Published in final edited form as:

Pediatr Blood Cancer. 2010 July 15; 55(1): 157–164. doi:10.1002/pbc.22443.

Health and Risk Behaviors in Survivors of Childhood Acute Myeloid Leukemia: A Report From the Children's Oncology Group

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Abstract

Background—Survivors of childhood acute myeloid leukemia (AML) face increased risks of chronic disease and secondary malignancies. Substance exposure may compound these risks.

Procedures—Participants were diagnosed with AML at <21 years of age and survived ≥5 years following diagnosis. All underwent chemotherapy alone or followed by autologous BMT (chemo ± autoBMT) or underwent allogeneic BMT (alloBMT) if an HLA-matched related donor was available. Survivors completed a health questionnaire and a Youth Risk Behavior Survey (YRBS).

Results—Of eligible survivors, 117 were ≥18 years of age and completed a YRBS. Survivors were a mean age of 10 years at diagnosis and 24 years at interview. Of the substance exposures assessed by YRBS, tobacco, alcohol, and marijuana were most common. Twenty-two percent (22%) had smoked cigarettes in the last 30 days. One-quarter (25%) reported binge drinking in the last month. None of these exposures varied by treatment group. Less than 10% of survivors reported cocaine, heroin, or methamphetamine use. Men were more likely to report high substance exposure ($P = 0.004$). Sadness/suicidality score was associated with cancer-related anxiety ($P = 0.006$) and multiple health conditions ($P = 0.006$).

Conclusions—This analysis reveals exposure to tobacco, alcohol, and marijuana in young adults with few differences based on treatment received. Survivors with cancer-related anxiety or multiple health conditions were more likely to report sadness/hopelessness.

Keywords

leukemia; pediatric; smoking; survivor

INTRODUCTION

Late effects following treatment for childhood cancer may include early-onset cardiovascular disease and cardiopulmonary insufficiency [1], metabolic syndrome, hypertension [2,3], and secondary malignant neoplasms [4,5]. Pertinent risk behaviors for these outcomes in the general population include cigarette and smokeless tobacco exposure, heavy or binge alcohol use, and illicit drug use.

Advances in multimodal therapy for acute myeloid leukemia (AML) have resulted in increasing survival rates for children with this diagnosis [6]. Since 1974, children treated on Children's Cancer Group (CCG) trials for AML have undergone biologic randomization to either chemotherapy with or without autologous transplantation (chemo $\pm$ auto) or allogeneic bone marrow transplantation (alloBMT) based on the availability of an HLA-matched related donor. Autologous BMT is not longer recommended for patients with AML; however, both chemo and alloBMT remain common treatment modalities for which risk stratification efforts are underway. This biologic randomization provides a unique population in which to study the effects of treatment with minimal confounding by disease severity. Thus, this study was undertaken through the Children's Oncology Group to assess the impact of alloBMT versus chemo $\pm$ auto on quality of life, chronic health conditions (CHCs), and health and risk behaviors.

We hypothesized that survivors of alloBMT versus chemo $\pm$ auto view their past treatments, health, and vulnerabilities differently, leading to differing substance exposures. We also hypothesized that survivors who underwent alloBMT would experience more late effects and thus would be more cautious in their behaviors and have higher rates of sadness. Previous studies have found age, race, gender, and socioeconomic status to be associated with tobacco exposure [7]. Likewise, depression and other mental health disorders are associated with an increased risk of substance use [8]. Thus, demographic and psychosocial factors were considered potential predictors of substance exposure.

METHODS

Eligible participants were identified from the records of the CCG. All survivors were diagnosed with AML at less than 21 years of age, received treatment on one of the four protocols from 1979 to 1995 (CCG 251, 213, 2861, or 2891) and were alive at least 5 years following diagnosis. Treatment details for each protocol have been previously reported [9–12]. Study protocols and materials were approved by the human subjects committee at each participating institution. Eligible survivors were contacted by mail and asked to participate. Adolescent (age at interview 12–17 years) and young adult survivors (≥ 18 years) without Down syndrome and without active AML or secondary malignant neoplasms are the focus of this analysis. Survivors were asked to complete a Childhood Cancer Survivor Study (CCSS) baseline questionnaire (see ccss.stjude.org) and a Youth Risk Behavior Survey (YRBS). Data regarding treatment and acute complications were abstracted from the CCG/COG registry in a standardized fashion. For determination of total body irradiation (TBI) exposure, patients were grouped by intent to treat. Patients were categorized by treatment group using the a priori hypothesis that chemo and autoBMT were more similar to one another than to alloBMT, particularly with regard to risk of late effects and CHCs.

