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Authors

DeRouen, Mindy C
Parsons, Helen M
Kent, Erin E
et al.

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Sociodemographic disparities in survival for adolescents and young adults with cancer differ by health insurance status

Mindy C. DeRouen, PhD,MPH[a], **Helen M. Parsons, PhD,MPH**[b], **Erin E. Kent, PhD,MS**[c], **Brad H. Pollock, PhD,MPH**[d], and **Theresa H. M. Keegan, PhD,MS**[e]

[a]Cancer Prevention Institute of California, 2201 Walnut Ave, Suite 300, Fremont, CA 94538

[b]Department of Epidemiology and Biostatistics, The University of Texas Health Science Center at San Antonio, 7703 Floyd Curl Drive, San Antonio, TX 78229

[c]Outcomes Research Branch, Healthcare Delivery Research Program, Division of Cancer Control and Population Sciences, National Cancer Institute, National Institutes of Health, 9609 Medical Center Drive, Rockville, MD 20850

[d]Department of Public Health Sciences, University of California, One Shields Avenue, Med Sci 1-C, Davis, CA 95616

[e]Division of Hematology and Oncology, UC Davis Comprehensive Cancer Center, 4501 X Street, Suite 3016, Sacramento, CA 95817

Abstract

Purpose—To investigate associations of sociodemographic factors—race/ethnicity, neighborhood socioeconomic status (SES), and health insurance—with survival for adolescent and young adults (AYAs) with invasive cancer.

Methods—Data on 80,855 AYAs with invasive cancer diagnosed in California 2001–2011 were obtained from the California Cancer Registry. We used multivariable Cox proportional hazards regression to estimate overall survival.

Results—Associations of public or no insurance with greater risk of death were observed for 11 of 12 AYA cancers examined. Compared to Whites, Blacks experienced greater risk of death, regardless of age or insurance, while greater risk of death among Hispanics and Asians was more apparent for younger AYAs and for those with private/military insurance. More pronounced neighborhood SES disparities in survival were observed among AYAs with private/military insurance, especially among younger AYAs.

Conclusions—Lacking or having public insurance was consistently associated with higher morality, while disparities according to race/ethnicity and neighborhood SES were greater among AYAs with private/military insurance. While health insurance coverage associates with survival, remaining racial/ethnic and socioeconomic disparities among AYAs with cancer suggest social factors also need consideration in intervention and policy development.

Corresponding author: Mindy C. DeRouen, PhD, MPH, Cancer Prevention Institute of California, 2201 Walnut Ave, Suite 300, Fremont, CA 94538, Phone: 510-608-5280, Fax: 510-608-5095, mindy.derouen@cpic.org.

Keywords

adolescents and young adults; cancer survival; sociodemographic factors; insurance status; race/ethnicity; neighborhood socioeconomic status

1. Background

Cancer is the most frequent cause of disease-related death among adolescents and young adults (AYAs) 15–39 years of age at diagnosis [1]. While cancer survival among AYAs with many types of cancer is good, above 80%, AYAs have not experienced the same improvements in relative survival as children and older adults for cancers common among AYAs [2, 3]. In addition, AYAs, historically, have had the highest uninsurance rates compared with children and older adults [4–6]. Furthermore, disparities in cancer survival by race/ethnicity and neighborhood socioeconomic status (SES)—previously well-documented only among older adults—have recently been reported among AYAs [7–10].

There is evidence that racial/ethnic disparities in cancer survival for some cancer sites may be mediated by access to health care or neighborhood SES [7, 8, 10]. It is well-documented that, compared to non-Hispanic White AYAs, Hispanic and Black AYAs are more likely to reside in lower SES neighborhoods [10] and are more likely to be uninsured or have public insurance [11, 12]. Furthermore, each of these sociodemographic factors (i.e., minority race/ethnicity, lower neighborhood SES, and public or no insurance at diagnosis) have been associated with later-stage at diagnosis [11–13], undertreatment [7, 11], and greater risk of death among AYAs [7–11, 13, 14]. The few studies that have considered the independent associations of all three factors with cancer survival suggest that these associations remain in multivariable analyses, but differences exist by cancer site [8–10, 14]. Of note, however, no studies have considered the joint relationship of race/ethnicity, neighborhood SES, and health insurance type with survival among AYAs.

Therefore, we analyzed patient data from the California Cancer Registry to determine joint associations of sociodemographic factors with overall survival for all invasive cancers and the twelve most common cancers among AYAs. In addition, given that survival among AYAs with cancer can differ markedly from that of younger or older patients [15], we hypothesized that associations of sociodemographic variables with survival would differ by age, so we stratified analyses into three AYA age subgroups. Identifying sociodemographic subgroups of AYAs experiencing greater risk of death is pivotal to alleviating health disparities among AYA cancer patients.

2. Methods

2.1 Study Population

The California Cancer Registry (CCR) is part of the National Cancer Institute's (NCI's) Surveillance, Epidemiology and End Results (SEER) Program and includes all cancer diagnoses in California since 1988 [16–19] with annual patient follow-up for vital status. We obtained information about California residents diagnosed with first-primary, invasive cancer from January 1, 2001 (first year of sufficient data regarding insurance type at diagnosis)

through December 31, 2011 at 15–39 years of age. For each case, we obtained cancer registry information routinely abstracted from the medical record (Table 1); race/ethnicity, age at diagnosis, marital status, year of diagnosis, sex, and SEER summary stage at diagnosis; in addition to vital status as of December 31, 2012. Categories for age at diagnosis (15–24, 25–34, and 35–39) utilize similar cut-points as standard reporting by cancer registries and optimize the distribution of cases among categories. Vital status is routinely determined by the CCR through hospital follow-up [8, 9] and database linkages.

