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ARTICLE

Impact of Health Insurance on Stage at Cancer Diagnosis Among Adolescents and Young Adults

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Abstract

Background: Uninsured adolescents and young adults (AYAs) and those with publicly funded health insurance are more likely to be diagnosed with cancer at later stages. However, prior population-based studies have not distinguished between AYAs who were continuously uninsured from those who gained Medicaid coverage at the time of cancer diagnosis.
Methods: AYA patients (ages 15–39 years) with nine common cancers diagnosed from 2005 to 2014 were identified using California Cancer Registry data. This cohort was linked to California Medicaid enrollment files to determine continuous enrollment, discontinuous enrollment, or enrollment at diagnosis, with other types of insurance determined from registry data. Multivariable logistic regression was used to evaluate factors associated with later stages at diagnosis.
Results: The majority of 52 774 AYA cancer patients had private or military insurance (67.6%), followed by continuous Medicaid (12.4%), Medicaid at diagnosis (8.5%), discontinuous Medicaid (3.9%), other public insurance (1.6%), no insurance (2.9%), or unknown insurance (3.1%). Of the 13 069 with Medicaid insurance, 50.1% were continuously enrolled. Compared to those who were privately insured, AYAs who enrolled in Medicaid at diagnosis were 2.2–2.5 times more likely to be diagnosed with later stage disease, whereas AYAs discontinuously enrolled were 1.7–1.9 times and AYAs continuously enrolled were 1.4–1.5 times more likely to be diagnosed with later stage disease. Males, those residing in lower socioeconomic neighborhoods, and AYAs of Hispanic or black race and ethnicity (vs non-Hispanic white) were more likely to be diagnosed at a later stage, independent of insurance.
Conclusions: Our findings suggest that access to continuous medical insurance is important for decreasing the likelihood of late stage cancer diagnosis.

Cancer incidence in adolescents and young adults (AYAs: ages 15–39 years) is increasing, and it is the leading cause of nonaccidental deaths in this age group (1,2). Although survival has substantially improved for pediatric and older cancer patients, less improvement has occurred among AYAs (3,4). One factor contributing to less survival improvements is more limited access to health care, as AYAs have historically been the most highly uninsured group in the United States (3,5).

Nationally representative studies of AYA cancer patients have found that lacking insurance or having publicly funded health insurance at diagnosis or initial treatment are associated with being diagnosed at a later stage, being undertreated, and experiencing worse survival (6–8). However, these studies were unable to distinguish between those who were uninsured from those who became publicly insured through Medicaid at the time of cancer diagnosis. In many states, including California, Medicaid coverage is extended to eligible uninsured patients after a cancer diagnosis. Because those who were uninsured prior to diagnosis may not have had cancer screening and other nonemergent care (9), it is important to differentiate patients continuously enrolled in Medicaid from those who enroll at the time of cancer diagnosis. Indeed, among older adults with

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selected cancers, Medicaid enrollment at diagnosis (vs being enrolled at least six months prior to diagnosis) was associated with being diagnosed at more advanced stages, with fewer definitive operations, and with higher one-year mortality (9).

To date, no previous study has focused on how continuous vs newly gained Medicaid enrollment influences stage at diagnosis compared with privately insured AYAs to estimate the potential gap in access to care. Therefore, we linked Medi-Cal (ie, California's Medicaid program) enrollment files to California Cancer Registry (CCR) data for AYAs diagnosed with the most common cancers during 2005–2014 to examine the impact of prior health insurance on stage at diagnosis, after adjustment for other demographic and clinical variables known to be associated with stage at diagnosis.

Materials and Methods

Study Population

Patients eligible for the study were all persons who resided in California when diagnosed at age 15–39 years with a first primary, invasive, histologically confirmed cancer from March 1, 2005, through December 1, 2014 (to coincide with Medi-Cal enrollment data available from October 1, 2004, through December 1, 2014) and reported to the CCR. As done previously (10), we focused on nine common cancers in the US AYA population with stage defined by the American Joint Commission on Cancer (AJCC), sixth edition: female breast carcinoma, thyroid carcinoma, melanoma, testicular cancer, Hodgkin lymphoma (HL), non-Hodgkin lymphoma (NHL), colorectal cancer, cervical cancer, and ovarian cancer. The Surveillance, Epidemiology, and End Results (SEER) AYA recode, based on the AYA classification suggested by Barr et al. (11) and updated based on histology changes in the World Health Organization (*WHO*) *Classification of Tumours of Hematopoietic and Lymphoid Tissues*, was primarily used to determine histologic types of cancer. For those primary sites not individually designated in the AYA recode listing (testicular, ovarian, cervical, colorectal cancers), we utilized the SEER site recode (ICD-O-3/WHO 2008) (12).