CCSS Baseline Questionnaire

Each survivor or proxy was asked to complete the CCSS baseline questionnaire [13] from which CHC variables were constructed as described by Oeffinger et al. [14]. Grade III and

IV CHCs were categorized as severe. Mental health was coded as described by Hudson et al. [15].

Youth Risk Behavior Survey

The national YRBS is administered biannually to a sample of high school students. In this study, the YRBS was administered to survivors directly, not to proxy caregivers, by a trained telephone interviewer. Substance use was assessed both qualitatively and quantitatively (e.g., “Have you ever tried cigarette smoking?” and “During the past 30 days, on how many days did you smoke cigarettes?”) We assigned each question a potential value of 1 or 2 points based on potential risk to childhood cancer survivors (ever smoked = 1, smoked last 30 days = 2, drank alcohol in last 30 days = 1, >5 drinks per day in last 30 days = 2, tried marijuana = 1, marijuana use in last 30 days = 2, use of chewing tobacco/snuff = 1, cocaine use in last 30 days = 2, and “ever tried” cocaine, heroin, methamphetamines, illicit steroids, and glue/aerosols sniffing = 1 each) creating a substance exposure (SubExp) score. Potential scores ranged from 0 to 17. Given the significant medical risks faced by survivors, a relatively low threshold of substance exposure was considered clinically significant. Scores were also calculated using the 2001 national YRBS cohort to ensure an appropriate distribution and that literature-documented predictors (age, gender, race, and household income) were valid predictors of our SubExp score.

In the nationally administered YRBS and in our study, survivors were also asked if during the past 12 months, they “felt so sad or hopeless almost every day for two weeks or more in a row, that you stopped doing some usual activities?” Suicidality was assessed based on answers to “during the past 12 months, did you ever seriously consider attempting suicide?” If the answer was yes, survivors were then asked if they had ever made a plan and how many times they had attempted suicide. Each positive answer was assigned a single point to create a sadness/suicidality score with potential scores ranging from 0 to 4.

Statistical Analysis

Demographic and health variables were compared in young adults between treatment groups using *t*-tests for continuous outcomes and chi-squared or Fisher’s exact tests for categorical variables. Results for each substance exposure, high (≥ 3), and very high (≥ 6) SubExp score were analyzed between treatment groups with chi-square or Fisher’s exact tests for statistical significance. Results of the mean SubExp score were compared using a *t*-test. Results described remained robust regardless of the definition of high exposure. Missing values were assumed to be missing at random and were excluded prior to analysis.

Results of the SubExp score and sadness score were then analyzed in linear regression models. First, factors known from the literature to be significant in the general population (sex, age, race, household income) were analyzed in multivariate models. Age at diagnosis was included due to the difference between treatment groups. Other possible predictors (cancer-related pain or anxiety, sadness, multiple and severe CHCs, and TBI exposure) were entered into the model separately based on a priori hypotheses. Multivariate analyses were not performed in the adolescent cohort due to sample size limitations.

RESULTS

Of participants enrolled on the aforementioned treatment studies, 257 provided consent at the local institution for enrollment in the overall study of late effects. Of these, 224 could be contacted regarding participation, 177 participated and 150 completed the YRBS. Thus, this analysis includes 117 young adult and 33 adolescent survivors who self-completed the YRBS.

Young Adults

Of the 117 young adult survivors in the study, 79 underwent chemo $\pm$ auto and 38 underwent intensive chemotherapy followed by alloBMT. Survivors were a mean age of 9.6 years at diagnosis and 24.4 (range, 18–39) years at the time of interview. Survivors who underwent alloBMT were slightly older at the time of diagnosis (11.2 vs. 8.8) as is expected based on the need for a matched related donor (Table I). Survivors of alloBMT were more likely to report a CHC ($P < 0.001$) and to report multiple ($P = 0.002$) or severe CHCs ($P = 0.01$). Survivors of both treatments were similarly likely to report their general health status as excellent, very good, or good ($P = 1.0$). Very few reported cancer-related pain or anxiety (Table II).

