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1 **Clinical, Demographic Factors, and Substance Use among Hispanic and Non-Hispanic**
2 **Young Adult Childhood Cancer Survivors**

3

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2 **Abstract**

3 *Purpose.* The purpose of this study is to examine the protective and risk factors of substance use
4 behaviors (tobacco, marijuana, e-cigarette, and alcohol) among young adult childhood cancer
5 survivors. The study focused on clinical care and status (receipt of cancer-related follow-up care,
6 treatment intensity, late effects, depressive symptoms, self-rated health) and demographic
7 (race/ethnicity, neighborhood socioeconomic status) factors and their associations with
8 polysubstance use.

9 *Methods.* Participants were from the Project Forward cohort, a population-based study of young
10 adult survivors of childhood cancers. Participants (N=1,166, $M_{age}=25.1$ years) were recruited
11 through the Los Angeles Cancer Surveillance Program (Cancer Registry covering Los Angeles
12 County, California). Multivariate path analyses were performed with substance use as the
13 outcome variables and clinical and demographic factors as independent variables. Covariates
14 included age and sex.

15 *Finding.* Substance use was positively associated with depressive symptoms, and inversely
16 associated with cancer-related follow-up care, female sex, age, Hispanic ethnicity, treatment
17 intensity, and self-rated health. Neighborhood SES was inversely associated with tobacco use,
18 while being positively associated with binge drinking and e-cigarette use. The results highlight
19 the interrelationship between the clinical and demographic variables and their associations with
20 different substance use.

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1 *Conclusion.* Findings support the need for effective interventions targeting polysubstance use
2 behavior among CCS. This will help improve long-term outcomes and mitigate the risk for early
3 morbidity.

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5 Keywords: Childhood cancer survivors, Substance use, Young adults, Cancer-related follow-up

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2 **Introduction**

3 A childhood cancer survivor, as defined by the National Cancer Institute (NCI), is an
4 individual who was diagnosed with cancer between birth and 19 years of age and has lived
5 beyond the diagnosis, including those who have surpassed 19 years of age but were diagnosed in
6 childhood [1]. Given significant advancements in cancer treatment, approximately **85% of**
7 **children** and adolescents **diagnosed with cancer will have long-term survival [2]. In the**
8 **United States, there are more than 500,000 childhood cancer survivors (CCS) [3,4]. The**
9 **NCI estimates that CCS are five times more likely to experience adverse health events than**
10 **their siblings [5,6].** In addition, 50% of CCS reported one or more late effects and about 40%
11 reported late effects graded as serious or life-threatening [7]. In the Childhood Cancer Survivor
12 Study (CCSS) cohort, 73% of CCS reported having a chronic health condition [8]. Long-term
13 late effects can include second cancer, chronic disease such as cardiomyopathy, pulmonary
14 fibrosis, and neurocognitive deficits [8-10]. These survivors had a ten-fold risk of dying earlier
15 than the general population [11,12].

16 The late effects extend beyond physical health to include psychological and social
17 outcomes. CCS are at risk for disrupted psychosocial development secondary to their cancer
18 diagnosis, treatment, and cancer-related late effects. The impact of the protracted time course
19 spanning cancer diagnosis, treatment, and survivorship may result in psychological distress,
20 adjustment difficulties, delay in educational attainment, and missed vocational opportunities [13].
21 Prior studies reported CCS had a 1.1 to 1.6 times as likely to develop anxiety and psychological
22 distress compared to non-cancer controls [14-17].

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1 The Children’s Oncology Group (COG) Long-Term Follow-Up Guidelines for Survivors
2 of Childhood, Adolescent, and Young Adult Cancers recommend that CCS receive lifelong
3 monitoring to facilitate early detection of late effects, and prevention or mitigation of late effects
4 through risk modification [12,18]. The comprehensive follow-up care for CCS includes
5 assessment and support of psychosocial functioning and health promoting behaviors especially
6 the avoidance of tobacco use, binge drinking, and other substance use [7,19] to delay or mitigate
7 cancer treatment-related late effects.