From the CCR, which operates under a state cancer reporting law and comprises three National Cancer Institute (NCI) SEER registries, we obtained information routinely recorded in the medical record at diagnosis for each patient on age, sex, race and ethnicity, stage at diagnosis, marital status, health insurance, hospital providing initial care (NCI-designated cancer center or not), and census-block group of residence. A Deyo and Romano-adapted Charlson comorbidity index was obtained from the CCR (13). For comparison, stage at diagnosis was classified as both AJCC stage I vs II–IV and stage I–II vs III–IV. For sensitivity analyses, we classified AYAs with unknown stage into AJCC stage categories with similar five-year survival for each cancer type (14) and considered AJCC stage I vs stage II, III, and IV separately.

We used a multicomponent index of neighborhood socioeconomic status (SES) based on patients' residential census-block group at diagnosis. The index is derived from data from the 2000 US Census and the 2006–2010 American Community Survey on education, occupation, unemployment, household income, poverty, rent, and house values (15) and is grouped into quintiles based on the distribution of SES across all census-block groups in California. Rural/urban designations are based on Medical Service Study Area from the 2000 and 2010 US Census.

Using a deterministic strategy, the California Department of Health Care Services linked CCR data to monthly Medi-Cal enrollment files, with linkage methods reported previously (9). Health insurance, defined as the primary source of payment at diagnosis or initial treatment, is routinely abstracted from the CCR. For this study, we utilized primary health insurance information from the earliest record in the CCR. Focusing on enrollment six months prior to and six months after diagnosis, linkage to the Medi-Cal enrollment files allowed for the mutually exclusive classification of 1) continuous enrollees, defined as enrolled five or six months prior to diagnosis; 2) Medicaid at diagnosis, defined as coverage beginning in the month prior to or within two months after diagnosis to account for reactive enrollment; and 3) discontinuous Medicaid coverage, defined as enrollment that does not meet the definitions for continuous enrollees or Medicaid at diagnosis or Medicaid insurance recorded in the CCR but without a match in the Medi-Cal enrollment files (1% of patients in this category) (Supplementary Figure 1, available online). From the CCR, we additionally classified AYAs into other public insurance (Medicare, Indian/Public Health Service, county-funded not otherwise specified), privately insured (health maintenance organizations, preferred provider organizations, managed care not otherwise specified, and Department of Defense [Tricare, military treatment facilities]), uninsured, and other and unknown.

The final study population included 52 774 AYA cancer patients after exclusion of 373 patients reported by Veterans Affairs medical centers (Supplementary Figure 1, available online). These analyses were performed under a research protocol approved by the California's Health and Human Services Agency Committee for the Protection of Human Subjects.

Statistical Analyses

The outcome of interest was later stage at diagnosis, defined as AJCC stage II–IV and III–IV. To evaluate associations with later stage at diagnosis, we used multivariable logistic regression to estimate odds ratios (ORs) and associated 95% confidence intervals (CIs). Models were built for all patients and those with Medicaid insurance only and included variables with a priori reasons for inclusion (eg, age, race and ethnicity, gender, year of diagnosis, marital status, facility type, neighborhood SES and urban/rural residence, and health insurance type). Multicollinearity in our models was assessed by examining variation inflation factors (VIF). All models met our criteria of non-multicollinearity with VIF less than 10. Effect modification was assessed between health insurance, cancer type, and year of diagnosis by including interaction terms in the multivariable models. As effect modification was evident by cancer type, but not year of diagnosis, separate logistic regression models were conducted by cancer type. The main analyses excluded patients with missing stage at diagnosis (n = 2739). Regression analyses were conducted using SAS version 9.4 software, SAS Institute Inc., Cary, NC. All statistical tests were two-sided, and 95% confidence intervals that did not cross 1.00 were considered statistically significant.

Results

The majority of the 52 774 AYA cancer patients had private or military insurance (67.6%) followed by continuous Medicaid (12.4%), Medicaid at diagnosis (8.5%), discontinuous Medicaid (3.9%), no insurance (2.9%) or unknown insurance (3.1%), and

other public insurance (1.6%). Of the 13 069 with Medicaid insurance, 50.1% were continuously enrolled. Sociodemographic and clinical characteristics of AYA patients varied by type of health insurance, with a higher proportion of non-Hispanic whites and Asian/Pacific Islanders with private or military insurance and higher proportions of blacks and Hispanics with Medicaid insurance (Table 1). AYAs with private or military health insurance were more likely to reside in the highest two categories of neighborhood SES and be diagnosed with stage I–II disease than AYAs with other types of insurance. AYAs who remained uninsured were more likely to be male, diagnosed with cancer from 2005 to 2009, and diagnosed with stage I–II disease than those who obtained Medicaid insurance at diagnosis.

In multivariable models of all cancers combined, health insurance type was statistically significantly associated with later stage at cancer diagnosis (Table 2). Compared to AYAs with private health insurance, AYAs who gained Medicaid coverage at diagnosis were 2.2–2.5 times more likely to be diagnosed at a later stage (stage II–IV vs I: OR = 2.46, 95% CI = 2.26 to 2.69; III–IV vs I–II: OR = 2.16, 95% CI = 2.00 to 2.33), whereas AYAs with discontinuous Medicaid were 1.7–1.9 times more likely to be diagnosed at a later stage (stage II–IV vs I: OR = 1.93, 95% CI = 1.70 to 2.18; III–IV vs I–II: OR = 1.74, 95% CI = 1.56 to 1.95). AYAs with continuous Medicaid insurance were 1.4–1.5 times more likely and AYAs with no insurance were 1.2 times more likely to be diagnosed at a later stage. Associations between health insurance and stage at diagnosis were similar in models that imputed unknown stage at diagnosis (Supplementary Table 1, available online), and associations with health insurance were stronger with each level of AJCC stage (Supplementary Table 2, available online).