Substance Use

Of the substance exposures assessed by YRBS, cigarette smoking and alcohol use were most common. Fifty-nine percent of survivors had smoked a cigarette. Twenty-two percent had smoked in the last 30 days. Nearly two-thirds (63%) had drunk alcohol in the last 30 days. One-quarter (25%) reported binge drinking (≥ 5 drinks/day) in the last 30 days. Forty-six percent had tried marijuana; however, only 10% reported current use. None of these exposures varied by treatment received (Table III). Less than 10% of participants reported exposure to each of the following: cocaine, methamphetamine, illicit steroid use, and glue/aerosols sniffing. When substance exposure was tabulated, the mean SubExp score was 3.0 overall (alloBMT 2.8 vs. chemo $\pm$ auto 3.1, $P = 0.58$, range 0–13).

Sadness/Hopelessness/Suicidality

Overall, 8% of young adult survivors reported sadness/hopelessness (alloBMT 16% vs. chemo $\pm$ auto 4%; $P = 0.06$). Although the power to detect a difference was relatively low between groups, there is no significant trend toward higher rates of considering suicide (alloBMT 5% vs. chemo $\pm$ auto 1%; $P = 0.25$) or making a plan for suicide within the last year (alloBMT 5% vs. chemo $\pm$ auto 0%, $P = 0.10$). Sadness/suicidality scores were low. Scores ranged from 0 to 3 with a mean of 0.13 (SD = 0.45) (Table IV).

Multivariate Analysis

In the multivariate analysis (Table V), female gender was associated with a lower SubExp score (mean 2.5 for females, 4.0 for males, $P = 0.004$). Low household income was strongly associated with higher SubExp scores (4.6 vs. 2.2, $P = 0.002$). Exposures did not vary by TBI status (data not shown).

In the adjusted analysis, sadness/suicidality score was 0.24 for alloBMT versus 0.08 chemo $\pm$ auto ($P = 0.09$). Cancer-related anxiety, but not cancer-related pain, was a significant predictor of sadness/hopelessness ($P = 0.006$). The presence of multiple health conditions was strongly associated with a higher sadness/suicidality score (0.30 vs. 0.05, $P = 0.006$) (Table VI).

Adolescent Survivors

Mean age at interview for the 33 adolescent participants was 14.3 (Table VII). Mean age at diagnosis was 3.4 (range, 0.4–8.8). Eight underwent alloBMT. Exposure rates were lower in the survivor population than in the national YRBS cohort. CHCs data were available for 25 adolescent participants. Forty percent had at least one CHC. Only three had a severe CHC. Due to the small number of adolescents in the cohort, further statistical testing was not performed.

DISCUSSION

Substance Exposure

Among a population of young adult survivors of childhood AML, we found that use of cigarettes, alcohol, and marijuana did not vary by treatment group and were similar to results obtained in surveys of the general population. Rates of other illicit drug use were low (<10%). To provide context for these results, we compared our results to those of the publicly available, contemporaneously administered 2001 Behavior Risk Factor Surveillance Study [16]. In an analysis limited to adults the age of our cohort (18–39), most (92%) rated their health as excellent, very good, or good compared to 93% in our cohort. Twenty-seven percent were considered at risk smokers based on reporting at least 100 cigarettes during his/her lifetime as well as current smoking. Sixty percent reported at least one drink in the last month compared to 63% in our cohort. Twenty-one percent reported binge drinking in the last 30 days compared to 25% in our cohort. With regard to illicit drug use, in the SAMHSA [17] survey in 2002, 60% of adults aged 18–25 reported use of an illicit drug, 20% reported illicit drug use within the last month. Approximately 15% of adults nationwide reported lifetime use of cocaine with between 0.7% and 2% reporting use in the last month depending on age [17].

Adolescents in our cohort reported low rates of substance exposure and sadness/suicidality compared to the national YRBS cohort. Due to the large sample size of the YRBS and low rates in our participants, these differences are statistically significant. Further analysis is limited by sample size. Our results are consistent with those reported by Tyc et al. [18] who found preadolescent and adolescent survivors reported fewer risky exposures to cigarettes and alcohol than the general population; however, our analyses extend these results to include illicit drug use and sadness/suicidality.