Individual primary cancer sites were defined with Primary Site and ICD-O-3 Histology codes according to the SEER AYA Site Recode, based on the AYA classification suggested by Barr et al. [20] and updated based on histology changes in the WHO Hematopoietic/ Lymphoid tissue book (AYA Site Recode ICD-O-3/WHO 2008). Primary sites not designated in the AYA recode were defined via Primary Site and ICD-O-3 Histology codes listed in the SEER Site recode (Site Recode ICD-O-3/WHO 2008).

Of the 81,954 AYAs diagnosed with histologically confirmed, first primary invasive cancer, we excluded those cases diagnosed by autopsy or death certificate and other cases with no survival time, due to missing dates (n=471, 0.57%). Patients with non-Hodgkin lymphoma or Kaposi sarcoma and HIV or who died of AIDS were also excluded (n=628, 0.77%) to eliminate the direct effects of the AIDS epidemic. The final study population included 80,855 AYAs.

2.2 Sociodemographic variables

Sociodemographic variables recorded in the CCR include race/ethnicity, SES, and insurance type. Race/ethnicity was classified as non-Hispanic White, non-Hispanic Black, Hispanic, non-Hispanic Asian/Pacific Islander (PI), and other/unknown; and are hereafter referred to as White, Black, Hispanic, Asian/PI, and other; respectively [21].

Neighborhood SES is a previously described index that incorporates 2000 U.S. Census (for cases diagnosed through 2005) [22] and 2006–2010 American Community Survey data (for cases diagnosed 2006 forward) [23] on education, occupation, unemployment, household income, poverty, rent, and home values. Index scores are grouped into quintiles from highest to lowest SES index value based on the distribution of scores across census tracts in California [22, 23]. Residential addresses of cancer cases were geocoded by the CCR to the census tract level, allowing assignment of a neighborhood SES index value to each case.

Health insurance, defined as the primary source of payment at diagnosis or initial treatment, is routinely abstracted for patients diagnosed since 2001. As in previous AYA studies [11, 13, 24, 25], insurance type was categorized as private/military (private insurance managed care, health maintenance organization, or preferred provider organization; private Insurance Fee-for-Service; military; Veterans Affairs; Tricare; or insurance, not otherwise specified), public/none (Medicaid, Medicare, Indian/Public Health Service, county funded not otherwise specified, not insured, not insured self-pay), and unknown. Consistent with prior observations that the small percentage of AYA cancer patients who were uninsured likely reflect retroactive enrollment in Medicaid at the time of cancer diagnosis [8, 13, 14], we considered publicly insured and uninsured together in the survival analyses.

2.3 Statistical analyses

Survival analyses were conducted using SAS software version 9.3 (SAS Institute Inc., Cary, North Carolina). Frequencies and column percentage by race/ethnicity were determined according to sociodemographic and clinical characteristics and select cancer sites. Bivariate chi-square tests of association were performed for each covariate among the total population and within each racial/ethnic group. Survival time was calculated in days from the date of diagnosis to date of death, date of last follow-up, or study end date (December 31, 2012), whichever came first.

Multivariable models for specific cancer sites were adjusted for marital status, age at diagnosis, sex, and SEER summary stage in addition to sociodemographic variables of interest. We assessed the proportional hazards assumption for all models by examining survival curves and by statistical testing of the correlation between weighted Shoenfeld residuals and logarithmically transformed survival time. Stage at diagnosis violated proportional hazards and was thus included as a stratifying variable in all models, which allows for differing baseline hazards but precludes report of HRs for this variable [26].

We examined associations of race/ethnicity, neighborhood SES and insurance type with overall survival using Cox multivariable proportional hazards regression to estimate hazard ratios (HRs) and 95% confidence intervals (CIs) for three AYA age groups (15–24 years of age, 25–34 years of age, and 35–39 years of age) for ease of interpretation. Multivariable models for each age group were additionally adjusted for marital status, year of diagnosis, sex, and SEER summary stage. Statistically significant main effects were evaluated at p<0.05. Within age-group specific models, we tested for interactions among sociodemographic variables of interest (race/ethnicity, neighborhood SES, and insurance type) and found two significant interactions (p<0.10): race/ethnicity an.d insurance type and neighborhood SES and insurance type. Thus, these interaction terms were included in models for every age group (p-values for each interaction term in footnote to Table 3).

3. Results

Of the 80,855 AYAs in our study, most are White (46.8%), followed by 33.5% Hispanic, 11.8% Asian/PI, 5.3% Black, and 2.5% other race/ethnicity. Nearly one-third of White (29.3%) and Asian/PI (29.4%) AYAs reside in the highest SES neighborhoods, while 26.8% of Black AYAs and 34.6% of Hispanic AYAs reside in lowest SES neighborhoods (Table 1). Thirty-seven (36.8) percent of Black AYAs and 40.7% of Hispanic AYAs have no or public insurance, proportions that were much higher than that of White (15.0%) or Asian/PI (17.6%) AYAs. Breast cancer is the most frequently diagnosed invasive cancer among AYAs in California (14.5%), followed by thyroid cancer (12.7%), melanoma (9.8%), testicular cancer (9.1%), non-Hodgkin lymphoma (5.8%), Hodgkin lymphoma (5.8%), leukemia (5.3%), cervical cancer and sarcoma (each 5.2%), central nervous system cancers (4.1%), and ovarian cancer (2.3%).