Blacks and Hispanics (vs non-Hispanic whites) had higher odds of later stage at diagnosis (Table 2). In contrast, Asian/Pacific Islanders and American Indian/Alaskan were not more likely than non-Hispanic whites to be diagnosed with later stage disease. AYAs with comorbidities or residing in the lowest three categories of neighborhood SES were more likely to be diagnosed with later stage disease. On the other hand, females and those diagnosed in 2010–2014 were less likely to be diagnosed with later stage disease.

In analyses limited to AYAs with Medicaid insurance (Supplementary Table 3, available online), those who gained Medicaid coverage at diagnosis were approximately 1.5–1.6 times more likely to be diagnosed at a later stage than those continuously enrolled in Medicaid (stage II–IV vs I: OR = 1.63, 95% CI = 1.47 to 1.81; III–IV vs I–II: OR = 1.49, 95% CI = 1.36 to 1.64). AYAs with discontinuous (vs continuous) Medicaid also were more likely to be diagnosed at a later stage (stage II–IV vs I: OR = 1.28, 95% CI = 1.12 to 1.46; III–IV vs I–II: OR = 1.20, 95% CI = 1.06 to 1.36). Associations between other factors and stage at diagnosis in AYAs with Medicaid insurance were similar to the model with AYAs with all types of health insurance, with the exception that associations among Hispanics and by neighborhood SES were less pronounced.

In multivariable models by cancer type, Medicaid at diagnosis was associated with later stage at diagnosis across all nine cancers considered (Table 3). Discontinuous Medicaid was associated with later stage at diagnosis for all cancer sites, except for thyroid cancer where there was a borderline association. In addition, compared to AYAs who were privately insured, AYAs without insurance or with continuous Medicaid also had a higher odds of later stage at diagnosis that varied somewhat by cancer site. In particular, being uninsured was associated with later stage at diagnosis for AYAs diagnosed with HL and cervical cancer, and continuous Medicaid enrollment was associated with later stage at diagnosis for AYAs diagnosed with breast cancer, melanoma, testicular cancer, NHL, cervical cancer, and ovarian cancer. Associations were similar in models that imputed unknown stage at diagnosis (Supplementary Table 4, available online).

Discussion

In this population-based study of more than 52 000 AYAs diagnosed with nine common invasive cancers, those enrolled in Medicaid were more likely to be diagnosed at a later stage than AYAs with private health insurance. The duration and continuity of Medicaid enrollment influenced these associations, with AYAs who enrolled at diagnosis more than 2.0 times, AYAs intermittently enrolled 1.7 to 1.9 times, and AYAs continuously enrolled 1.4–1.5 times more likely to have later stage disease than those with private insurance. Among those insured by Medicaid, we observed that only half were continuously insured prior to diagnosis, with those discontinuously insured or insured at diagnosis 1.2 to 1.6 times more likely to be diagnosed at a later stage than AYAs who were continuously insured. Those who remained uninsured were approximately 1.2 times more likely to be diagnosed at a later stage than those with private insurance. Sociodemographic factors, including sex, race and ethnicity, and neighborhood SES, were also independently associated with later stage at diagnosis. Overall, our study suggests that lacking continuous health insurance (as demonstrated by variations in Medicaid access) hinders the early detection of cancer.

In our study, obtaining Medicaid at diagnosis, which was consistently associated with a later stage at diagnosis for all cancers considered in this study, or being intermittently enrolled in Medicaid were the most strongly associated with later stage at diagnosis among AYAs. As cancer screening is not recommended for most cancer sites in AYAs, except cervical cancer, identifying cancer early through symptom evaluation and physical examination, the main strategies used in the AYA population (7), requires regular contact with the health care system, something less likely to occur among those without insurance. Further, AYAs commonly present to their primary care provider or emergency department with nonspecific symptoms, often being dismissed as being too young or unlikely to have a cancer diagnosis, which could lead to delays in diagnoses, particularly among the uninsured or underinsured population (16–18). However, AYAs who were continuously insured with Medicaid still had a higher likelihood of later stage at diagnosis for many of the cancers considered in our study, highlighting that other factors (eg, access to paid sick leave, reliable transportation) may influence accessing medical care in this population. Although studies have documented improvements in usual source of care and lower financial barriers to care among the Medicaid (vs uninsured) population, narrow networks or high out-of-pocket costs have been cited as barriers to accessing care for those with Medicaid insurance and should continue to be a focus of future studies (19–21).

