Original Article

# Insurance Status and Distant-Stage Disease at Diagnosis Among Adolescent and Young Adult Patients With Cancer Aged 15 to 39 Years: National Cancer Data Base, 2004 Through 2010

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**BACKGROUND:** The percentage of adolescent and young adult (AYA) patients with cancer (those aged 15-39 years) diagnosed at a distant stage of disease did not significantly change between 1975 and 2004. It has been hypothesized that a lack of health insurance may be a significant risk factor for a diagnosis of distant-stage disease among AYA patients, but to the authors' knowledge this has not been examined in a national sample. **METHODS:** The National Cancer Data Base, a hospital-based cancer registry, was used to obtain data regarding incident cancer cases among patients aged 15 years to 39 years who were diagnosed between 2004 and 2010. After all exclusions, a total of 285,448 cases were available for analysis; all AYA cancer sites were included. A retrospective study was conducted to assess the association between insurance status and stage of disease at diagnosis. **RESULTS:** After adjusting for age, race/ethnicity, facility type, ZIP code-based income and education levels, and US Census region, it was found that among males, uninsured patients were 1.51 times more likely to be diagnosed at a distant stage of disease compared with patients with private insurance (95% confidence interval, 1.46-1.55). Among females, the effect of insurance was stronger, with uninsured patients found to be 1.86 times more likely to be diagnosed at a distant stage (95% confidence interval, 1.79-1.94). The effect of insurance status was substantially stronger for malignancies that are more amenable to early detection (melanoma, thyroid carcinoma, breast carcinoma, genitourinary carcinoma), and substantially weaker for those that are less amenable to early detection (lung carcinoma, adrenocortical carcinoma, Wilms tumor). **CONCLUSIONS:** In a large national sample of AYA patients with cancer, insurance status was found to be a strong independent risk factor for distant-stage disease at the time of diagnosis. ***Cancer* 2014;120:1212–9.** © *2014 American Cancer Society.*

**KEYWORDS:** adolescents, young adults, health insurance, cancer disparities, health care reform.

## INTRODUCTION

Adolescent and young adult (AYA) patients with cancer, variously defined as those between the ages of 15 and 24 years, 29 years, or 39 years,[1] have benefitted the least from the War on Cancer initiated in 1971, as evidenced by comparative analyses of long-term trends in cancer surveillance data across age groups.[2-4] For example, using population-based cancer registry data gathered by the Surveillance, Epidemiology, and End Results (SEER) program of the National Cancer Institute (NCI), among AYA patients with cancer aged 15 to 39 years, there was no significant change noted with regard to the percentage of cases diagnosed at distant stage during the 30-year period between 1975 and 2004.[5] Stage at diagnosis has a profound effect on survival: SEER data from patients aged 15 to 39 years who were diagnosed in 2004 demonstrate that the 5-year survival rate was 93.3% for patients with disease of localized stage, 79.6% for those with disease of regional stage, and 47.1% for those with disease of distant stage.[5] Furthermore, between 1975 and 2004, the 5-year survival rate for patients with cancer aged birth to 14 years and residing in SEER regions increased approximately 46% in relative terms, whereas patients aged 15 to 29 years experienced only a 17% relative increase. Adults aged $\geq$ 30 years experienced a 34% relative increase.[5] Thus, the long-term survival gains experienced by AYA patients were either 63% smaller or 50% smaller than the gains noted in other age groups, depending on whether the comparisons are made with younger or older patients, respectively. Moreover, patients aged 15 to 25 years were the only age group aged $<$ 75 years that did not experience a statistically significant increase in survival over this 30-year period.[4]

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As noted by Bleyer et al, potential reasons for this lack of progress for AYA patients with cancer may include low rates of accrual to clinical trials and collection of biospecimens for translational research, inadequate training of health care professionals in AYA oncology, the distinctive distribution and biology of cancers in this age group, and the unique psychosocial and financial challenges faced by the AYA population, especially health insurance.[4] According to data from the US Census Bureau, individuals aged 19 to 25 years and 26 to 34 years were found to have the highest percentage of persons with no health insurance: in 2009: 31.4% and 28.1%, respectively, were uninsured.[6] These challenges contribute to delays in diagnosis and presentation with advanced disease.

