to understand because it is a significant risk factor for self-destructive behaviors and is itself an indicator of emotional suffering.²⁵⁻²⁷

By demonstrating that SI of survivors is associated with specific cancer diagnoses and health outcomes, the findings add to the understanding of the relationship between childhood cancer and risk for later SI. As hypothesized, poor physical health was associated with SI, even after adjusting for depression and other covariates. This is consistent with reports that pain and chronic medical conditions are a significant risk factor for suicide and SI.²⁸⁻³³ A previous CCSS study demonstrated that childhood cancer survivors are significantly more burdened by chronic medical conditions than controls,²⁴ making any

Table 5. Summary of Hierarchical Logistic Regression Analysis for Correlates of Suicidal Ideation in Survivors (n = 9,103)

Step	Improvement in Model Fit	Final B	Odds Ratio	95% CI
Step 1: Demographic				
	2.50			
Female sex		0.17	1.2	1.0 to 1.4
Age, years				
25-29		-0.05	1.0	0.8 to 1.2
30-34		-0.03	1.0	0.7 to 1.3
≥ 35		0.13	1.1	0.8 to 1.6
Step 2: Cancer related				
	18.54*			
Diagnosis				
Hematologic		0.04	1.0	0.8 to 1.3
CNS		0.38	1.5*	1.1 to 1.9
Age at diagnosis, years				
< 3		0.62	1.9†	1.2 to 3.0
3-6		0.36	1.4	1.0 to 2.2
7-10		0.52	1.7†	1.1 to 2.5
11-17		0.43	1.5†	1.1 to 2.2
Step 3: Depression				
	1180.52‡			
Depression score ≥ 63		2.80	16.4‡	13.7 to 19.7
Step 4: Physical health				
	89.35‡			
Health				
Poor		0.97	2.6‡	1.5 to 4.5
Fair		0.74	2.1‡	1.5 to 3.0
Good		0.60	1.8‡	1.3 to 2.5
Very good		0.22	1.2	0.9 to 1.7
No. of chronic conditions				
1		0.05	1.1	0.8 to 1.3
2		-0.18	0.8	0.6 to 1.1
≥ 3		-0.08	0.9	0.7 to 1.2
Cancer pain				
Small amount		0.62	1.9‡	1.4 to 2.4
Medium amount		0.54	1.7‡	1.3 to 2.3
Very bad		0.71	2.0‡	1.4 to 2.9
No. of hospital admissions				
1-5		0.04	1.0	0.8 to 1.3
> 5		0.30	1.3	0.7 to 2.6

*P < .01.

†P < .05.

‡P < .001.

association with suicidal thoughts or other psychological symptoms critically important to understand in this population. Treatment of suicidal symptoms is often multifaceted, including crisis intervention and treatment for mental disorders (eg, substance abuse, depression) when present.³⁴⁻³⁶ Interventions for SI in cancer survivors may need to build on these models and broaden them to address physical health more directly. The relatively high utilization of hospital services among the suicidal survivors suggests that these points of contact with the health system could be used to address their emotional needs.

The increased risk for SI found among CNS tumor survivors was not anticipated but may be consistent with the known risks for neurocognitive late effects affecting education, employment, and social relationships in this population.^{13,37,38} Problems in these critical areas of personal development can lead to significant frustration and emotional distress, and these results suggest SI may be one manifestation of this. Significant associations of age and sex with suicidality are commonly reported in the literature, although the nature of these relationships depends on the specific suicidal symptoms under inves-

tigation.^{25,39} In the survivor sample, no relationship with SI was found, making the extent to which these variables play a role in the expression of suicidality in this population unclear. Future studies using longitudinal data and a broader array of suicidal symptoms may be useful in examining this more thoroughly. Finally, although SI is strongly associated with depression, the results are an important reminder that suicide risk may be present even when symptoms of depression are not.

A notable limitation of the study was use of a single item to assess recent SI. Suicidal symptoms can vary over short periods of time, making prevalence estimates from a single time point somewhat limited. In a previously reported study of 226 patients at a pediatric cancer survivor clinic (conducted by several members of the research team), SI was found in 12.8% of survivors,¹⁷ a rate that is considerably higher than the 7.8% in the CCSS cohort. However, in the survivor clinic study, multiple questions were used to assess SI. Only 8.8% of the clinic sample endorsed SI on the BSI-18 item alone, which is not substantially different from rate reported in the CCSS cohort. A more complete understanding of the nature of SI in this population will require detailed assessment of suicidal thoughts. Specifically, onset, duration, and intensity of suicidal thoughts as well as suicidal impulses, plans, or attempts will be critical to understanding more about the effect of SI on survivors' adaptation and functioning, as well as their risk for self-harm or suicide completion. Reliance on self-reported health outcomes is another limitation because reports of these conditions may be affected by emotional states in a manner that could potentially bias the results. A sibling control group could be a limitation, particularly if SI in siblings was less prevalent than in the general population, because this would tend to inflate the estimate of risk of SI in survivors. The SI rate for siblings that we found is similar or higher than other recent population estimates,^{25,40} making this type of bias somewhat unlikely.

Despite these limitations, study findings are consistent with the growing literature on suicidal thoughts and behaviors in cancer patients and survivors^{1-5,31,41,42} and have important implications for identifying and intervening with survivors most at risk. Medical variables, such as CNS cancer diagnosis, physical pain, and medical comorbidities, are typically available from medical records or patient-completed forms and could be used to stratify survivors for targeted screening, particularly in situations where universal screening is not practical. Direct assessment of hopelessness and suicidal thoughts is recommended in evaluating cancer patients,⁴³ and these results indicate that similar assessment should be routine for cancer survivors, especially those facing significant health problems or limitations in functioning. Depression screening is also important for identifying survivors with SI, but depression measures that do not specifically inquire about SI^{44,45} should not be expected to identify all survivors with SI. Research examining the aspects of depression (eg, anhedonia, sleep disturbance, and so on) most strongly associated with SI of survivors may be useful in enhancing depression screening for this group. Finally, the association of physical health with SI is an important reminder of the importance of a comprehensive biopsychosocial⁴⁶ perspective on survivorship care. Helping survivors find appropriate medical care for their treatment-related medical late effects is already a priority for improving the physical health of survivors⁴⁷ and may be essential to improving their emotional health as well.

AUTHORS' DISCLOSURES OF POTENTIAL CONFLICTS OF INTEREST

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

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