Our study expands on prior studies in AYAs that have found that public or no insurance is associated with later stage at diagnosis (6–8,22) by considering Medicaid enrollment prior to diagnosis. Our findings of less pronounced associations with later stage among the uninsured compared to those who obtain Medicaid at diagnosis may reflect Medicaid enrollment at diagnosis being more common among those with advanced stage

Table 1. Demographic and clinical characteristics of adolescents and young adults diagnosed with nine common cancers, by type of health insurance, 2005–2014, California

Characteristic	Total n = 52 774 No.(%)	Private or military n = 35 682 No.(%)	Continuous Medicaid n = 6546 No.(%)	Medicaid at diagnosis n = 4473 No.(%)	Discontinuous Medicaid n = 2050 No.(%)	Other public n = 870 No.(%)	Uninsured n = 1537 No.(%)	Unknown n = 1616 No.(%)
Age, y								
15–19	2899 (5.5)	1640 (4.6)	768 (11.7)	264 (5.9)	113 (5.5)	26 (3.0)	33 (2.2)	55 (3.4)
20–24	6138 (11.6)	3902 (10.9)	654 (10.0)	594 (13.3)	303 (14.8)	167 (19.2)	301 (19.6)	217 (13.4)
25–29	9623 (18.2)	6231 (17.5)	1125 (17.2)	901 (20.1)	424 (20.7)	196 (22.5)	402 (26.1)	344 (21.3)
30–34	13 940 (26.4)	9577 (26.8)	1705 (26.1)	1096 (24.5)	547 (26.7)	215 (24.7)	361 (23.5)	439 (27.2)
35–39	2174 (38.2)	14 332 (40.2)	2294 (35.0)	1618 (36.2)	663 (32.3)	266 (30.6)	440 (28.6)	561 (34.7)
Sex								
Male	18 364 (34.8)	11 994 (33.6)	1690 (25.8)	1816 (40.6)	785 (38.3)	505 (58.1)	860 (55.9)	714 (44.2)
Female	34 410 (65.2)	23 688 (66.4)	4856 (74.2)	2657 (59.4)	1265 (61.7)	365 (41.9)	677 (44.1)	902 (55.8)
Year of diagnosis								
Mar 2005–Dec 2009	25 337 (48.0)	17 620 (49.4)	2663 (40.7)	1962 (43.9)	912 (44.5)	434 (49.9)	860 (55.9)	886 (54.8)
Jan 2010–Dec 2014	27 437 (52.0)	18 062 (50.6)	3883 (59.3)	2511 (56.1)	1138 (55.5)	436 (50.1)	677 (44.1)	730 (45.2)
Comorbidity								
0	34 821 (66.0)	25 291 (70.9)	3949 (60.3)	2903 (64.9)	988 (48.2)	464 (53.3)	806 (52.4)	420 (25.9)
1	4009 (7.6)	2566 (7.2)	782 (11.9)	349 (7.8)	129 (6.3)	75 (8.6)	78 (5.1)	30 (1.9)
>1	763 (1.4)	338 (1.0)	281 (4.3)	83 (1.9)	29 (1.4)	15 (1.7)	9 (0.6)	8 (0.5)
Missing	13 181 (25.0)	7487 (20.9)	1534 (23.4)	1138 (25.4)	904 (44.1)	316 (36.3)	644 (41.9)	1158 (71.7)
Marital status								
Married	23 210 (44.0)	18 266 (51.2)	2076 (31.7)	1317 (29.4)	673 (32.8)	194 (22.3)	414 (26.9)	270 (16.7)
Not married	26 133 (49.5)	15 607 (43.7)	4214 (64.4)	3000 (67.1)	1318 (64.3)	624 (71.7)	1043 (67.9)	327 (20.2)
Unknown	3431 (6.5)	1809 (5.1)	256 (3.9)	156 (3.5)	59 (2.9)	52 (6.0)	80 (5.2)	1019 (63.1)
Facility type								
NCI-designated	1785 (20.4)	6557 (18.4)	1499 (22.9)	1407 (31.5)	603 (29.4)	265 (30.5)	313 (20.4)	141 (8.7)
Non NCI-designated	41 989 (79.6)	29 125 (81.6)	5047 (77.1)	3066 (68.5)	1447 (70.6)	605 (69.5)	1224 (79.6)	1475 (91.3)
Race and ethnicity								
Non-Hispanic white	24 714 (46.8)	19 607 (55.0)	1762 (26.9)	1382 (30.9)	488 (23.8)	294 (33.8)	551 (35.9)	630 (39.0)
Non-Hispanic black	2457 (4.7)	1299 (3.6)	667 (10.2)	242 (5.4)	121 (5.9)	41 (4.7)	65 (4.2)	22 (1.4)
Hispanic	17 592 (33.3)	8902 (24.9)	3476 (53.1)	2381 (53.2)	1257 (61.3)	434 (49.9)	772 (50.2)	370 (22.9)
Asian/Pacific Islander	6337 (12.0)	5017 (14.1)	497 (7.6)	407 (9.1)	158 (7.7)	79 (9.1)	117 (7.6)	62 (3.8)
American Indian/Alaskan Native	331 (0.6)	188 (0.5)	65 (1.0)	39 (0.9)	14 (0.7)	11 (1.3)	8 (0.5)	6 (0.4)
Other/Unknown	1343 (2.5)	669 (1.9)	79 (1.2)	22 (0.5)	12 (0.6)	11 (1.3)	24 (1.6)	526 (32.5)
Urban/Rural residence								
Rural	5895 (11.2)	3514 (9.9)	1003 (15.3)	648 (14.5)	280 (13.7)	112 (12.9)	143 (9.3)	195 (12.1)
Urban	46 879 (88.8)	32 168 (90.1)	5543 (84.7)	3825 (85.5)	1770 (86.3)	758 (87.1)	1394 (90.7)	1421 (87.9)
Neighborhood socioeconomic status (quintiles)								
5 (highest)	11 417 (21.6)	9817 (27.5)	368 (5.6)	385 (8.6)	155 (7.5)	89 (10.2)	211 (13.7)	392 (24.3)
4	11 865 (22.5)	9402 (26.4)	771 (11.8)	669 (15.0)	270 (13.2)	131 (15.1)	237 (15.4)	385 (23.8)
3	1790 (20.4)	7471 (20.9)	1144 (17.5)	911 (20.3)	412 (20.1)	196 (22.5)	316 (20.6)	340 (21.0)
2	9849 (18.7)	5593 (15.7)	1811 (27.7)	1140 (25.5)	488 (23.8)	218 (25.1)	331 (21.5)	268 (16.6)
1 (lowest)	8853 (16.8)	3399 (9.5)	2452 (37.5)	1368 (30.6)	725 (35.4)	236 (27.1)	442 (28.8)	231 (14.3)