Table 2 presents associations of race/ethnicity, neighborhood SES, and insurance type with overall survival by cancer site/type. In models adjusted for neighborhood SES and insurance type, Black AYAs with breast cancer, testicular cancer, Hodgkin lymphoma, leukemia, and

cervical cancer have greater risk of death than White AYAs with these cancers. In addition, Hispanic AYAs with testicular cancer, non-Hodgkin lymphoma, and leukemia also have greater risk of death than White AYAs with these cancers. Independent neighborhood SES disparities are present for half of the cancer sites examined (breast cancer, melanoma, non-Hodgkin lymphoma, Hodgkin lymphoma, leukemia, sarcoma and colorectal cancer). For every cancer site except ovarian cancer, AYAs with no or public insurance at diagnosis had greater risk of death compared to AYAs with private/military insurance, with HR's ranging from 1.16 (95% CI 1.04–1.29) for leukemia to 2.61 (95% CI 2.13–3.20) for melanoma.

Table 3 presents multivariable models of overall survival after invasive cancer separately for three AYA age groups. For each age group, no or public insurance is associated with greater risk of death compared to private/military insurance (HR for 15–24 years, 1.50 [95% CI, 1.38–1.64]; HR for 25–34 years, 1.76 [95% CI 1.66–1.87]; HR for 35–39 years, 1.52 [95% CI 1.44–1.62]; data not shown in table). Of note, however, within each age group, racial/ethnic disparities in survival differ by insurance type and are generally more persistent among groups under age 35 and those with private/military insurance. Among AYAs 15–24 years of age; Black, Hispanic, and Asian/PI AYAs with both private/military and no or public insurance have greater risk of death than White AYAs, although the higher HR for Hispanics compared to Whites with no or public insurance is non-significant. Only for Black AYAs does this survival disparity compared to non-Hispanic White AYAs persist for each insurance type within each age group. For Hispanics 25–34 years of age, a survival disparity is only apparent for those with private/military insurance (HR, 1.26; 95% CI, 1.16–1.38). Hispanics 35–39 years of age do not have greater risk of death compared to Whites, regardless of insurance type, and in fact, Hispanics in this age group with public or no insurance actually have lower risk of death compared to Whites (HR, 0.84; 95% CI, 0.76–0.93). Greater risk of death for Asian/PI AYAs with public or no insurance is borderline (present, but non-significant) for those 25–34 years of age (HR, 1.14; 95% CI, 0.98–1.33) and undetected for those 35–39 years of age (HR, 1.02; 95% CI, 0.87–1.18) while greater risk of death for Asian/PI AYAs with private/military insurance is present in each AYA age group.

Survival disparities according to neighborhood SES are more apparent with increasing age and among AYAs with private/military insurance (Table 3). There are no associations between neighborhood SES and survival for AYAs 15–24 years of age with public insurance. However, among AYAs 15–24 years of age with private insurance, those residing in lower SES neighborhoods have greater risk of death than those in the highest SES neighborhoods. Among AYAs 25–34 years of age, those with public insurance residing in lower-middle or the lowest SES neighborhoods have greater risk of death than AYAs in the highest SES neighborhoods (the HR for lowest compared to highest SES neighborhood is non-significant), while, among those with private/military insurance, AYAs residing in the three lowest SES neighborhoods have greater risk of death than those in the highest SES neighborhoods. For AYAs 35–39 years of age, those with public insurance residing in the lowest versus highest SES neighborhoods have greater risk of death, but among AYAs with private/military insurance, those residing in the four lowest SES neighborhoods have greater risk of death than those in the highest SES neighborhoods, with HR's ranging from 1.19

(95% CI, 1.09–1.31) for higher-middle to 1.71 (95% CI, 1.52–1.92) for lowest neighborhood SES.

4. Discussion

In this population-based study of AYAs with invasive cancer, we found that lacking insurance or having public insurance was consistently associated with greater risk of death for AYAs of all ages and with nearly all types of cancer. While we observed persistent survival disparities for Black AYAs, compared to White AYAs, regardless of age group or insurance type, disparities among Hispanic and Asian AYAs were more pronounced for younger age groups and for those with private/military insurance. We also observed more pronounced neighborhood SES disparities in survival among AYAs with private/military insurance, compared to those with nor or public insurance, especially among younger AYAs.

Expanding upon the findings of a prior study that reported greater risk of death for AYAs with no or public insurance [13], our results indicate these associations persist when additional, potentially confounding, sociodemographic factors (i.e. marital status, race/ethnicity, and neighborhood SES) are considered and is apparent for each of the eleven most common AYA cancers. Given that the small percentage of AYA cancer patients who were uninsured likely reflect retroactive enrollment in Medicaid at the time of cancer diagnosis [8, 13, 14], we considered publicly insured and uninsured together in the survival analyses. A number of factors related to healthcare access may mediate associations of no or public insurance with survival; including stage at diagnosis, delays in treatment receipt, details of treatment receipt and completion, Medicaid provider restrictions, or availability of information and support services among patients and survivors. While we considered stage at diagnosis, we were unable to include other access-related factors due to the broad scope of the study and/or lack of additional patient-level data. The importance of these potential mediators, however, has been indicated by recent research. AYAs with no insurance are more likely to experience delays in treatment initiation [24] and less likely to receive definitive treatment [11], and estimates for treatment non-adherence among AYAs with cancer range from 27% to 60% [27]. In addition, the quality of cancer-care received at safety-net hospitals may not be comparable to other hospitals [28]. Furthermore, we have shown that AYA survivors without insurance more frequently report cancer-related information needs [29], and are less likely to receive cancer-related medical care in survivorship compared to survivors with insurance [5]—factors that may put uninsured AYA survivors at greater risk for long-term cancer-related complications. Indeed, we observed that the six AYA cancer sites with the highest relative survival rates (thyroid, testis, melanoma, breast, Hodgkin's lymphoma, and non-Hodgkin lymphoma) [30] have the strongest associations between health insurance and survival, suggesting that insurance likely influences not only the initial diagnosis and treatment, as found previously [11, 12], but what happens beyond the initial treatment period.