Several studies have shown that race/ethnicity, sex, income, level of education, and geographic region are predictors of distant stage at the time of diagnosis.[7-9] The role of health insurance in the question of disease stage at diagnosis among AYA patients is less well understood. To our knowledge, there have been only 2 studies of insurance status and distant-stage cancer diagnosis in AYA patients, one of which was from a single institution[10] and the other from a state cancer registry.[7] Thus, we conducted a retrospective study to examine the relationship between insurance status and stage of disease at diagnosis among patients aged 15 to 39 years with cancer in a large national sample from the National Cancer Data Base (NCDB). In contrast with the 2 earlier studies, which included either 6 cancer sites or a single site, we included all AYA cancer sites for which staging was applicable.

## MATERIALS AND METHODS

Data from the NCDB, a hospital-based cancer registry jointly sponsored by the American Cancer Society and the Commission on Cancer (CoC) of the American College of Surgeons, were used for the current study. The NCDB captures nearly 70% of incident cancer cases in the United States, receiving data from $>1400$ facilities accredited by the CoC; all CoC-accredited facilities are required to collect and submit data to the NCDB. The NCDB does not contain patient identifiers but does contain standardized data elements regarding patient demographics (including primary payer at the time of diagnosis), tumor characteristics, first course of treatment, ZIP code-level measures of socioeconomic status, and facility-level factors. The current study was classified as exempt by the Morehouse University Institutional Review Board.

American Joint Committee on Cancer staging is not defined for a substantial percentage of AYA cases, whereas SEER summary stage (using the 2000 manual) is defined for all anatomic sites and classifies all cases as in situ, localized, regional, distant, or unknown stage. Thus, we chose to use the SEER staging system for the current study.

The current study consisted of 2 distinct analyses from 2 overlapping study populations. The first, a descriptive analysis, included all cancer sites including leukemia, benign/borderline brain tumors, and benign/borderline germ cell tumors. Because of the difficulty in distinguishing in situ from invasive bladder cancers, cancer registries typically recode bladder cancers reported as in situ to invasive; we followed this convention. The second analysis, which examined the association between insurance status and stage of disease at diagnosis (hypothesis-testing), excluded tumor sites for which staging was either not defined or not applicable. We began by selecting all cancer cases in the NCDB diagnosed between January 1, 2004 and December 31, 2010 among patients aged 15 to 39 years. For patients with $>1$ primary tumor in the database, only the first was included. We only included patients who received all or part of their first course of treatment at a CoC-accredited facility (although they may have been diagnosed elsewhere and then referred for treatment). Very small percentages of patients had forms of government insurance other than Medicaid or Medicare (0.2%), and very small percentages were treated in pediatric programs (0.3%) or "other" programs (0.2%) and thus these cases were not included. The initial sample included 331,311 cases. We then excluded patients who were missing data for AYA site group ($n = 313$), stage at diagnosis ($n = 9908$), sex ($n = 168$), race/ethnicity ($n = 5709$), insurance status ($n = 5841$), ZIP code-based income or education level ($n = 23{,}042$), facility type ($n = 3908$), or US Census region ($n = 1593$). A total of 45,863 cases (13.8% of initial sample) were excluded due to missing data for $\geq 1$ of these variables. Thus, after all exclusions, 285,448 cases were available for the descriptive analysis and 258,857 cases were available for the hypothesis-testing analysis.