Although these data show that survivors of childhood AML have substance exposure rates no higher than the general population, these results are still concerning. Survivors of childhood AML face increased risks of CHCs. Mulrooney et al. [19] reported outcomes in childhood AML survivors who underwent chemotherapy alone. In that analysis, as in ours, CHCs were frequent; most involved the cardiac or endocrine systems. Additionally, 5% of survivors developed a second cancer. The US Preventive Health Services Task Force [20,21] recommends universal counseling regarding tobacco and alcohol use; however, these recommendations are of even greater importance to childhood cancer survivors. Exposure to alkylating agents, bleomycin, radiation, surgical procedures, and chronic GVHD increase risks of cardiopulmonary insufficiency [22,23]. Risk of Raynaud's phenomenon is elevated in recipients of vinca alkaloids and may be worsened by tobacco or illicit drugs. In addition, alcohol has been associated with second cancers in childhood cancer survivors [5] and both tobacco and alcohol have been associated with second cancers in adults with oropharyngeal cancers [24]. Alcohol and cocaine are both risk factors for cardiomyopathy in the general population and may influence anthracycline-mediated cardiomyopathy.

Tao et al. [30] found that survivors of childhood acute lymphoblastic leukemia were less likely than siblings to have ever smoked but once they had smoked at least 10 cigarettes, were equally likely to become regular smokers. Emmons et al. also found that survivors who viewed themselves as more vulnerable to smoking-related illnesses felt more confident in their ability to quit and determined they may be more amenable to interventions to limit tobacco exposure. Thus, long-term follow-up clinics and primary care physicians may have an opportunity to educate survivors of cancer therapy and provide motivation and resources for cessation/avoidance [25]. Studies have documented the efficacy of peer-delivered

telephone counseling, nicotine replacement, and educational services in smoking cessation in survivors of childhood cancer [26–28].

Overall, rates of illicit drug use were low. Parents may be concerned regarding the risk for opioid or other drug addiction in children who receive opioids during intensive therapies; however, this study found no heroin use.

Sadness/Suicidality

Cancer therapy may also be associated with significant psychosocial sequelae. We found that 8% of young adult survivors and 15% of adolescent survivors reported sadness/hopelessness, which limited their activities for at least 2 weeks out of the last year. Our survey specifically assessed rates of considering and attempting suicide and found very low rates of suicidality. In the general population, depression and suicidality are associated with substance use; however, our analysis did not reveal this association. We found sadness/suicidality score in young adults was associated with cancer-related anxiety and the presence of multiple CHCs. Rates of sadness/suicidality were considerably lower in the adolescent survivors than in the national YRBS cohort suggesting a role of resiliency following cancer therapy.

Strengths and Limitations

A substantial strength of this study is the unique population identified: participants with a history of AML who underwent biologic randomization to alloBMT versus chemo $\pm$ auto. This provides a unique opportunity to study the specific psychosocial effects of treatment with minimal confounding by disease severity.

Our study assessed some recent exposures, but for questions which included “ever tried” we are unable to distinguish which exposures may have predated the cancer diagnosis. These data rely on self-report rather than biochemical assessment of substance exposure. Also, due to the small number of non-white survivors in our cohort, we were unable to fully evaluate potential effects of race on these outcomes.

In this, as in any study of risk behaviors, response bias is a concern. Eligible participants engaging in risky behaviors may be more difficult to locate or less likely to respond. Depressed patients may be less likely to consent to participation and if consent is provided, they may be less likely to complete surveys. Participants may also be concerned about confidentiality and thus may underreport exposures and sadness. We would expect that this form of response bias would result in an underestimation of substance use and sadness/hopelessness rates in this and comparison studies. In this study, many eligible participants did not consent for participation in the study of late effects and thus were not asked to complete the YRBS. Among survivors who provided informed consent for study participation, however, response rates were similar to those of national telephone surveys [29]. We compared our results generally to contemporaneously administered national surveys. However, full statistical comparisons are limited as the YRBS is not generally administered to adults.

Despite the aforementioned limitations, our cohort was surveyed in a comprehensive fashion and represents the first documentation of the prevalence of illicit drug use in the childhood cancer survivor population. All patients received treatment on a clearly defined treatment protocol with demographic and current health information to allow us to determine which of these factors may influence exposures.