Greater risk of death among AYAs lacking or having public insurance is particularly alarming because, compared to children and older adults, AYAs have historically had the highest uninsurance rates [11], Since 2010, a provision of the Patient Protection and Affordable Care Act (ACA) allows young adults to remain on their parents' insurance plan

until they are 26 years of age (rather than 23 years of age). Consequently, the percent of young adults 19–25 years of age insured increased from around 65% to greater than 72% between 2010 and 2011 [4]. Mandated coverage and the insurance marketplace, components of the ACA that took effect in 2014, have further increased insurance coverage among AYAs [31]. Our results from 2001–2011, then, suggest that increases in the number of AYAs insured at the time of cancer diagnosis will have a positive impact on survival, but whether this is the case cannot yet be determined. The racial/ethnic and neighborhood SES disparities in survival we observe among AYAs with private/military insurance, however, suggest that increasing insurance coverage alone will not alleviate all outcome disparities.

Insurance coverage is often presented as a key mediator of racial/ethnic and SES disparities in survival, and recent reports, including ours, of associations between no or public insurance and cancer outcomes among AYAs after adjustment for race/ethnicity and SES support this view [11, 13, 32–34]. Our results confirm the importance of insurance coverage, but also indicate that substantial racial/ethnic and neighborhood SES disparities remain even among the privately insured. Our findings are consistent with recent studies that found greater financial burden associated with a cancer diagnosis for those that are relatively young, of non-White race/ethnicity, or have lower SES, regardless of insurance status [35–42]. For those with private insurance, financial burden can result from out-of-pocket costs associated with, for example, co-payments, co-insurance, deductibles, and out-of-network costs that may determine treatment plans, treatment completion, and overall well-being [36, 41–43]. For example, in studies of individuals of all ages, African Americans and residents of low SES neighborhoods are overall less likely to receive standard medical treatment compared to Whites, even when they have the same insurance coverage [28], a disparity noted by other reports specific to cancer care [44, 45]. Financial burden among minority and low SES groups, even if privately insured, may thus be a key contributor to racial/ethnic and SES disparities in treatment and survival. The issue of financial burden will likely increase in importance as ACA requirements result in cost-shifting on the part of insurance providers and cancer care costs continue to rise [46]. Further research should aim to determine the degree to which financial burden directly contributes to independent racial/ethnic and neighborhood SES disparities in treatment receipt and survival.

There are also likely other factors influencing the racial/ethnic and neighborhood SES disparities in survival that we observed, including treatment receipt (independent of insurance type) [7, 47], biological differences in cancer subtypes [48], racial/ethnic discrimination [49–54], racially/ethnically patterned differences in social capital or social support [55], and neighborhood contextual factors [56]. For example, we have reported that Black and Hispanic AYAs and AYAs from lower SES neighborhoods with breast cancer were less likely to receive radiation after breast conserving surgery [7] or combined-modality therapy for their Hodgkin lymphoma [14]. Furthermore, biological differences in cancer subtypes may be relevant to some cancer sites: Black AYAs are more likely to be diagnosed with breast cancer molecular subtypes associated with a shorter prognosis [48], and it has been reported that inclusion of molecular subtype and insurance type in survival models diminishes the association of Black race/ethnicity with greater risk of death [9]. While studies of the effects of racial/ethnic discrimination have not been conducted specifically among AYAs, it has been observed that discrimination may impact care

utilization (independent of insurance status) [49–51], and that chronic stress due to discrimination impacts health outcomes [52–54]. In addition, greater racial/ethnic disparities for cancers more amenable to prevention and treatment suggest that differences in access to social and economic resources (social capital) likely contribute to residual racial/ethnic disparities in cancer survival [55]. Finally, survival disparities for AYAs residing in lower SES neighborhoods may be mediated by a number of built and social factors, including (but not limited to) walkability, proximity to medical facilities, food availability, cultural norms, quality of education, and social support [8, 56]. In order to understand the relative contributions of sociodemographic factors to cancer survival, continued research should consider specific cancer sites along with available sociodemographic factors, and site-specific tumor and treatment factors that may impact the associations reported here.

Our study includes a highly diverse and large population of AYAs treated across nearly all facilities in California, but is also subject to some limitations not previously discussed. Joint associations of sociodemographic factors with survival may differ according to whether overall or cancer site-specific survival is considered. For example, among AYAs with thyroid cancer, we recently reported higher thyroid cancer-specific survival among Black AYAs, but did not observe these associations in analyses of overall survival [8]. Another important mediator of associations of race/ethnicity with survival may be individual-level SES, but the CCR does not collect individual SES indicators. In addition, the CCR collects insurance type at diagnosis or initial treatment, so does not capture changes in insurance status over time. In order to have a large enough population size to accommodate stratification of survival analyses by cancer type (Table 2) or age group and insurance type (Table 3), we were not able to further divide the private/military insurance type category into separate categories of private and military insurance. Finally, as with all registry studies, differential misclassification of race/ethnicity is possible. However, it has previously been determined that the level of agreement between CCR data and self-reported race/ethnicity is excellent for Whites and Blacks and intermediate for Hispanics and Asians [21, 57].