(continued)

Table 1. (continued)

Characteristic	Total n = 52 774 No.(%)	Private or military n = 35 682 No.(%)	Continuous Medicaid n = 6546 No.(%)	Medicaid at diagnosis n = 4473 No.(%)	Discontinuous Medicaid n = 2050 No.(%)	Other public n = 870 No.(%)	Uninsured n = 1537 No.(%)	Unknown n = 1616 No.(%)
Cancer type								
Breast	1608 (20.1)	7316 (20.5)	1355 (20.7)	1220 (27.3)	416 (20.3)	80 (9.2)	138 (9.0)	83 (5.1)
Thyroid	1782 (20.4)	8335 (23.4)	1487 (22.7)	244 (5.5)	251 (12.2)	132 (15.2)	194 (12.6)	139 (8.6)
Melanoma	6665 (12.6)	5071 (14.2)	311 (4.7)	166 (3.7)	86 (4.2)	70 (8.0)	181 (11.8)	780 (48.3)
Testicular	7200 (13.6)	4457 (12.5)	722 (11.0)	770 (17.2)	349 (17.0)	239 (27.5)	466 (30.3)	197 (12.2)
Non-Hodgkin lymphoma	4435 (8.4)	2683 (7.5)	573 (8.8)	556 (12.4)	246 (12.0)	86 (9.9)	129 (8.4)	162 (10.0)
Hodgkin lymphoma	4161 (7.9)	2730 (7.7)	472 (7.2)	413 (9.2)	179 (8.7)	109 (12.5)	160 (10.4)	98 (6.1)
Cervical	3584 (6.8)	1796 (5.0)	836 (12.8)	470 (10.5)	284 (13.9)	48 (5.5)	70 (4.6)	80 (4.9)
Colorectal	3638 (6.9)	2281 (6.4)	516 (7.9)	442 (9.9)	153 (7.5)	66 (7.6)	122 (7.9)	58 (3.6)
Ovarian	1701 (3.2)	1013 (2.8)	274 (4.2)	192 (4.3)	86 (4.2)	40 (4.6)	77 (5.0)	19 (1.2)
Stage at diagnosis*								
I	28 455 (53.9)	21 020 (58.9)	3130 (47.8)	1288 (28.8)	785 (38.3)	466 (53.6)	792 (51.5)	974 (60.3)
II	9965 (18.9)	6716 (18.8)	1240 (18.9)	1093 (24.4)	427 (20.8)	135 (15.5)	262 (17.1)	92 (5.7)
III	7308 (13.8)	4249 (11.9)	1103 (16.9)	1125 (25.2)	406 (19.8)	139 (16.0)	230 (15.0)	56 (3.5)
IV	4307 (8.2)	2272 (6.4)	682 (10.4)	817 (18.3)	271 (13.2)	80 (9.2)	131 (8.5)	54 (3.3)
Unknown	2739 (5.2)	1425 (4.0)	391 (6.0)	150 (3.4)	161 (7.9)	50 (5.7)	122 (7.9)	440 (27.2)

*Stage was defined as American Joint Commission on Cancer (AJCC) stage. NCI = National Cancer Institute.

disease, as found previously (7,8). Although ours is the first study to focus on AYAs (to our knowledge), our results are consistent with studies that have considered the timing of Medicaid enrollment in primarily older adult populations (9,23–27). Continuous Medicaid enrollment also was found to provide a survival benefit among older adults with colon, esophageal, ovarian, pancreatic, stomach, or lung cancer, with the observed benefit primarily mediated through earlier stage at diagnosis (9), underscoring the importance of detecting cancers early.