Race/ethnicity was categorized as non-Hispanic white, black, Hispanic, Asian/Pacific Islander, and other. Insurance status was classified using the primary payer at diagnosis: privately insured, uninsured, Medicaid, and Medicare. Among younger patients, Medicare is only available to patients who are permanently disabled. Treating facilities were categorized as community cancer centers, comprehensive community cancer centers, teaching/research hospitals, and NCI-designated comprehensive cancer centers. Area-based measures of socioeconomic status were assessed using the median income in patients' ZIP code of residence and the percentage of residents in

the patients' ZIP code without a high school diploma. We categorized patients' state of residence using US Census regions (Northeast, South, Midwest, and West).[11]

The dependent variable of interest was cancer stage at the time of diagnosis. For all analyses, we included data from cases with disease of localized and distant stage. Using cases with localized stage as the reference group, these comparisons allowed us to separately evaluate factors associated with diagnosis at distant stage (not distant plus regional stage). All analyses were performed using SAS software (version 9.3; SAS Institute Inc, Cary, NC). Predictors of distant stage at diagnosis were examined using multivariate log-binomial models to estimate risk ratios (RRs) and 95% confidence intervals (95% CIs). RRs were used instead of odds ratios because the odds ratio is a biased estimator when the outcome is common.[12] Our main analyses were stratified by sex to account for the interaction between sex and insurance status we noted in preliminary analyses.

## RESULTS

Table 1 shows the distribution of cancers among AYA patients using the classification scheme developed by Barr et al.[13] The most common sites were carcinoma of the breast, thyroid carcinoma, carcinoma of the genitourinary tract (58.7% of which were in the cervix), lymphomas, germ cell and trophoblastic neoplasms (93.4% of which were in the testis), carcinoma of the gastrointestinal tract, and melanoma and skin carcinomas (98.9% of which were melanomas). Together, these top 7 sites accounted for nearly 80% of total cases. Although much more frequent among younger children, leukemias only accounted for 4.5% and central nervous system and related tumors for 4.8% of total cases among AYA patients.

Table 2 shows that insurance status was strongly related to a host of sociodemographic and treatment-related factors, as well as to stage of disease at the time of diagnosis. For example, compared with patients with private insurance, uninsured patients were younger, more likely to be male, more likely to be black or Hispanic, more likely to reside in the South, more likely to be treated in teaching/research facilities, and less likely to be treated in NCI-designated facilities. Uninsured patients were more likely to reside in ZIP codes with the lowest median income, as well as in ZIP codes with the highest percentage of residents without a high school diploma. Stage of disease at the time of diagnosis also differed markedly by insurance status, with uninsured patients more likely to be diagnosed at distant stage and less likely to be diagnosed at localized stage.

**TABLE 1.** Cancer Cases Among AYA Patients Aged 15 to 39 Years by SEER AYA Site Recode: National Cancer Data Base, 2004 Through 2010 (n = 285,448)

| SEER AYA Site Recode | No. of Cases (% of Total) |
|---|---|
| Leukemias | 12,931 (4.5) |
| Lymphomas | 32,411 (11.4) |
| CNS and other intracranial and intraspinal neoplasms[a] | 13,660 (4.8) |
| Osseous and chondromatous neoplasms | 4215 (1.5) |
| Soft tissue sarcomas | 10,513 (3.7) |
| Germ cell and trophoblastic neoplasms[a] | 25,738 (9.0) |
| Melanoma and skin carcinomas | 22,243 (7.8) |
| Thyroid carcinoma | 42,568 (14.9) |
| Other carcinoma of head and neck | 6734 (2.4) |
| Carcinoma of trachea, bronchus, and lung | 5031 (1.8) |
| Carcinoma of breast | 44,620 (15.6) |
| Carcinoma of genitourinary tract | 34,865 (12.2) |
| Carcinoma of gastrointestinal tract | 22,745 (8.0) |
| Carcinoma of other and ill-defined sites | 979 (0.3) |
| Miscellaneous specified neoplasms | 5778 (2.0) |
| Unspecified malignant neoplasms | 417 (0.2) |

Abbreviations: AYA, adolescent and young adult; CNS, central nervous system; SEER, Surveillance, Epidemiology, and End Results.
[a] Although the great majority of cases listed in the table had invasive behavior, these site groups also included cases with benign and borderline behavior.