5. Conclusions

We found that lacking or having public health insurance was associated with greater risk of death for AYAs of all ages and for most cancer sites. Our findings also reveal associations of race/ethnicity and neighborhood SES with greater risk of death for AYAs with many types of cancer, independent of health insurance type. Survival disparities for Black AYAs compared to White AYAs persisted regardless of age group or health insurance type, while disparities for Hispanic and Asian/PI AYAs, compared to White AYAs, and for those in lower SES neighborhoods were more prominent among younger AYAs and those with private/military insurance. Persistent survival disparities according to race/ethnicity and neighborhood SES among the privately insured may indicate financial burdens associated with private healthcare coverage, and further research is needed to identify whether financial burden and other social factors directly contribute to undertreatment, follow-up care, and greater risk of death for these groups.

Acknowledgments

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Table 1

Frequencies and column percents of demographic and clinical factors according to race/ethnicity among adolescents and young adults 15–39 years of age diagnosed with invasive cancer[1], California 2001–2011

Covariate[3]	Total (N = 80855)		NH[2] White (N = 37815)		NH Black (N = 4302)		Hispanic (N = 27111)		NH Asian/Pacific Islander (N = 9571)		Other (N = 2056)	
	N	(%)	N	(%)	N	(%)	N	(%)	N	(%)	N	(%)
Neighborhood SES[2] quintiles												
Highest	16746	(20.7%)	11076	(29.3%)	362	(8.4%)	1950	(7.2%)	2818	(29.4%)	540	(26.3%)
Higher-middle	17573	(21.7%)	10278	(27.2%)	745	(17.3%)	3606	(13.3%)	2473	(25.8%)	471	(22.9%)
Middle	16531	(20.4%)	8049	(21.3%)	952	(22.1%)	5101	(18.8%)	1972	(20.6%)	457	(22.2%)
Lower-middle	15491	(19.2%)	5528	(14.6%)	1090	(25.3%)	7075	(26.1%)	1432	(15.0%)	366	(17.8%)
Lowest	14514	(18.0%)	2884	(7.6%)	1153	(26.8%)	9379	(34.6%)	876	(9.2%)	222	(10.8%)
Insurance status												
Private/Military	56765	(70.2%)	30609	(80.9%)	2574	(59.8%)	14776	(54.5%)	7592	(79.3%)	1214	(59.0%)
Public/None	20270	(25.1%)	5681	(15.0%)	1581	(36.8%)	11027	(40.7%)	1689	(17.6%)	292	(14.2%)
Unknown	3820	(4.7%)	1525	(4.0%)	147	(3.4%)	1308	(4.8%)	290	(3.0%)	550	(26.8%)
Marital status												
Married	36594	(45.3%)	17236	(45.6%)	1303	(30.3%)	12256	(45.2%)	5224	(54.6%)	575	(28.0%)
Not married	40187	(49.7%)	18779	(49.7%)	2839	(66.0%)	13742	(50.7%)	4088	(42.7%)	739	(35.9%)
Unknown	4074	(5.0%)	1800	(4.8%)	160	(3.7%)	1113	(4.1%)	259	(2.7%)	742	(36.1%)
Year of diagnosis												
2001–2006	43224	(53.5%)	21279	(56.3%)	2403	(55.9%)	13610	(50.2%)	4899	(51.2%)	1033	(50.2%)
2007–2011	37631	(46.5%)	16536	(43.7%)	1899	(44.1%)	13501	(49.8%)	4672	(48.8%)	1023	(49.8%)
Age at diagnosis (years)												
15–24	15112	(18.7%)	6686	(17.7%)	753	(17.5%)	5875	(21.7%)	1417	(14.8%)	381	(18.5%)
25–34	34103	(42.2%)	15847	(41.9%)	1707	(39.7%)	11681	(43.1%)	3934	(41.1%)	934	(45.4%)
35–39	31640	(39.1%)	15282	(40.4%)	1842	(42.8%)	9555	(35.2%)	4220	(44.1%)	741	(36.0%)
Sex												
Male	32534	(40.2%)	15926	(42.1%)	1573	(36.6%)	11096	(40.9%)	3079	(32.2%)	860	(41.8%)
Female	48321	(59.8%)	21889	(57.9%)	2729	(63.4%)	16015	(59.1%)	6492	(67.8%)	1196	(58.2%)
SEER Summary Stage												