CONCLUSIONS

Although the rates of tobacco, alcohol, and marijuana exposure found in this study are not higher than those reported in the general population, the exposures are still of significant concern. No conclusive data are available to prove that avoidance/cessation will reduce the risk of late effects for individual survivors; current recommendations are based on expert consensus. In the general population, however, substance exposure is associated with substantial health risks and cancer survivorship may compound these risks. Thus, providers should discuss substance exposures with childhood cancer survivors and provide education regarding risk and resources for cessation. In addition, the assessment of sadness/hopelessness and cancer-related anxiety, particularly in survivors of alloBMT or those with multiple health conditions, is warranted.

Acknowledgments

We thank Children's Cancer Research Fund, Children's Oncology Group, and the National Cancer Institute, Children's Cancer Study Group (5U10 CA07306, 5U10CA78960, U10 CA98413, and U10 CA98543) for their support of this research.

Grant sponsor: Children's Cancer Research Fund; Grant sponsor: Children's Oncology Group; Grant sponsor: National Cancer Institute, Children's Cancer Study Group; Grant numbers: 5U10 CA07306, 5U10CA78960, U10 CA98413, U10 CA98543; Grant sponsor: National Cancer Institute; Grant number: U24 CA55727.

Abbreviations

AML	acute myeloid leukemia
CHC	chronic health condition
YRBS	Youth Risk Behavior Survey
CCSS	Childhood Cancer Survivor Study
BRFSS	Behavior Risk Factor Surveillance System
alloBMT	allogeneic bone marrow transplantation
chemo ± auto	chemotherapy with or without autologous bone marrow transplantation
TBI	total body irradiation
SubExp score	substance exposure score

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TABLE I**Demographic and Treatment Characteristics of Young Adult Survivors**

Characteristics	All (N = 117)	AlloBMT (N = 38)	Chemo ± auto (N = 79)	P-value
Mean age at interview (years)	24.4 (SD = 5.3)	25.3 (SD = 5.8)	23.9 (SD = 5.0)	0.19 *
Mean age at diagnosis (years)	9.6 (SD = 5.4)	11.2 (SD = 5.6)	8.8 (SD = 5.1)	0.02 *
Time since diagnosis (years)	14.8 (SD = 4.2)	14.1 (SD = 4.9)	15.1 (SD = 3.8)	0.22 *
Gender, N (%)				0.72
Male	52 (44)	16 (42)	36 (46)	
Female	65 (56)	22 (58)	43 (54)	
Race, N (%)				0.75
White	105 (90)	35 (92)	70 (89)	
Non-white/unknown	12 (10)	3 (8)	9 (11)	
Household income, N (%)				0.60
<\$20,000	19 (19)	4 (13)	15 (21)	
\$20,000–\$59,999	54 (54)	18 (60)	36 (51)	
≥\$60,000	27 (27)	8 (27)	19 (27)	
Has health insurance?				0.71 **
(US residents only), N (%)				
Yes	92 (92)	29 (91)	63 (93)	
No	8 (8)	3 (9)	5 (7)	
Treatment protocol, N (%)				
CCG 251	42 (36)	14 (37)	28 (35)	
CCG 213	46 (39)	11 (29)	35 (44)	
CCG 2861/2891	29 (25)	13 (34)	16 (20)	
Received TBI				—
Yes	25 (21)	25 (66)	—	
No	92 (79)	13 (34)		