Our findings of a later stage of diagnosis being independently associated with male sex, lower neighborhood SES, and Hispanic or black race and ethnicity are consistent with prior studies (6,27,28). As recently reported (29), we also observed that American Indian/Alaskan Natives were not more likely than non-Hispanic whites to be diagnosed with later stage disease. Although health insurance is an important barrier to receiving timely health care, our findings highlight that other social, cultural, and economic barriers (30–35) impact seeking care that can result in worse cancer survival, as we have observed previously (10).

The percentage of AYAs who remained uninsured and the likelihood of being diagnosed at a later stage was lower in the more recent time period, after the implementation of the dependent coverage expansion of the Patient Protection and Affordable Care Act (ACA), which required insurers to allow children to remain on their parent's insurance plans until the age of 26 years, and the early expansion of Medicaid to low-income adults in California (36). Our results are consistent with prior studies finding increased insurance rates (37,38) and a shift toward early stage disease (39,40) in adults less than 26 years of age. Although not specifically focused on AYAs, recent data after the full implementation of the ACA found a small shift toward the diagnosis of stage I disease in 18- to 64-year-olds from 2011 to 2013 to the fourth quarter of 2014 (41), highlighting the likely positive effects of the ACA provisions on health outcomes and the importance of continuous health insurance. Despite the benefits of the ACA, it also has created challenges (eg, more restrictive access to in-network oncologists, altering prescription drug formularies) that could negatively impact outcomes for vulnerable populations, including AYAs with cancer (21). Although our study did not distinguish between traditional Medicaid enrollees and those gaining coverage under Medicaid expansion, we acknowledge this important area of future research on the ACA's impact.

Our study has some limitations. Although the linkages between Medicaid and the CCR have been used previously (9), the matching process is subject to some uncertainty, potentially resulting in an underestimation of the impact of health insurance on stage at diagnosis. The study also relied on health insurance information from the CCR. Further, our study lacked data on factors, besides insurance, that could impact obtaining timely health care, such as health or cultural beliefs, financial or geographic barriers, or availability of care. Despite these limitations, this study was population-based and included a large diverse population of AYA cancer patients who received their care across all types of institutions, increasing the generalizability of these findings. In addition, our findings were robust across multiple definitions of late stage disease and cancer types. Lastly, our study is one of the first to differentiate continuous Medicaid enrollment from discontinuous enrollment and enrollment at cancer diagnosis among common cancers in young adults, a historically highly uninsured population [with uninsured rates ranging from 28% to 31% in 2008 (42)],

Table 2. Multivariable adjusted odds ratio (OR) and 95% confidence interval (CI) estimates for characteristics associated with later stage at cancer diagnosis among adolescents and young adults with nine common cancers, 2005–2014, California (N = 50 035)*

Characteristics	No.	Stage II–IV (vs I) OR (95% CI)	Stage III–IV (vs I–II) OR (95% CI)
Age at diagnosis, y			
15–19	2784	Reference	Reference
20–24	5799	0.99 (0.88 to 1.13)	1.05 (0.93 to 1.18)
25–29	9089	0.94 (0.83 to 1.06)	1.02 (0.91 to 1.15)
30–34	13 212	0.93 (0.83 to 1.05)	1.01 (0.90 to 1.13)
35–39	19 151	0.96 (0.85 to 1.08)	0.99 (0.89 to 1.11)
Sex			
Male	17 252	Reference	Reference
Female	32 783	0.74 (0.68 to 0.79)	0.69 (0.65 to 0.74)
Year of diagnosis			
Mar 2005–Dec 2009	23 708	Reference	Reference
Jan 2010–Dec 2014	26 327	0.96 (0.91 to 1.00)	0.98 (0.93 to 1.02)
Comorbidity			
0	33 492	Reference	Reference
1	3858	1.21 (1.11 to 1.33)	1.17 (1.07 to 1.28)
>1	718	1.78 (1.44 to 2.20)	2.25 (1.87 to 2.70)
Missing	11 967	0.75 (0.71 to 0.80)	0.77 (0.72 to 0.82)
Marital status			
Married	22 256	Reference	Reference
Not married	24 888	1.06 (1.00 to 1.11)	1.02 (0.97 to 1.08)
Unknown	2891	0.74 (0.66 to 0.84)	0.66 (0.58 to 0.75)
Facility type			
NCI-designated	10 475	Reference	Reference
Non NCI-designated	39 560	0.62 (0.58 to 0.65)	0.66 (0.63 to 0.70)
Race and ethnicity			
Non-Hispanic white	23 564	Reference	Reference
Non-Hispanic black	2318	1.32 (1.17 to 1.48)	1.38 (1.24 to 1.53)
Hispanic	16 677	1.23 (1.16 to 1.30)	1.12 (1.06 to 1.19)
Asian/Pacific Islander	6079	1.03 (0.95 to 1.11)	0.97 (0.90 to 1.05)
American Indian/Alaskan Native	315	0.96 (0.72 to 1.29)	0.91 (0.68 to 1.23)
Other/Unknown	1082	0.39 (0.31 to 0.48)	0.36 (0.27 to 0.48)
Urban/Rural residence			
Urban	44 446	Reference	Reference
Rural	5589	1.00 (0.93 to 1.08)	0.97 (0.90 to 1.05)
Neighborhood socioeconomic status (quintiles)			
5 (highest)	8298	Reference	Reference
4	9325	1.11 (1.03 to 1.19)	1.07 (0.99 to 1.15)
3	10 250	1.29 (1.19 to 1.39)	1.20 (1.11 to 1.29)
2	11 294	1.32 (1.22 to 1.43)	1.29 (1.20 to 1.40)
1 (lowest)	10 868	1.38 (1.27 to 1.51)	1.40 (1.29 to 1.52)
Health insurance			
Private or military	34 257	Reference	Reference
Continuous Medicaid	6155	1.49 (1.37 to 1.61)	1.41 (1.31 to 1.52)
Discontinuous Medicaid	1889	1.93 (1.70 to 2.18)	1.74 (1.56 to 1.95)
Medicaid at diagnosis	4323	2.46 (2.26 to 2.69)	2.16 (2.00 to 2.33)
Other public	820	0.98 (0.82 to 1.18)	1.18 (0.99 to 1.41)
Uninsured	1415	1.24 (1.08 to 1.42)	1.24 (1.08 to 1.43)
Unknown	1176	0.63 (0.51 to 0.76)	0.78 (0.62 to 0.98)