Covariate[3]	Total (N = 80855)		NH[2] White (N = 37815)		NH Black (N = 4302)		Hispanic (N = 27111)		NH Asian/Pacific Islander (N = 9571)		Other (N = 2056)	
	N	(%)	N	(%)	N	(%)	N	(%)	N	(%)	N	(%)
Local	40176	(49.7%)	20821	(55.1%)	1745	(40.6%)	11910	(43.9%)	4254	(44.4%)	1446	(70.3%)
Regional	21774	(26.9%)	9626	(25.5%)	1235	(28.7%)	7701	(28.4%)	2968	(31.0%)	244	(11.9%)
Distant	16281	(20.1%)	6287	(16.6%)	1154	(26.8%)	6562	(24.2%)	2086	(21.8%)	192	(9.3%)
Unknown	2624	(3.2%)	1081	(2.9%)	168	(3.9%)	938	(3.5%)	263	(2.7%)	174	(8.5%)
Cancer site or type[4]												
Breast	11703	(14.5%)	5076	(13.4%)	922	(21.4%)	3633	(13.4%)	1951	(20.4%)	121	(5.9%)
Thyroid	10289	(12.7%)	4754	(12.6%)	311	(7.2%)	3450	(12.7%)	1611	(16.8%)	163	(7.9%)
Melanoma	7928	(9.8%)	6262	(16.6%)	28	(0.7%)	773	(2.9%)	101	(1.1%)	764	(37.2%)
Testis	7329	(9.1%)	3715	(9.8%)	127	(3.0%)	2998	(11.1%)	312	(3.3%)	177	(8.6%)
Non-Hodgkin lymphoma	4660	(5.8%)	2068	(5.5%)	336	(7.8%)	1565	(5.8%)	572	(6.0%)	119	(5.8%)
Hodgkin lymphoma	4650	(5.8%)	2519	(6.7%)	356	(8.3%)	1301	(4.8%)	397	(4.1%)	77	(3.7%)
Leukemia	4247	(5.3%)	1403	(3.7%)	212	(4.9%)	2066	(7.6%)	510	(5.3%)	56	(2.7%)
Cervical	4176	(5.2%)	1682	(4.4%)	206	(4.8%)	1837	(6.8%)	363	(3.8%)	88	(4.3%)
Sarcoma	4167	(5.2%)	1668	(4.4%)	338	(7.9%)	1610	(5.9%)	453	(4.7%)	98	(4.8%)
Colorectal	3929	(4.9%)	1653	(4.4%)	273	(6.3%)	1344	(5.0%)	591	(6.2%)	68	(3.3%)
Central nervous system	3351	(4.1%)	1743	(4.6%)	145	(3.4%)	1073	(4.0%)	344	(3.6%)	46	(2.2%)
Ovarian	1832	(2.3%)	659	(1.7%)	101	(2.3%)	734	(2.7%)	324	(3.4%)	14	(0.7%)

[1] Excluding patients with non-Hodgkin's lymphoma and Kaposi sarcoma who also have HIV or died of AIDS

[2] SES, socioeconomic status; NH, non-Hispanic

[3] Bivariate chi-square tests of association were performed for each covariate among the total population and within each racial/ethnic group. All corresponding p-values were p<0.001.

[4] Column percents for 'Cancer site or type' do not add up to 100%, because not all cancer sites and types are listed.

Table 2

Frequencies of deaths and hazard ratios (95% confidence intervals) for Cox proportional hazards regression models of overall survival according to social factors for adolescents and young adults 15–39 years of age with select invasive cancers[1], California 2001–2011

Cancer site or type[3]	Race/ethnicity	Deaths	HR[2] (95% CI[2])	Neighborhood SES[2] quintile	Deaths	HR (95% CI)	Insurance type	Deaths	HR (95% CI)
Breast	NH[2] White	840	reference	Highest	352	reference	Private/Military	1279	reference
	NH Black	**260**	**1.35 (1.17, 1.56)**	Higher-middle	386	1.08 (0.93, 1.25)	**Public/Uninsured**	**690**	**1.62 (1.47, 1.80)**
	Hispanic	698	0.97 (0.86, 1.08)	**Middle**	**414**	**1.29 (1.11, 1.49)**	Unknown	96	1.19 (0.96, 1.47)
	NH Asian/PI	249	0.89 (0.77, 1.02)	**Lower-middle**	**464**	**1.50 (1.29, 1.73)**			
	Other	18	0.93 (0.58, 1.48)	**Lowest**	**449**	**1.48 (1.26, 1.73)**			
Thyroid	NH White	42	reference	Highest	19	reference	Private/Military	62	reference
	NH Black	6	1.95 (0.81, 4.69)	Higher-middle	17	0.81 (0.42, 1.56)	**Public/Uninsured**	**31**	**2.27 (1.41, 3.63)**
	Hispanic	36	1.06 (0.65, 1.74)	Middle	17	0.85 (0.43, 1.66)	**Unknown**	**6**	**3.33 (1.37, 8.10)**
	NH Asian/PI	13	0.90 (0.48, 1.69)	Lower-middle	27	1.43 (0.77, 2.67)			
	Other	~	~	Lowest	19	1.12 (0.55, 2.25)			
Melanoma	NH White	451	reference	Highest	131	reference	Private/Military	347	reference
	NH Black	~	~	Higher-middle	119	0.98 (0.76, 1.26)	**Public/Uninsured**	**184**	**2.61 (2.13, 3.20)**
	Hispanic	80	1.02 (0.79, 1.31)	**Middle**	**127**	**1.50 (1.17, 1.92)**	Unknown	26	0.98 (0.64, 1.51)
	NH Asian/PI	12	1.22 (0.68, 2.18)	Lower-middle	100	1.28 (0.98, 1.67)			
	Other	**9**	**0.41 (0.21, 0.80)**	Lowest	80	1.24 (0.91, 1.68)			
Testis	NH White	161	reference	Highest	51	reference	Private/Military	189	reference
	NH Black	**16**	**1.88 (1.12, 3.16)**	Higher-middle	78	1.21 (0.85, 1.72)	**Public/Uninsured**	**233**	**2.12 (1.71, 2.62)**
	Hispanic	**241**	**1.42 (1.14, 1.77)**	Middle	84	1.00 (0.70, 1.42)	**Unknown**	**23**	**1.90 (1.22, 2.96)**
	NH Asian/PI	22	1.52 (0.97, 2.38)	Lower-middle	101	1.09 (0.77, 1.55)			
	Other	~	~	Lowest	131	1.22 (0.86, 1.74)			
Non-Hodgkin lymphoma[1]	NH White	313	reference	Highest	120	reference	Private/Military	426	reference
	NH Black	76	1.21 (0.93, 1.56)	Higher-middle	146	1.12 (0.88, 1.43)	**Public/None**	**356**	**1.69 (1.45, 1.98)**
	Hispanic	**353**	**1.27 (1.07, 1.50)**	Middle	149	1.09 (0.85, 1.39)	**Unknown**	**53**	**1.46 (1.08, 1.96)**
	NH Asian/PI	86	1.13 (0.89, 1.44)	**Lower-middle**	**186**	**1.42 (1.12, 1.81)**			