Because preliminary analyses demonstrated that the effect of insurance status differed by sex, we conducted our main analyses of insurance status and distant stage at the time of diagnosis after stratifying by sex (Table 3). In our main analyses, we included all AYA site groups except leukemias and brain/central nervous system tumors (for which stage is not applicable). After controlling for age, race/ethnicity, US Census region, facility type, ZIP code-based median income, and percentage of residents in the ZIP code without a high school diploma, we found that among males, compared with patients with private insurance, uninsured patients were 1.51 times more likely to be diagnosed at a distant stage of disease (95% CI, 1.46-1.55); among females, the effect of insurance was stronger, with uninsured patients found to be 1.86 times more likely to be diagnosed at a distant stage (95% CI, 1.79-1.94). After stratifying by sex, RR estimates for patients with Medicaid and Medicare insurance were generally similar to those for uninsured patients. The unadjusted RRs for uninsured patients were 1.62 for males and 2.01 for females, which shows that adjustment for confounding factors explained approximately 18% of the unadjusted effect of being uninsured among males and approximately 14% of the unadjusted effect among females.

Risk of distant stage at the time of diagnosis generally declined with increasing age among both males and females. Race/ethnicity remained a strong predictor of

**TABLE 2.** Characteristics of AYA Cancer Patients Aged 15 to 39 Years by Insurance Status: National Cancer Data Base, 2004 Through 2010 (n = 258,857)[a]

| Patient Characteristic | No. of Cases (% of Total) by Insurance Status | | | |
|---|---|---|---|---|
| | Private (n = 194,359) | Uninsured (n = 21,311) | Medicaid (n = 36,307) | Younger Medicare (n = 6880) |
| Mean age at diagnosis, y | 31.8 | 31.0 | 30.7 | 33.2 |
| Age at diagnosis, y | | | | |
| 15-19 | 10,480 (5.4) | 702 (3.3) | 2753 (7.6) | 155 (2.3) |
| 20-24 | 18,270 (9.4) | 3205 (15.0) | 4388 (12.1) | 436 (6.3) |
| 25-29 | 31,107 (16.0) | 4302 (20.2) | 6598 (18.2) | 984 (14.3) |
| 30-34 | 50,565 (26.0) | 5416 (25.4) | 9109 (25.1) | 1771 (25.7) |
| 35-39 | 83,937 (43.2) | 7686 (36.1) | 13,459 (37.1) | 3534 (51.4) |
| Sex | | | | |
| Male | 67,067 (34.5) | 10,684 (50.1) | 11,886 (32.7) | 3114 (45.3) |
| Female | 127,292 (65.5) | 10,627 (49.9) | 24,421 (67.3) | 3766 (54.7) |
| Race/ethnicity | | | | |
| White, non-Hispanic | 151,454 (77.9) | 11,204 (52.6) | 19,408 (53.5) | 4269 (62.1) |
| Black | 17,796 (9.2) | 3352 (15.7) | 7914 (21.8) | 1405 (20.4) |
| Hispanic | 15,060 (7.8) | 5820 (27.3) | 7149 (19.7) | 940 (13.7) |
| Asian/Pacific Islander | 7933 (4.1) | 699 (3.3) | 1322 (3.6) | 178 (2.6) |
| Other | 2116 (1.1) | 236 (1.1) | 514 (1.4) | 88 (1.3) |
| US Census region[b] | | | | |
| Northeast | 42,403 (21.8) | 2649 (12.4) | 7334 (20.2) | 1283 (18.7) |
| Midwest | 51,068 (26.3) | 4393 (20.6) | 8715 (24.0) | 1573 (22.9) |
| South | 66,485 (34.2) | 10,756 (50.5) | 12,506 (34.5) | 2481 (36.1) |
| West | 34,403 (17.7) | 3513 (16.5) | 7752 (21.4) | 1543 (22.4) |
| Facility type | | | | |
| Community cancer program | 35,378 (18.2) | 4071 (19.1) | 7115 (19.6) | 1326 (19.3) |
| Comprehensive community cancer program | 73,566 (37.9) | 6548 (30.7) | 10,591 (29.2) | 2265 (32.9) |
| Teaching/research program | 54,669 (28.1) | 8686 (40.8) | 13,540 (37.3) | 2287 (33.2) |
| National Cancer Institute program | 30,746 (15.8) | 2006 (9.4) | 5061 (13.9) | 1002 (14.6) |
| ZIP code-based median income | | | | |
| <$30,000 | 19,268 (9.9) | 4357 (20.4) | 9221 (25.4) | 1583 (23.0) |
| $30,000-$34,999 | 29,193 (15.0) | 4831 (22.7) | 8439 (23.2) | 1503 (21.9) |
| $35,000-$45,999 | 53,509 (27.5) | 6336 (29.7) | 10,605 (29.2) | 1900 (27.6) |
| ≥$46,000 | 92,389 (47.5) | 5787 (27.2) | 8042 (22.2) | 1894 (27.5) |
| Percentage of residents in ZIP code without a high school diploma | | | | |
| <14% | 81,706 (42.0) | 4992 (23.4) | 6829 (18.8) | 1574 (22.9) |
| 14%-19.9% | 45,723 (23.5) | 4203 (19.7) | 7458 (20.5) | 1475 (21.4) |
| 20.0%-28.9% | 40,446 (20.8) | 5732 (26.9) | 10,254 (28.2) | 1836 (26.7) |
| ≥29.0% | 26,484 (13.6) | 6384 (30.0) | 11,766 (32.4) | 1995 (29.0) |
| SEER summary stage at diagnosis | | | | |
| Localized[c] | 109,386 (56.3) | 9298 (43.6) | 15,000 (41.3) | 3412 (49.6) |
| Regional | 59,471 (30.6) | 6674 (31.3) | 12,195 (33.6) | 1969 (28.6) |
| Distant | 25,502 (13.1) | 5339 (25.1) | 9112 (25.1) | 1499 (21.8) |