8 As the number of childhood cancer survivors (CCS) increases, there’s a corresponding
9 rise in the population of young adults—those aged 18 to 39—who were diagnosed with cancer in
10 their childhood. This particular group is confronting challenges related to substance use [21].
11 Research in a nationally representative sample has shown that young adult childhood cancer
12 survivors are at least as likely, if not more so, to encounter problems with substance use
13 compared to their non-cancer peers. [22]. The rates of substance use among CCS are equivalent
14 to, or less than their healthy peers [23-28], suggesting the cancer experience influences or delay
15 initiation/use of substances. However, this reduced rate of smoking does not extend to survivors
16 who are particularly susceptible to heart or lung problems [23]. Prior research showed that
17 substance use among CCS increases with age and the rates becomes comparable to their non-
18 cancer peers as they mature into adulthood [22, 24, 25]. Another study found AYA cancer
19 survivors were more likely to report binge drinking than non-cancer peers [27]. This result
20 requires particular attention because CCS health risk behaviors occur in the context of increased
21 risk of late effects and early life morbidity and mortality. Thus, despite the presence of potential
22 additive effects of health risk behaviors on early life morbidity and mortality, 16-29% and 55-

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1 90% of adolescent and adult CCS report tobacco or alcohol use, respectively [21,22].
2 Additionally, there is an upward trend in polysubstance use, defined as the concurrent use of
3 multiple drugs or substances, which is particularly prevalent among older survivors of childhood
4 cancer [29].

5 The established protective and risk factors of substance use in young adult CCS lend
6 support for the biopsychosocial framework [30]. The biopsychosocial model encompasses
7 biological, psychological, and social dimensions of health and has been utilized in healthcare
8 research and practice [30]. Recent research on CCS underscores the interaction of physical
9 health, psychosocial wellbeing, and issues of cancer-related follow-up care [31]. The burden of
10 cancer-related late effects among CCS has numerous impacts on mental health outcomes
11 especially depression [32]. Higher numbers of cancer-related late effects in CCS predicted
12 greater stress and depression and decreased physical and social functioning [33]. Many CCS face
13 a myriad of physical and psychosocial health challenges [34,35]. However, its application in the
14 context of substance use among young adult CCS during the transitional care phase remains
15 limited. In current study, the biological area covers clinical care and status such as cancer-related
16 follow-up care, treatment intensity, and late effects. The psychological area considers depressive
17 symptoms. The social area refers to neighborhood socioeconomic status. Demographic variable
18 includes age, sex, and race/ethnicity. The study examines how each factor is related to substance
19 use. Furthermore, the relationship between clinical and demographic factors and substance uses
20 especially among underrepresented CCS populations has been relatively understudied.

21 Many of childhood cancer survivorship studies have limited representation of ethnic
22 minorities. Thus, further investigation is needed to determine the protective and risk factors of

1 substance use among ethnically diverse YA CCS. Hispanic YACCS are underrepresented in
2 cancer survivorship studies and there are no population-based studies that adequately examine
3 tobacco and other substance use behaviors among this population. Prior study showed Hispanic
4 survivors reported less tobacco use compared with non-Hispanic White survivors [33]. Another
5 study also reported tobacco use was negatively associated with cancer treatment intensity [29].
6 We hypothesized that late effects would be inversely associated with substance use because those
7 with more cancer-related late effects are more likely to refrain from substance use. In this study,
8 we examined the associations between clinical, demographic factors, and substance use among
9 ethnically diverse young adult survivors of childhood cancers. We hypothesized that substance
10 use will be positively associated with depressive symptoms and negatively associated with
11 Hispanic and clinical factors including receipt of cancer-related follow-up care (which may
12 include patient counseling regarding health promoting behaviors), late effects, treatment
13 intensity, and self-rated health. A multivariate approach allows us to examine the
14 interrelationship among the variables included and explicitly model the correlation among the
15 substance use outcome variables simultaneously.

16 **Methods**

17 *Participants and procedures*

18 Data were from the Project Forward Cohort, which is a population-based study examined risk
19 and protective factors of cancer-related follow-up care among young adult CCS [36].
20 Participants were identified through the Los Angeles Cancer Surveillance Program, which is the
21 cancer registry for Los Angeles County (part of the Surveillance, Epidemiology, and End Results
22 program, SEER). Participants included CCS who were 18-39 years old when the study was

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1 launched in 2015, and who were diagnosed under 19 years of age between the years of 1996-
2 2010 in Los Angeles County with any cancer diagnosis (stage 1+ for brain, stage 2+ for others),
3 and at least 5 years post-diagnosis. Eligible participants were surveyed using an internet-based
4 questionnaire, postal mail, or telephone interviews, with the recruitment phase spanning from
5 2015 to 2018. Recruitment methods included introductory postcards and self-report survey
6 mailings in English and Spanish. Mailings included brochures describing the study and the
7 California Cancer Registry. We sent reminder mailings and made follow-up calls for those who
8 did not respond. Accompanying the mailing, we included paper surveys and provided a link to
9 the online survey for those preferring to participate via the internet. For participants who
10 indicated a preference for a phone survey, we followed up with a telephone call. We employed
11 address tracing techniques, which involved updating contact details and re-engaging with
12 potential participants who were initially unreachable, to enhance the accuracy of our contact
13 information. This process ensured that individuals were only classified as lost to follow-up after
14 exhaustive attempts to establish contact. Participants received \$20 cash and a lottery entry (\$300)
15 upon survey completion. The study procedures were approved by the California State Committee
16 for the Protection of Human Subjects, the Institutional Review Board at the University of
17 Southern California, and the California Cancer Registry.