Cancer site or type[3]	Race/ethnicity	Deaths	HR[2] (95% CI[2])	Neighborhood SES[2] quintile	Deaths	HR (95% CI)	Insurance type	Deaths	HR (95% CI)
	Other	7	0.49 (0.23, 1.06)	**Lowest**	**234**	**1.72 (1.34, 2.19)**	Private/Military	172	reference
Hodgkin lymphoma	NH White	149	reference	Highest	44	reference	Private/Military	172	reference
	NH Black	**42**	**1.47 (1.03, 2.10)**	Higher-middle	60	1.19 (0.80, 1.76)	**Public/Uninsured**	**141**	**2.22 (1.74, 2.84)**
	Hispanic	104	1.04 (0.79, 1.37)	Middle	67	1.37 (0.93, 2.01)	Unknown	14	1.24 (0.71, 2.16)
	NH Asian/PI	29	1.36 (0.91, 2.03)	**Lower-middle**	**76**	**1.59 (1.08, 2.34)**			
	Other	~	~	**Lowest**	**80**	**1.85 (1.23, 2.78)**			
Leukemia	NH White	467	reference	Highest	191	reference	Private/Military	845	reference
	NH Black	**95**	**1.30 (1.04, 1.63)**	Higher-middle	514	1.13 (0.94, 1.37)	**Public/Uninsured**	**748**	**1.16 (1.04, 1.29)**
	Hispanic	**905**	**1.30 (1.14, 1.47)**	**Middle**	**376**	**1.30 (1.08, 1.56)**	Unknown	64	1.10 (0.85, 1.42)
	NH Asian/PI	170	1.01 (0.85, 1.21)	**Lower-middle**	**305**	**1.31 (1.09, 1.57)**			
	Other	20	1.23 (0.78, 1.92)	**Lowest**	**271**	**1.42 (1.18, 1.71)**			
Cervix	NH White	269	reference	Highest	72	reference	Private/Military	322	reference
	NH Black	**67**	**1.64 (1.25, 2.16)**	Higher-middle	110	0.87 (0.64, 1.17)	**Public/Uninsured**	**370**	**1.23 (1.05, 1.46)**
	Hispanic	315	0.95 (0.79, 1.13)	Middle	137	1.08 (0.81, 1.44)	Unknown	31	1.08 (0.74, 1.59)
	NH Asian/PI	63	1.17 (0.89, 1.54)	Lower-middle	142	0.98 (0.73, 1.31)			
	Other	9	0.89 (0.46, 1.74)	Lowest	262	1.32 (0.99, 1.75)			
Sarcoma[1]	NH White	453	reference	Highest	186	reference	Private/Military	657	reference
	NH Black	109	1.14 (0.92, 1.42)	Higher-middle	204	1.21 (0.99, 1.48)	**Public/Uninsured**	**485**	**1.47 (1.29, 1.68)**
	Hispanic	480	1.05 (0.91, 1.21)	**Middle**	**251**	**1.21 (1.00, 1.47)**	Unknown	52	1.28 (0.95, 1.71)
	NH Asian/PI	140	1.14 (0.94, 1.38)	Lower-middle	263	1.14 (0.94, 1.39)			
	Other	12	0.83 (0.46, 1.49)	**Lowest**	**290**	**1.27 (1.04, 1.55)**			
Colorectal	NH White	517	reference	Highest	177	reference	Private/Military	753	reference
	NH Black	105	1.09 (0.88, 1.35)	**Higher-middle**	**262**	**1.43 (1.18, 1.73)**	**Public/Uninsured**	**486**	**1.29 (1.13, 1.46)**
	Hispanic	441	0.89 (0.77, 1.02)	**Middle**	**259**	**1.46 (1.20, 1.77)**	Unknown	47	0.93 (0.69, 1.26)
	NH Asian/PI	210	1.09 (0.93, 1.28)	**Lower-middle**	**272**	**1.65 (1.35, 2.01)**			
	Other	13	0.90 (0.51, 1.56)	**Lowest**	**316**	**1.88 (1.54, 2.30)**			
Central nervous system	NH White	572	reference	Highest	221	reference	Private/Military	680	reference

Cancer site or type[3]	Race/ethnicity			Neighborhood SES[2] quintile			Insurance type		
		Deaths	HR[2] (95% CI[2])		Deaths	HR (95% CI)		Deaths	HR (95% CI)
	NH Black	55	1.11 (0.83, 1.47)	Higher-middle	250	1.01 (0.84, 1.21)	**Public/Uninsured**	**405**	**1.37 (1.20, 1.57)**
	Hispanic	378	1.10 (0.95, 1.27)	Middle	222	0.95 (0.79, 1.15)	**Unknown**	**47**	**1.39 (1.03, 1.88)**
	NH Asian/PI	117	1.20 (0.99, 1.47)	Lower-middle	230	1.09 (0.90, 1.33)			
	Other	10	0.70 (0.37, 1.30)	Lowest	209	1.11 (0.90, 1.37)			
Ovary	NH White	135	reference	Highest	63	reference	Private/Military	231	reference
	NH Black	30	1.49 (0.99, 2.24)	Higher-middle	61	0.90 (0.63, 1.29)	**Public/Uninsured**	115	0.97 (0.76, 1.24)
	Hispanic	132	0.99 (0.76, 1.28)	Middle	75	1.05 (0.74, 1.48)	Unknown	13	0.99 (0.54, 1.80)
	NH Asian/PI	61	1.16 (0.85, 1.57)	Lower-middle	83	0.95 (0.68, 1.34)			
	Other	~	~	Lowest	77	1.13 (0.78, 1.63)			