*Adjusted for all variables in the table and cancer type. NCI = National Cancer Institute.

who comprise a large proportion of the Medicaid population in California [41% of 19- to 44-year-olds in 2013 (43)].

Overall, our findings suggest that access to continuous medical insurance and care is important for decreasing the likelihood of late stage cancer diagnosis; however, half of AYAs with Medicaid insurance did not have continuous enrollment at the time of our study. Taken together with recent studies demonstrating substantial declines in uninsured rates in Medicaid expansion states corresponding with shifts to earlier stage cancers (41), our findings emphasize the importance of strengthening the Health Insurance Marketplace and Medicaid expansion to increase continuous medical insurance coverage. In addition, strategies that target awareness about Medicaid eligibility, conduct outreach to vulnerable populations, simplify the enrollment process, and educate about affordable plan selection (20) could positively impact access to health care in AYAs. Although lacking continuous health insurance is a substantial barrier to medical care, even with insurance, our

Table 3. Multivariable adjusted odds ratio (OR) and 95% confidence interval (CI) estimates for associations between health insurance type and stage at cancer diagnosis among adolescents and young adults, by cancer type, 2005–2014, California (N = 50 035)*

Health insurance type	No.	Stage II–IV (vs I) OR (95% CI)	Stage III–IV (vs I–II) OR (95% CI)
Breast	10 174		
Private or military	7097	Reference	Reference
Continuous Medicaid	1274	1.64 (1.39 to 1.93)	1.53 (1.33 to 1.76)
Discontinuous Medicaid	373	1.97 (1.45 to 2.68)	1.67 (1.33 to 2.10)
Medicaid at diagnosis	1178	1.80 (1.52 to 2.14)	1.77 (1.54 to 2.04)
Other public	73	1.45 (0.80 to 2.62)	2.09 (1.30 to 3.37)
Uninsured	124	1.25 (0.81 to 1.93)	1.44 (0.98 to 2.11)
Unknown	55	0.81 (0.45 to 1.48)	1.62 (0.90 to 2.93)
Thyroid	10 648		
Private or military	8245	Reference	Reference
Continuous Medicaid	1472	1.32 (0.86 to 2.03)	0.62 (0.28 to 1.40)
Discontinuous Medicaid	247	1.66 (0.78 to 3.54)	2.58 (0.98 to 6.82)
Medicaid at diagnosis	241	2.42 (1.25 to 4.66)	2.98 (1.23 to 7.19)
Other public	131	1.32 (0.47 to 3.75)	1.38 (0.29 to 6.68)
Uninsured	192	1.33 (0.56 to 3.13)	1.51 (0.43 to 5.30)
Unknown	120	0.87 (0.21 to 3.68)	0.79 (0.06 to 10.25)
Melanoma	6062		
Private or military	4746	Reference	Reference
Continuous Medicaid	267	2.18 (1.63 to 2.91)	1.86 (1.33 to 2.60)
Discontinuous Medicaid	63	3.64 (2.10 to 6.31)	2.43 (1.35 to 4.37)
Medicaid at diagnosis	158	4.18 (2.92 to 5.99)	4.38 (3.03 to 6.32)
Other public	64	2.68 (1.55 to 4.63)	2.23 (1.22 to 4.08)
Uninsured	161	1.39 (0.92 to 2.10)	1.49 (0.92 to 2.43)
Unknown	603	0.60 (0.38 to 0.93)	0.40 (0.19 to 0.83)
Testicular	6803		
Private or military	4239	Reference	Reference
Continuous Medicaid	677	1.48 (1.23 to 1.79)	1.62 (1.30 to 2.03)
Discontinuous Medicaid	322	1.96 (1.53 to 2.50)	2.03 (1.54 to 2.68)
Medicaid at diagnosis	742	3.31 (2.78 to 3.93)	3.93 (3.26 to 4.75)
Other public	226	0.71 (0.51 to 1.00)	0.80 (0.52 to 1.21)