*
t-test,

**
Fisher's exact test; all others by chi-square test; numbers may not reach column totals due to missing values.

TABLE II

Young Adult Survivor Outcomes

	N (%)			
Characteristics	All	AlloBMT	Chemo ± auto	P-value
Chronic health conditions				
Any chronic health condition				<0.001
Yes	61 (58)	27 (82)	34 (47)	
No	44 (42)	6 (18)	38 (53)	
Any severe health condition				0.01
Yes	28 (27)	14 (42)	14 (19)	
No	77 (73)	19 (58)	58 (81)	
Two or more health conditions				
Yes	41 (39)	20 (61)	21 (29)	0.002
No	64 (61)	13 (39)	51 (71)	
Three or more health conditions				0.002
Yes	27 (26)	15 (45)	12 (17)	
No	78 (74)	18 (55)	60 (83)	
Self-reported health				
General health				1.00**
Fair or poor	7 (7)	2 (6)	5 (7)	
Excellent, very good, or good	96 (93)	30 (94)	66 (93)	
Impaired global mental health				0.76**
Yes	13 (16)	5 (18)	8 (15)	
No	67 (84)	23 (82)	44 (85)	
Has pain as a result of cancer				1.00**
Yes	7 (7)	2 (6)	5 (7)	
No	93 (93)	30 (94)	63 (93)	
Has anxiety as a result of cancer				0.54**
Yes	13 (13)	5 (16)	8 (12)	
No	88 (87)	27 (84)	61 (88)	

** Fisher's exact test; all others by chi-square test; numbers may not reach column totals due to missing values.

TABLE III

Substance Use by Treatment Group for Young Adults

	N (%)			P-value
	All (N = 117)	AlloBMT (N = 38)	Chemo ± auto (N = 79)	
Ever smoked				0.81
Yes	69 (59)	23 (61)	46 (58)	
No	48 (41)	15 (39)	33 (42)	
Smoked in last 30 days				0.79
Yes	26 (22)	9 (24)	17 (22)	
No	91 (78)	29 (76)	62 (78)	
Used chewing tobacco or snuff in last 30 days				0.66**
Yes	5 (4)	2 (5)	3 (4)	
No	112 (96)	36 (95)	76 (96)	
Drank alcohol in last 30 days				0.23
Yes	73 (63)	21 (55)	52 (67)	
No	43 (37)	17 (45)	26 (33)	
≥5 drinks/day in last 30 days				0.10
Yes	29 (25)	6 (16)	23 (30)	
No	86 (75)	32 (84)	54 (70)	
Tried marijuana				0.85
Yes	54 (46)	18 (47)	36 (46)	
No	63 (54)	20 (53)	43 (54)	
Used marijuana in last 30 days				0.75**
Yes	12 (10)	3 (8)	9 (11)	
No	105 (90)	35 (92)	70 (89)	
Used cocaine				0.72**
Yes	9 (8)	2 (5)	7 (9)	
No	108 (92)	36 (95)	72 (91)	
Used cocaine in last 30 days				0.32**
Yes	1 (1)	1 (3)	0 (0)	
No	116 (99)	37 (97)	79 (100)	
Used heroin				—
Yes	0 (0)	0 (0)	0 (0)	
No	117 (100)	38 (100)	79 (100)	
Used methamphetamines				0.68**
Yes	7 (6)	3 (8)	4 (5)	
No	110 (94)	35 (92)	75 (95)	
Had sniffed glue/aerosols to get high				1**
Yes	1 (1)	0 (0)	1 (1)	
No	116 (99)	38 (100)	78 (99)	
Had used illicit steroids				1**

	N (%)			P-value
	All (N = 117)	AlloBMT (N = 38)	Chemo ± auto (N = 79)	
Yes	1 (1)	0 (0)	1 (1)	0.93
No	116 (99)	38 (100)	78 (99)	
SubExp score ≥3				0.22
Yes	53 (45)	17 (45)	36 (46)	
No	64 (55)	21 (55)	43 (54)	0.58*
SubExp score ≥6				
Yes	23 (20)	5 (13)	18 (23)	0.58*
No	94 (80)	33 (87)	61 (77)	
Substance exposure score (mean)	3.0 (SD = 2.9)	2.8 (SD = 3.0)	3.1 (SD = 2.9)	0.58*

*
t-test,

**
Fisher's exact test; all others by chi-square test.

TABLE IV

Reports of Sadness/Hopelessness and Suicide in Last 12 Months in Young Adults by Treatment Group

	N (%)			P-value
	All	AlloBMT	Chemo ± auto	
Report sadness/hopelessness ≥2 weeks which limited activities				0.06 ^a
Yes	9 (8)	6 (16)	3 (4)	
No	108 (92)	32 (84)	76 (96)	
Considered suicide				0.25 ^a
Yes	3 (3)	2 (5)	1 (1)	
No	114 (97)	36 (95)	78 (99)	
Made a suicide plan				0.10 ^a
Yes	2 (2)	2 (5)	0 (0)	
No	115 (98)	36 (95)	79 (100)	
Attempted suicide				1.00 ^a
Yes	1 (1)	0 (0)	1 (1)	
No	115 (99)	37 (100)	78 (99)	
Sadness/suicidality score (mean)	0.13 (SD = 0.45)	0.26 (SD = 0.64)	0.06 (SD = 0.29)	0.08 ^b

^a Fisher's exact test;^b *t*-test.