Abbreviations: AYA, adolescent and young adult; SEER, Surveillance, Epidemiology, and End Results.

[a] Only cases for which staging was defined and applicable are included. Staging was not defined or not applicable for benign/borderline tumors, leukemias, and brain/central nervous system tumors.

[b] Northeast region includes the states of Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont, New Jersey, New York, and Pennsylvania; Midwest includes Illinois, Indiana, Michigan, Ohio, Wisconsin, Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, and South Dakota; South includes Delaware, the District of Columbia, Florida, Georgia, Maryland, North Carolina, South Carolina, Virginia, West Virginia, Alabama, Kentucky, Mississippi, Tennessee, Arkansas, Louisiana, Oklahoma, and Texas; West includes Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, Wyoming, Alaska, California, Hawaii, Oregon, and Washington.

[c] For carcinoma of the bladder, in situ cases were grouped together with localized stage.

distant stage disease at diagnosis in the multivariate models among both males and females, second only to insurance status. Compared with white patients, black, Hispanic, and Asian/Pacific Islander patients all had a significantly higher risk of distant stage disease at the time of diagnosis, with blacks having the highest risk among both males and females. Geographic factors played a relatively minor role, with a very slightly higher risk of distant-stage disease at the time of diagnosis observed among males diagnosed in the Midwest, South, and West, and a slightly higher risk for females diagnosed in the West. Facility type was found to be an important predictor for distant stage of disease at the time of diagnosis, with risk being elevated among both males and females who were treated