Uninsured	437	0.99 (0.78 to 1.25)	1.10 (0.83 to 1.46)
Unknown	160	0.77 (0.48 to 1.24)	0.59 (0.30 to 1.16)
Non-Hodgkin lymphoma	4109		
Private or military	2531	Reference	Reference
Continuous Medicaid	516	1.27 (1.01 to 1.59)	1.38 (1.12 to 1.71)
Discontinuous Medicaid	230	1.71 (1.24 to 2.35)	1.52 (1.14 to 2.03)
Medicaid at diagnosis	542	1.47 (1.18 to 1.83)	1.66 (1.35 to 2.02)
Other public	81	0.97 (0.60 to 1.55)	0.92 (0.58 to 1.47)
Uninsured	119	1.21 (0.81 to 1.81)	0.96 (0.65 to 1.42)
Unknown	90	1.08 (0.68 to 1.73)	1.35 (0.83 to 2.17)
Hodgkin lymphoma	3966		
Private or military	2622	Reference	Reference
Continuous Medicaid	447	0.94 (0.66 to 1.34)	1.17 (0.93 to 1.47)
Discontinuous Medicaid	172	1.33 (0.76 to 2.32)	1.66 (1.20 to 2.29)
Medicaid at diagnosis	403	1.74 (1.15 to 2.65)	1.67 (1.33 to 2.08)
Other public	109	0.77 (0.44 to 1.35)	1.47 (0.99 to 2.19)
Uninsured	155	2.52 (1.21 to 5.24)	1.35 (0.96 to 1.90)
Unknown	58	0.42 (0.22 to 0.80)	0.92 (0.52 to 1.63)
Cervical	3399		
Private or military	1736	Reference	Reference
Continuous Medicaid	791	1.56 (1.27 to 1.91)	1.42 (1.15 to 1.77)
Discontinuous Medicaid	264	1.96 (1.47 to 2.63)	1.71 (1.25 to 2.32)
Medicaid at diagnosis	457	2.98 (2.36 to 3.77)	2.39 (1.88 to 3.05)
Other public	42	1.30 (0.66 to 2.56)	1.26 (0.60 to 2.64)
Uninsured	60	2.44 (1.42 to 4.17)	1.45 (0.80 to 2.62)
Unknown	49	0.87 (0.35 to 2.16)	1.27 (0.51 to 3.20)
Colorectal	3320		
Private or military	2105	Reference	Reference
Continuous Medicaid	462	1.22 (0.90 to 1.64)	1.05 (0.84 to 1.32)
Discontinuous Medicaid	136	1.72 (1.00 to 2.97)	1.56 (1.06 to 2.31)

(continued)

Table 3. (continued)

Health insurance type	No.	Stage II–IV (vs I) OR (95% CI)	Stage III–IV (vs I–II) OR (95% CI)
Medicaid at diagnosis	424	3.75 (2.37 to 5.95)	1.95 (1.51 to 2.52)
Other public	58	1.19 (0.55 to 2.59)	1.12 (0.64 to 1.96)
Uninsured	108	1.12 (0.65 to 1.93)	1.07 (0.71 to 1.62)
Unknown	27	0.33 (0.14 to 0.79)	0.67 (0.29 to 1.53)
Ovarian	1554		
Private or military	936	Reference	Reference
Continuous Medicaid	249	1.45 (1.06 to 1.99)	1.49 (1.07 to 2.06)
Discontinuous Medicaid	82	1.77 (1.10 to 2.85)	1.75 (1.08 to 2.82)
Medicaid at diagnosis	178	2.69 (1.88 to 3.83)	2.51 (1.76 to 3.57)
Other public	36	0.48 (0.22 to 1.06)	0.54 (0.24 to 1.23)
Uninsured	59	1.37 (0.79 to 2.38)	1.65 (0.94 to 2.89)
Unknown	14	0.78 (0.24 to 2.54)	1.08 (0.33 to 3.54)

*Each cancer site considered separately and adjusted for age group, sex, comorbidity, marital status, facility type, race and ethnicity, urban/rural residence, neighborhood socioeconomic status, and year of diagnosis.

findings highlight that subgroups of AYAs, including males, those residing in lower SES neighborhoods, and blacks and Hispanics, continue to be diagnosed at a later stage. These findings suggest that social, cultural, and economic barriers in addition to health insurance may influence seeking and accessing medical care in this population and should be the focus of future research to reduce sociodemographic disparities in outcomes among AYAs with cancer.

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Notes

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