18 *Measures*

19 *Substance use.* Current tobacco, alcohol, marijuana, and e-cigarette use was defined as any
20 reported use in the prior 30 days. Binge drinking was defined as consuming five or more drinks
21 in one sitting at least once in the past 30 days [37]. Questions asked participants “During the 30
22 days, on how many days did you do any of the following: smoke cigarettes; smoke e-cigarettes;

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1 have 5 or more drinks of alcohol in a row within a couple of hours; smoke/consume Marijuana.”

2 The measure is adapted from Youth Risk Behavior Surveillance System (YRBSS) developed by

3 Centers for Disease Control and Prevention (CDC). Substance use behaviors were dichotomized

4 to indicate current use versus no use. All substance use were treated as individual binary

5 variables (1=used in any day or any number of times in past 30 days, 0=no use at all in past 30

6 days) in the analyses.

7 *Cancer-related follow-up care.* Receipt of cancer-related follow-up care in the prior two years

8 was defined as any healthcare visit where CCS received an examination to assess health

9 problems from prior cancer or the cancer treatment. Participants also reported the type of

10 healthcare provider they had seen for this care. Responses were dichotomized yes/no.

11 *Treatment intensity.* Treatment intensity was evaluated using a method modeled after the

12 Intensity of Treatment Rating Scale 3.0 (ITR-3) [38]. This scale combines cancer registry data

13 and the survivors’ self-reported treatment and relapse information to categorize treatments into

14 four levels of intensity: 1 = “Least intensive” (e.g., surgery only), 2 = “Moderately intensive”

15 (e.g., chemotherapy or radiation), 3 = “Very intensive” (e.g., two or more treatment modalities),

16 and 4 = “Most intensive” (e.g., relapse protocols) [39].

17 *Self-rated health.* Self-rated health was assessed using one item from the SF-36 “How would you

18 rate your general health overall?” [40]. It was scored using a 5-point Likert scale ranging from 0

19 = “Poor” to 4 = “Excellent.”

20 *Late effects.* Self-reported late effects of cancer treatment included 11 items (e.g., infertility,

21 heart problems, difficulties with learning and memory, vision problem). Items were selected

1 based on the most prevalent chronic conditions previously reported among CCS. Summed scores
2 were categorized as none, one, or two or more late effects [41].

3 *Depressive symptoms.* Depressive symptoms were measured using The Center for Epidemiologic
4 Studies Depression Scale (CES-D) [42]. This scale includes 20 items about how often
5 participants experienced symptoms during the previous week on a 4-point scale, such as sleep
6 disruption, feelings of hopelessness, and negative affect. Response options range from
7 “rarely/none of the time” (less than one day) to “most or all of the time” (5-7 days). The total
8 score was used in the analyses (Cronbach’s alpha = 0.80).

9 *Demographic and clinical factors.* Clinical variables included age at diagnosis, age at survey,
10 years since diagnosis, treatment intensity, cancer type (e.g., endocrine, lymphoma, skin). The
11 variables were assessed in clinic and provided by the SEER cancer registry. Information on
12 gender, race/ethnicity, neighborhood socioeconomic status at diagnosis, relationship status,
13 educational attainment, employment status, were obtained using both the SEER registry and self-
14 reported questionnaire data. Neighborhood socioeconomic status (nSES) quintiles at the time of
15 cancer diagnosis were obtained from the cancer registry. nSES is a composite score derived from
16 census data, encompassing seven indicators: education index, percentage of individuals above
17 200% of the poverty line, percentage of individuals with a blue-collar job, percentage of
18 individuals employed, median rental cost, median value of owner-occupied housing units, and
19 median household income [43].