[1] Excluding patients with non-Hodgkin lymphoma or Kaposi sarcoma who also have HIV or died of AIDS

[2] HR, hazard ratio; CI, confidence interval; SES, socioeconomic status; NH, non-Hispanic; PI, Pacific Islander

[3] Separate models are presented for each cancer site. All models include stage at diagnosis as a stratifying variable and are adjusted for race/ethnicity, neighborhood SES quintile, insurance type, marital status, year of diagnosis, and sex.

[4] Bold type indicates statistical significance.

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Table 3

Frequency of deaths and hazard ratios (95% confidence intervals) from Cox proportional hazards regression models of overall survival of adolescents and young adults 15–39 years of age diagnosed with invasive cancer[1] by age group and insurance type[2], California 2001–2011

Insurance type[3]	15–24 Private Deaths	15–24 Private HR[4] (95% CI[4])	15–24 Public/Uninsured Deaths	15–24 Public/Uninsured HR (95% CI)	25–34 Private Deaths	25–34 Private HR (95% CI)	25–34 Public/Uninsured Deaths	25–34 Public/Uninsured HR (95% CI)	35–39 Private Deaths	35–39 Private HR (95% CI)	35–39 Public/Uninsured Deaths	35–39 Public/Uninsured HR (95% CI)
Race/ethnicity												
NH[4] White	616	reference	243	reference	1371	reference	641	reference	1883	reference	754	reference
NH Black	78	1.30 (1.02, 1.66)	104	1.49 (1.18, 1.88)	213	1.56 (1.35, 1.81)	244	1.31 (1.13, 1.52)	278	1.28 (1.12, 1.45)	277	1.14 (0.99, 1.31)
Hispanic	438	1.23 (1.08, 1.41)	742	1.16 (0.99, 1.35)	988	1.26 (1.16, 1.38)	1195	1.03 (0.93, 1.14)	948	1.03 (0.95, 1.12)	999	0.84 (0.76, 0.93)
NH Asian/PI[4]	168	1.36 (1.15, 1.62)	106	1.36 (1.08, 1.71)	508	1.41 (1.27, 1.56)	221	1.14 (0.98, 1.33)	613	1.19 (1.08, 1.30)	220	1.02 (0.87, 1.18)
Other	14	0.64 (0.38, 1.09)	8	0.71 (0.35, 1.43)	24	0.58 (0.38, 0.86)	25	0.78 (0.52, 1.17)	38	0.77 (0.56, 1.06)	24	0.98 (0.65, 1.47)
Neighborhood SES quintile[4]												
Highest	262	reference	74	reference	614	reference	151	reference	832	reference	169	reference
Higher-middle	286	1.15 (0.97, 1.36)	142	1.01 (0.76, 1.34)	702	1.04 (0.93, 1.16)	309	1.03 (0.85, 1.25)	887	1.19 (1.09, 1.31)	266	1.04 (0.86, 1.26)
Middle	285	1.21 (1.02, 1.43)	213	0.93 (0.71, 1.21)	677	1.16 (1.04, 1.30)	405	1.03 (0.85, 1.24)	814	1.33 (1.21, 1.47)	418	1.06 (0.89, 1.27)
Lower-middle	259	1.32 (1.11, 1.58)	290	0.88 (0.68, 1.14)	609	1.20 (1.07, 1.34)	633	1.23 (1.03, 1.47)	713	1.49 (1.35, 1.66)	550	1.13 (0.95, 1.34)
Lowest	222	1.43 (1.18, 1.73)	484	1.06 (0.82, 1.36)	502	1.41 (1.25, 1.60)	828	1.14 (0.95, 1.36)	514	1.71 (1.52, 1.92)	871	1.33 (1.12, 1.58)

[1] Excluding patients with non-Hodgkin's lymphoma and Kaposi sarcoma who also have HIV or died of AIDS

[2] Due to low numbers of cases in stratified cells, results for patients with 'unknown' insurance type were excluded from this presentation.

[3] Separate models are presented for age groups. Each model contains stage at diagnosis as a stratifying variable, is adjusted for race/ethnicity, neighborhood SES quintile, insurance, marital status, year of diagnosis, and sex; and includes interaction terms for insurance type with race/ethnicity and neighborhood SES quintile.

[3] For AYAs 15–24 years of age, the p-value for the interaction of insurance type and race/ethnicity was p=0.35 and of insurance type and neighborhood SES quintile was p=0.12. For AYAs 25–34 years of age, the p-value for the interaction of insurance type and race/ethnicity was p=0.01 and of insurance type and neighborhood SES quintile was p=0.04. For AYAs 35–39 years of age, the p-value for the interaction of insurance type and race/ethnicity was p<0.001 and of insurance type and neighborhood SES was p=0.20.

[4] HR, hazard ration; CI, confidence interval; SES, socioeconomic status; NH, non-Hispanic; PI, Pacific Islander