TABLE V

Adjusted* Substance Exposure and Sadness/Suicidality Scores in Young Adults by Demographic Variables

	<u>Substance exposure score</u>		<u>Sadness/suicidality score</u>	
	Estimate	P-value ^a	Mean score	P-value ^a
Gender				
Females	2.5	0.004	0.15	0.66
Males	4.0	Ref.	0.11	Ref.
Age at diagnosis				
<10	3.7	0.14	0.10	0.59
≥10	2.7	Ref.	0.16	Ref.
Age at interview				
≥25	4.0	0.025	0.08	0.39
<25	2.5	Ref.	0.18	Ref.
Race				
White	3.5	0.58	0.09	0.54
Non-white	3.0	Ref.	0.17	Ref.
Household income				
<\$20,000	4.6	0.002	0.18	0.56
\$20,00–59,999	2.9	0.21	0.11	0.90
≥\$59,999	2.2	Ref.	0.10	Ref.

* Adjusted for all other terms in the table;

^a P-value from multivariate analysis.

TABLE VI

Adjusted* Substance Exposure and Sadness/Suicidality Scores in Young Adults by Treatment Group and Self-Reported Presence of Cancer-Related Pain or Anxiety and Severe or Multiple Chronic Health Conditions

	<u>Substance exposure score</u>		<u>Sadness/suicidality score</u>	
	Mean score	<i>P</i> -value ^a	Mean score	<i>P</i> -value ^a
Treatment				
AlloBMT	3.0	0.53	0.24	0.09
Chemo ± auto	3.3	Ref.	0.08	Ref.
Reports cancer-related pain				
Yes	3.9	0.54	0.15	0.91
No	3.2	Ref.	0.13	Ref.
Reports cancer-related anxiety				
Yes	3.8	0.41	0.45	0.006
No	3.2	Ref.	0.09	Ref.
Reports sadness/hopelessness				
Yes	4.0	0.49	NA	NA
No	3.2	Ref.	NA	
Severe CHC present				
Yes	3.6	0.49	0.20	0.40
No	3.1	Ref.	0.11	Ref.
Number of CHC				
≥2	3.7	0.24	0.30	0.006
<2	3.0	Ref.	0.05	Ref.

* Adjusted for gender, age at diagnosis, age at interview, race, and household income.

^a *P*-value from multivariate analysis.

TABLE VII

Demographic and Treatment Characteristics and Substance Exposures and Sadness in 33 Adolescent Survivors Versus National YRBS Cohort

	AML survivors (N = 33)	National YRBS ^a (N = 11,392)
Mean age (range, SD)	14.3 (12–17, SD = 1.9)	15.8 (12–17, SD = 1.0)
Age at diagnosis (range, SD)	3.4 (0.4–8.8, SD = 2.2)	NA
Time since diagnosis (range, SD)	10.9 (7.4–15.8, SD = 2.4)	NA
Ever smoked	33%	63%
Smoked in last 30 days	11%	24%
Used chewing tobacco or snuff in last 30 days	3%	7%
Drank alcohol in last 30 days	16%	45%
≥5 drinks/day in last 30 days	10%	27%
Tried marijuana	24%	42%
Used marijuana in last 30 days	3%	23%
Used cocaine	0%	9%
Used cocaine in last 30 days	0%	4%
Used heroin	0%	3%
Used methamphetamines	3%	8%
Had sniffed glue/aerosols to get high	0%	13%
Had used illicit steroids	0%	4%
SubExp score ≥3	18%	45%
SubExp score ≥6	12%	26%
Substance exposure score (mean, SD)	1.2 (SD = 2.1)	3.5 (SD = 3.8)
Report sadness/hopelessness ≥2 weeks which limited activities	15%	29%
Considered suicide	0%	18%
Made a suicide plan	0%	14%
Attempted suicide	0%	9%

^a Analysis limited to participants ages 12–17. All column differences are statistically significant.