20 *Statistical Analysis*

21 We conducted multivariate regression analysis to test the hypothesized associations and obtained
22 estimates of the structural path coefficients. We also adjusted the estimates by controlling for age

1 at survey and sex. Univariate analyses showed years since diagnosis was not significantly
2 associated with any of the substance uses, therefore it was not included in the final model.
3 Unstandardized coefficients, standardized errors, standardized coefficient, and p-values for beta
4 of direct effects were identified and reported. Data analyses were conducted using SAS (version
5 9.4; SAS Institute, Inc., Cary, NC) and Mplus version 8.6 (Muthén & Muthén).

6 **Findings**

7 A total of 1,166 CCS responded to the questionnaire out of the 2,788 eligible cases. There
8 were 1,426 individuals who did not participate (e.g., lost after all efforts, declined to participate)
9 and 196 were **deemed ineligible (e.g., hospitalized or deceased)**. The final sample consisted of
10 1,106 young adult CCS; 60 participants were excluded from analyses as they reported receiving
11 cancer treatment within the last two years prior to the study. Responder analyses were performed
12 using the demographic and clinical variables provided by the registry (at the time of sample
13 selection). Although the analyses could not directly address differences in substance use, there
14 were no differences between non-responders ($n = 1,426$) and responders ($n = 1,166$) in terms of
15 age at diagnosis, years since diagnosis, age, cancer diagnosis, or stage of disease ($ps > 0.05$) [36].

16 The final analytic sample included 980 observations due to 126 cases with missing any of
17 the independent variables in the multivariate regression analyses. The mean age was 26.2 (4.9)
18 years old, the mean age at diagnosis was 11.6 (5.4) years old, and 50.8% identified as female
19 (Table 1). More than half of the sample (51.1%) identified as Hispanic, and 29.3% identified as
20 White, 9.7% as Asian, and 9.5% as other. A majority was single/not married (68.9%) and
21 attained at least some college, vocational or training education (76%).

1 32.7% reported binge drinking, 19% reported marijuana use, 11.6% reported tobacco use,
2 and 8% reported e-cigarette use in the prior 30 days. More than 60% of the participants reported
3 that they received very to most intensive treatment. 37.7% reported having one or more late
4 effects. The mean depressive symptom score was 13.88 (10.9). 31% was in the lowest
5 neighborhood socioeconomic status (SES) quintile and 16% in the highest neighborhood SES
6 quintile.

7 Table 2 summarizes the standardized estimates of the paths. Current tobacco use, binge
8 drinking, e-cigarette use, and marijuana use were positively correlated. Cancer-related follow-up
9 care was negatively associated with tobacco use ($\beta = -0.31, p < 0.01$) and marijuana use (
10 $\beta = -.21, p = 0.04$). Treatment intensity was negatively associated with tobacco use
11 ($\beta = -0.13, p < 0.01$). Depressive symptoms were positively associated with tobacco use (
12 $\beta = 0.15, p < 0.01$), marijuana use ($\beta = 0.23, p < 0.001$), and e-cigarette use ($\beta = 0.17, p = 0.01$).
13 Self-rated health was negatively associated with tobacco use ($\beta = -0.14, p = 0.03$) and binge
14 drinking ($\beta = -0.10, p = 0.03$).

15 Hispanic ethnicity was negatively associated with tobacco use ($\beta = -0.42, p < 0.01$).
16 Neighborhood SES was positively associated with binge drinking ($\beta = 0.09, p = .01$) and e-
17 cigarette use ($\beta = 0.15, p = 0.04$), and marginally associated with tobacco use (
18 $\beta = -0.12, p = 0.06$). Age at survey and late effects were not associated with any of the substance
19 uses. Female (vs. male) was negatively associated with tobacco use ($\beta = -0.37, p < 0.01$), binge
20 drinking ($\beta = -0.40, p < 0.001$), marijuana use ($\beta = -0.43, p < 0.001$), and e-cigarette use (
21 $\beta = -0.63, p < 0.001$) (Figure 1).

22 **Conclusions/Interpretation**

1 This study examined associations between substance use and clinical and demographic
2 factors among a population of young adult survivors of childhood cancer. Although all substance
3 use variables were moderately correlated with each other, they showed different patterns of
4 association with dependent variables. For example, depressive symptoms were positively
5 associated with all substances except binge drinking whereas neighborhood socioeconomic status
6 was positively associated with binge drinking and e-cigarette use, while only marginally
7 associated with decreased tobacco use. The results underscore the interrelationship among the
8 clinical and demographic variables and their associations with different substance use.