**TABLE 3.** Insurance Status and Distant Stage at Diagnosis[a] Among AYA Cancer Patients Aged 15 to 39 Years by Sex: National Cancer Data Base, 2004 Through 2010 (n = 178,548)[b]

| | Relative Risk[c] of Distant Stage at Diagnosis[a] (95% CI) by Sex | |
|---|---|---|
| Patient Characteristic | Male (n = 67,009) | Female (n = 111,539) |
| Insurance status | | |
| Private | 1.00 (referent) | 1.00 (referent) |
| Uninsured | 1.51 (1.46-1.55) | 1.86 (1.79-1.94) |
| Medicaid | 1.76 (1.71-1.80) | 1.80 (1.74-1.86) |
| Younger Medicare | 1.27 (1.20-1.34) | 1.58 (1.47-1.69) |
| Age at diagnosis, y | | |
| 15-19 | 1.00 (referent) | 1.00 (referent) |
| 20-24 | 0.95 (0.91-0.99) | 0.78 (0.73-0.82) |
| 25-29 | 0.84 (0.80-0.87) | 0.62 (0.59-0.65) |
| 30-34 | 0.83 (0.80-0.86) | 0.60 (0.57-0.63) |
| 35-39 | 0.94 (0.90-0.97) | 0.66 (0.63-0.70) |
| Race/ethnicity | | |
| White, non-Hispanic | 1.00 (referent) | 1.00 (referent) |
| Black | 1.35 (1.31-1.40) | 1.45 (1.40-1.50) |
| Hispanic | 1.17 (1.13-1.21) | 1.12 (1.07-1.16) |
| Asian/Pacific Islander | 1.31 (1.25-1.38) | 1.30 (1.23-1.38) |
| Other | 1.04 (0.94-1.15) | 1.08 (0.96-1.21) |
| US Census region | | |
| Northeast | 1.00 (referent) | 1.00 (referent) |
| Midwest | 1.05 (1.02-1.09) | 1.02 (0.98-1.06) |
| South | 1.04 (1.01-1.07) | 1.01 (0.98-1.05) |
| West | 1.07 (1.03-1.10) | 1.13 (1.08-1.18) |
| Facility type | | |
| Community cancer program | 1.00 (referent) | 1.00 (referent) |
| Comprehensive community cancer program | 1.01 (0.98-1.05) | 1.00 (0.97-1.04) |
| Teaching/research program | 1.09 (1.06-1.13) | 1.05 (1.01-1.09) |
| National Cancer Institute program | 1.23 (1.18-1.27) | 1.24 (1.19-1.29) |
| ZIP code-based median income | | |
| ≥$46,000 | 1.00 (referent) | 1.00 (referent) |
| $35,000-$45,999 | 1.03 (1.00-1.06) | 1.02 (0.98-1.06) |
| $30,000-$34,999 | 1.04 (1.00-1.07) | 1.02 (0.97-1.06) |
| <$30,000 | 1.04 (1.00-1.08) | 1.02 (0.97-1.07) |
| Percentage of residents in ZIP code without a high school diploma | | |
| <14% | 1.00 (referent) | 1.00 (referent) |
| 14%-19.9% | 1.06 (1.03-1.09) | 1.05 (1.01-1.09) |
| 20.0%-28.9% | 1.08 (1.04-1.12) | 1.06 (1.01-1.10) |
| ≥29.0% | 1.09 (1.04-1.13) | 1.12 (1.07-1.17) |

Abbreviations: 95% CI, 95% confidence interval; AYA, adolescent and young adult.
[a] The dependent variable was diagnosis at distant stage versus diagnosis at localized stage. For carcinoma of the bladder, in situ cases were grouped together with localized stage.
[b] Only cases for which staging was defined and applicable are included. Staging was not defined or not applicable for benign/borderline tumors, leukemias, and brain/central nervous system tumors.
[c] Adjusted for all factors in the table.

in NCI-designated facilities; the risk was also very slightly elevated for males and females treated in teaching/research facilities. In these multivariate models, socioeconomic factors were found to have relatively minor independent effects on the risk of distant-stage disease at the time of diagnosis, with the risk slightly elevated for males and females residing in ZIP codes with lower high school graduation rates.