9 Our findings support previous studies that polysubstance use including tobacco, alcohol,
10 marijuana, and e-cigarette is common in young adults [44,45]. Polysubstance use has been
11 associated with poor mental health and risk-seeking behavior [44], screening in clinical settings
12 for tobacco, e-cigarette, marijuana use, and binge drinking among CCS could help identify those
13 with more vulnerable mental health. Promoting substance use reduction or cessation in CCS who
14 use multiple substances may require more complex and/or tailored interventions focused on
15 positive coping strategies in their long-term follow-up care regimen among CCS (consistent with
16 Children’s Oncology Group guidelines).

17 The data showed a significant positive association between depressive symptoms and the
18 use of tobacco, marijuana, and e-cigarettes. Our findings are consistent with the self-medication
19 hypothesis, which suggests that individuals may use substances like tobacco and marijuana to
20 cope with negative affect or to temporarily alleviate depression symptoms [46, 47]. The positive
21 correlation with e-cigarette use is particularly noteworthy, given its high popularity among
22 younger males [48]. This suggests that newer forms of substance use are also being incorporated

1 into patterns of self-medication. Prior study showed alcohol use was associated with increased
2 risk of psychological distress including depressive symptoms and anxiety [49,50]. However, this
3 relationship was not supported in our analyses. This result may suggest that the relationship
4 between depressive symptoms and binge drinking is different from other substance use, and
5 further study is needed to clarify the relationship between binge drinking and depressive
6 symptoms. Our study extends this body of evidence to a unique population of CCS, emphasizing
7 the need for mental health and substance use interventions tailored to this group.

8 Self-rated health was negatively associated with tobacco use and binge drinking. This in
9 line with previous research showing that lower health rating predicts stable smoking behavior
10 over time among young adults [51]. Furthermore, self-rated health was negatively associated
11 with more substance use than treatment intensity and cancer-related late effects. This suggests
12 that substance use behavior is more dependent on the CCS current evaluation of their health
13 status, compared with their past cancer experience. This may explain why CCS and their non-
14 cancer peers have similar substance use rates.

15 We found differential associations between neighborhood SES and various substance
16 uses. Higher neighborhood socioeconomic status was positively associated with binge drinking
17 and e-cigarette use, suggesting that substance use behaviors among CCS vary with
18 socioeconomic context. This is consistent with previous studies that found a positive relationship
19 between SES and frequency of e-cigarette use [51,52], alcohol use [53,54]. This is often
20 attributed to the greater social acceptance and accessibility of alcohol in higher SES
21 neighborhoods. Similarly, the rise of e-cigarette use in affluent areas could be linked to targeted
22 marketing and the perception of e-cigarettes as a safer alternative to traditional tobacco products.

1 Our findings suggest that interventions to reduce substance use among CCS should be tailored to
2 neighborhood SES, with particular attention to the types of substances used. For higher SES
3 groups, programs might focus on addressing social norms and reducing the appeal of alcohol and
4 e-cigarettes. For lower SES groups, interventions could involve enhancing access to follow-up
5 care and developing stress-coping mechanisms that do not involve substance use.

6 The lower prevalence of tobacco use in the Hispanic CCS subgroup is consistent with
7 prior research demonstrating similar trends in the general population. This finding is also in line
8 with a prior study which showed Hispanic CCS were less likely to report smoking compared
9 with non-Hispanic White CCS [55]. However, the mechanisms driving this association may be
10 complex, involving socioeconomic, cultural, and familial factors that differ across ethnic groups.
11 For instance, strong family ties and cohesive social support networks, which are prevalent in
12 many Hispanic communities, could contribute to lower rates of engagement in health-
13 compromising behaviors like tobacco use. Previous studies have suggested that acculturation
14 plays a role in substance use behaviors, with less acculturated Hispanics typically reporting
15 lower substance use [56]. It is possible that the Hispanic CCS in our study, who may maintain
16 stronger ties to traditional values, are less influenced by the tobacco use.

17 We found significant sex differences in substance use among CCS with females reporting
18 lower substance use rates across tobacco, alcohol, marijuana, and e-cigarette. Our results
19 corroborate the existing literature indicating that males are generally more likely to engage in
20 substance use than females. This pattern is consistent across various substances, suggesting a
21 pervasive sex difference in substance-related behaviors. Previous study found that male adult
22 survivors of childhood cancers were more likely to report polysubstance use and had greater

1 odds to belong to the moderate drinking, smoking, and risk-taking cluster than female adult CCS
2 [49]. These differences may be particularly impactful on long-term health outcomes for CCS
3 given their previous health challenges.

4 The strengths of this study are manifold, encompassing a large, population-based sample
5 of ethnically diverse CCS, sourced from cancer-registry data. The study design incorporates the
6 measurement of polysubstance use behaviors, as well as a comprehensive array of clinical and
7 demographic factors. The notable representation of Hispanic CCS within our dataset enables an
8 in-depth investigation of this specific demographic factor in relation to substance use.

9 Additionally, the recency of the data collection enhances the study's relevance by capturing the
10 latest patterns in substance use, such as those concerning e-cigarettes.

11 E-cigarettes first entered the market in the early 2000s and gained significant popularity
12 in the 2010s, often marketed as safer alternatives to traditional cigarettes among the young adult
13 population [48]. Unlike traditional tobacco products, e-cigarettes have been perceived as more
14 socially acceptable, accessible, and come with a variety of flavors, which appeal to the younger
15 demographic. This perception might contribute to their increasing prevalence, despite the
16 potential risks and long-term health effects, which are not yet fully understood. The implications
17 of this trend for our findings are significant. The novelty and evolving nature of e-cigarette use
18 might mean that its full impact on health and social behaviors is not yet visible, potentially
19 underestimating its true prevalence and health consequences within this cohort. As e-cigarettes
20 continue to be integrated into the young adult lifestyle, their long-term effects on this population
21 will require ongoing research, especially among childhood cancer survivors who may have
22 increased health vulnerabilities.

1 Relatively lower response rate would be a limitation of the study. Current study depends
2 on CCS self-report data on substance use and no additional strategies were adopted to minimize
3 the self-reporting bias associated with substance use. Future studies need to compare self-
4 reported substance use with objective biochemical data to minimize self-reporting bias and
5 underreporting of substance use. Analyses were restricted to those diagnosed in one geographical
6 region (LA county) and may not be generalizable to other areas with different geographical
7 conditions and health care access. In-depth assessments of chart abstract data validating self-
8 report can further contextualize CCS substance use and their clinical characteristics for future
9 studies.

10 This study's cross-sectional design limits our ability to draw causal inferences about the
11 relationship between clinical and demographic factors and substance use over time. Longitudinal
12 research would be beneficial to determine if the patterns observed here persist into later
13 adulthood and to understand the long-term health impacts of these behaviors in CCS. A
14 prospective design that establishes temporality between clinical factors (e.g., healthcare
15 utilization and long-term follow-up care) including depressive symptoms leading to substance
16 use and changes across time in substance use is recommended.

17 While the current study has illuminated the association between depressive symptoms
18 and increased substance use among young adult survivors of childhood cancers, it has also
19 uncovered a noteworthy subset of this population, 5% of participants reported the use of
20 prescription drugs in the past month. This behavior was not included in the primary model due to
21 the low frequency of endorsement. However, the use of prescription medication, particularly

1 when it falls outside the bounds of medical guidance, is a subject of growing concern due to its
2 potential for misuse and the serious health risks associated with it.

3 Considering the vulnerability of childhood cancer survivors to health complications,
4 future research should investigate the patterns of prescription substance misuse within this group.
5 It is crucial to understand the full scope of substance use behaviors, especially as they relate to
6 complex mental health challenges like anxiety disorders. Investigating these patterns will help
7 clarify the potential risks and inform targeted interventions to prevent misuse among both
8 adolescent and adult survivors. This research is particularly pertinent given that our analysis
9 indicated that survivors under 21 showed different substance use trends, suggesting that age-
10 specific factors may influence the propensity for certain behaviors, including prescription drug
11 misuse.

12 We used neighborhood SES at diagnosis provided by the registry as a demographic
13 variable predicting substance use. Since this is an indirect measure, future studies need to use
14 SES reported by participants. Not all medical variables provided by the registry data, for
15 example, cancer types, years since diagnosis, age at diagnosis were not included in the
16 multivariate regression model.

17 **Implications for Psychosocial Providers or Policy**

18 The transition from pediatric to adult survivorship care is a pivotal time for young adult
19 cancer survivors who face numerous health challenges. This study highlights the benefits of
20 employing a biopsychosocial approach to better comprehend the substance use behaviors and
21 health conditions of these individuals during this critical period. The overarching aim is to
22 improve their involvement in long-term follow-up care as they integrate into the adult healthcare

1 system. Our findings support the interplay between the clinical and demographic factors and their
2 associations with different substance uses. Findings emphasize the need to improve cancer-
3 related follow-up care by targeting integrative care and health promotion efforts for
4 polysubstance use behavior among CCS. Effective interventions are needed to reduce substance
5 use among CCS to prevent early morbidity and improve lifelong wellbeing.

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SUBSTANCE USE IN YOUNG ADULT CCS

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TABLE 1 Descriptive statistics of childhood cancer survivors (n = 1,106; diagnosed in 1996-2010; Los Angeles County).

Variables	Mean (SD), range or N (weighted %)
Sex	
Female	562 (50.8)
Male	544 (49.2)
Age at survey completion (years)	26.2 (4.9), 18-41
Age group at survey completion (years)	
18 - 20	131 (11.8)
21 - 25	422 (38.2)
26 - 30	339 (30.6)
31 - 39	214 (19.4)
Age at diagnosis	11.6 (5.4), 1-19
Years since diagnosis	14.52 (4.36)
Race/ethnicity	
Hispanic	570 (51.5)
White	324 (29.3)
Asian	107 (9.7)
Other	105 (9.5)
Cancer type	
Leukemia	392 (36.1)
Lymphoma	240 (21.7)
Brain & other nervous system	169 (15.2)
Endocrine system	60 (5.1)
Bones & joints	56 (5.0)
Skin	41 (3.5)
Genital system	56 (5.2)
Other †	92 (8.2)
Treatment intensity ‡	
least intensive	69 (6.0)
moderately intensive	344 (30.9)
very intensive	544 (49.9)

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SUBSTANCE USE IN YOUNG ADULT CCS

most intensive	149 (13.3)
Relationship status	
Single	751 (68.9)
Married	201 (18.4)
Living with a partner	111 (10.2)
Divorced/Separated	26 (2.4)
Widowed	1 (0.1)
Education	
Grade school or some high school (<12 years)	58 (5.4)
High school graduate or GED (12 years)	205 (18.8)
Some college, vocational or training school	417 (38.2)
Associate degree	95 (8.7)
Bachelor's degree	241 (22.1)
Post graduate education	75 (6.9)
Neighborhood Socioeconomic Status	
Q1 (Lowest)	344 (31.1)
Q2	238 (21.5)
Q3	167 (15.1)
Q4	180 (16.3)
Q5 (Highest)	177 (16.0)
Cancer-related follow-up care (prior 2 years)	632 (58.1)
Late effects	
0	689 (62.3)
1	201 (18.2)
2+	216 (19.5)
Depressive symptoms	13.88 (10.9), 0-58
Self-rated health §	2.34 (1.0), 0-4
Substance Use (prior 30 day)	
Binge drinking	354 (32.7)
Marijuana use	206 (19.0)
Tobacco use	126 (11.6)
E-cigarette use	79 (8.0)

1 † Oral cavity & pharynx, digestive system, respiratory system, soft tissue including heart, urinary system,
 2 eye & orbit, miscellaneous

3 ‡ Based on the Intensity of Treatment Rating (ITR-3), Division of Oncology, Center for Childhood
 4 Cancer Research, The Children's Hospital of Philadelphia

5 § Higher scores indicate better health

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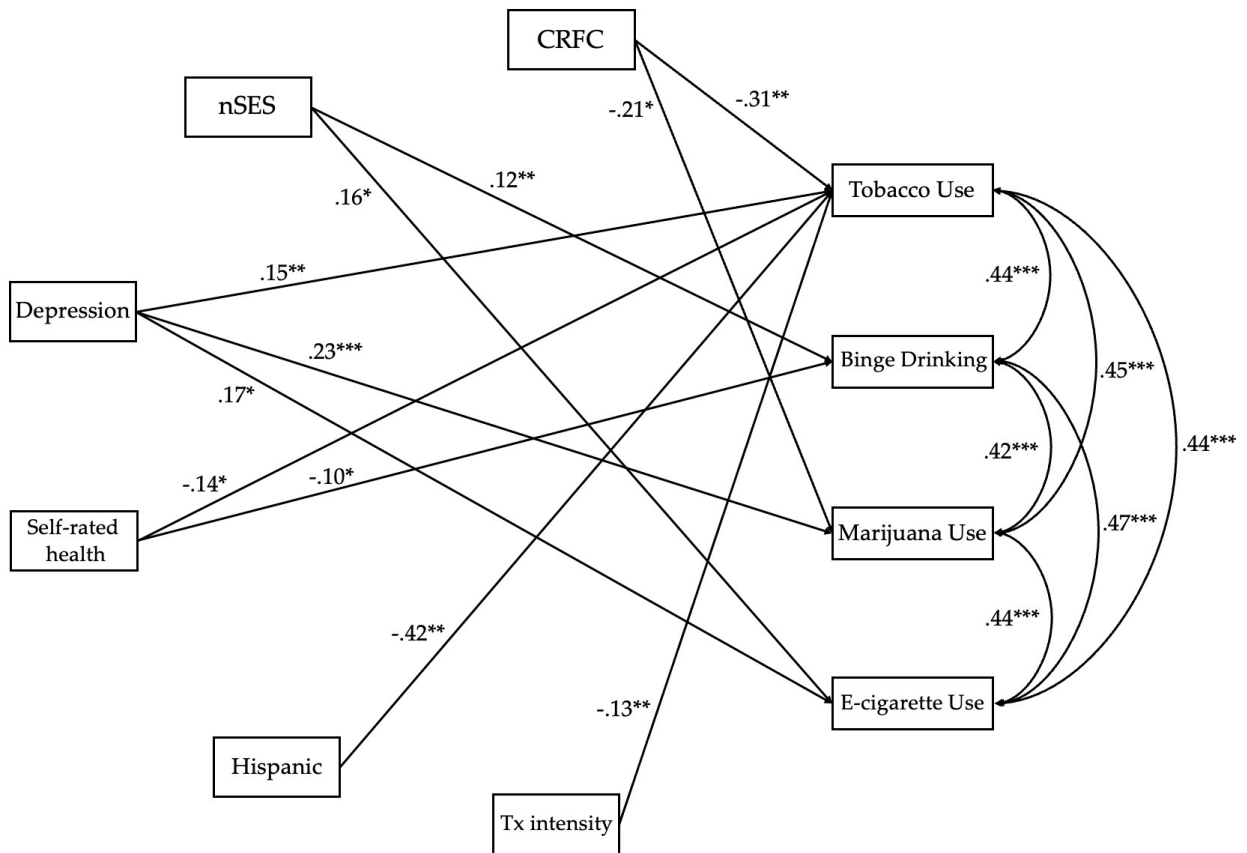
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SUBSTANCE USE IN YOUNG ADULT CCS

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SUBSTANCE USE IN YOUNG ADULT CCS

1 **Figure 1.** Standardized parameter estimates model showing the associations among clinical,
2 demographic factors, and substance use in CCS controlling for age at survey and gender (n=980).
3 Only statistically significant ($p<0.05$) paths are shown for clarity of presentation. CRFC=cancer-
4 related follow-up care. nSES=neighborhood socioeconomic status. * $p<0.05$, ** $p<0.01$
5 *** $p<0.001$.
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SUBSTANCE USE IN YOUNG ADULT CCS

1 **TABLE 2** Standardized and unstandardized parameter estimates of the multivariate regression analysis model (n=980)

Characteristic	Tobacco Use				Binge Drinking				Marijuana Use				E-cigarette Use			
	B	β	SE	<i>p</i>	B	β	SE	<i>p</i>	B	β	SE	<i>p</i>	B	β	SE	<i>p</i>
Cancer-related follow-up care	-0.31	-0.31	0.12	0.01	-0.17	-0.17	0.09	0.06	-0.21	-0.21	0.10	0.04	-0.14	-0.14	0.15	0.34
Gender (female vs. male)	-0.37	-0.37	0.12	<0.01	-0.39	-0.40	0.09	<0.001	-0.43	-0.43	0.10	<0.001	-0.63	-0.63	0.15	<0.001
Race/ethnicity (Hispanic vs. non-Hispanic)	-0.42	-0.42	0.14	<0.01	0.18	0.18	0.10	0.08	-0.19	-0.19	0.11	0.09	0.14	0.14	0.17	0.43
Age at survey	0.01	0.06	0.01	0.25	0.01	0.06	0.01	0.16	-0.02	-0.10	0.01	0.06	-0.02	-0.09	0.02	0.18
Depression	0.02	0.15	0.01	<0.01	<0.01	0.01	<0.01	0.85	0.02	0.23	0.01	<0.001	0.02	0.17	0.01	0.01
Treatment intensity	-0.18	-0.13	0.07	<0.01	0.01	0.01	0.06	0.84	0.03	0.03	0.06	0.57	-0.16	-0.11	0.08	0.06
Late effects	0.11	0.08	0.08	0.15	-0.08	-0.06	0.06	0.15	-0.10	-0.07	0.06	0.12	0.10	0.08	0.09	0.23
Self-rated health	-0.15	-0.14	0.07	0.03	-0.11	-0.10	0.05	0.03	-0.08	-0.08	0.06	0.14	-0.12	-0.11	0.09	0.19
Neighborhood Socioeconomic Status	-0.09	-0.12	0.05	0.06	0.09	0.12	0.04	0.01	0.03	0.04	0.04	0.40	0.12	0.16	0.06	0.04