Table 4 shows the variation in the effect of insurance status on distant-stage disease at the time of diagnosis across site groups. Generally, there was considerable overlap in the 95% CIs for specific insurance categories across site groups, but we noted for example that compared with patients with private insurance, the RRs for uninsured patients were higher for melanoma and skin carcinomas, thyroid carcinoma, carcinoma of the breast, and carcinoma of the genitourinary tract. These sites may be characterized as most amenable to early detection. In contrast, the RRs for uninsured patients were lower for carcinoma of the trachea, bronchus, and lung; carcinoma of other

**TABLE 4.** Insurance Status and Distant Stage at Diagnosis[a] Among AYA Cancer Patients Aged 15 to 39 Years by AYA Site Group: National Cancer Data Base, 2004 Through 2010 (n = 178,548)[b]

| AYA Site Group[c] | No. of Cases | Insurance Status | Relative Risk[d] of Distant Stage at Diagnosis (95% CI) |
|---|---|---|---|
| Lymphomas | 20,149 | Private | 1.00 (referent) |
| | | Uninsured | 1.21 (1.17-1.24) |
| | | Medicaid | 1.22 (1.19-1.25) |
| | | Younger Medicare | 1.11 (1.05-1.18) |
| Germ cell and trophoblastic neoplasms | 20,383 | Private | 1.00 (referent) |
| | | Uninsured | 1.46 (1.34-1.58) |
| | | Medicaid | 2.06 (1.92-2.21) |
| | | Younger Medicare | 1.44 (1.18-1.72) |
| Melanoma and skin carcinomas | 18,982 | Private | 1.00 (referent) |
| | | Uninsured | 3.50 (2.86-4.23) |
| | | Medicaid | 6.22 (5.24-7.34) |
| | | Younger Medicare | 3.03 (2.07-4.23) |
| Thyroid carcinoma | 29,316 | Private | 1.00 (referent) |
| | | Uninsured | 1.61 (1.21-2.09) |
| | | Medicaid | 1.33 (1.07-1.64) |
| | | Younger Medicare | 1.60 (1.06-2.31) |
| Carcinoma of trachea, bronchus, and lung | 3934 | Private | 1.00 (referent) |
| | | Uninsured | 1.23 (1.18-1.29) |
| | | Medicaid | 1.21 (1.16-1.26) |
| | | Younger Medicare | 1.15 (1.07-1.22) |
| Carcinoma of breast | 23,427 | Private | 1.00 (referent) |
| | | Uninsured | 2.12 (1.86-2.39) |
| | | Medicaid | 2.15 (1.97-2.35) |
| | | Younger Medicare | 2.02 (1.65-2.43) |
| Carcinoma of genitourinary tract | 27,326 | Private | 1.00 (referent) |
| | | Uninsured | 1.82 (1.65-2.01) |
| | | Medicaid | 1.66 (1.53-1.79) |
| | | Younger Medicare | 1.05 (0.88-1.25) |
| Carcinoma of gastrointestinal tract | 13,833 | Private | 1.00 (referent) |
| | | Uninsured | 1.22 (1.16-1.27) |
| | | Medicaid | 1.24 (1.19-1.28) |
| | | Younger Medicare | 0.88 (0.80-0.97) |
| Carcinoma of other and ill-defined sites | 642 | Private | 1.00 (referent) |
| | | Uninsured | 1.42 (1.03-1.85) |
| | | Medicaid | 1.39 (1.10-1.73) |
| | | Younger Medicare | 0.61 (0.21-1.21) |
| Miscellaneous specified neoplasms | 5170 | Private | 1.00 (referent) |
| | | Uninsured | 1.07 (1.01-1.13) |
| | | Medicaid | 1.12 (1.07-1.17) |
| | | Younger Medicare | 1.13 (1.05-1.20) |
| All other sites | 15,386 | Private | 1.00 (referent) |
| | | Uninsured | 1.44 (1.31-1.58) |
| | | Medicaid | 1.66 (1.56-1.77) |
| | | Younger Medicare | 1.23 (1.04-1.44) |

Abbreviations: 95% CI, 95% confidence interval; AYA, adolescent and young adult.
[a] The dependent variable was diagnosis at distant stage versus diagnosis at localized stage. For carcinoma of the bladder, in situ cases were grouped together with localized stage.
[b] Only cases for which staging was defined and applicable are included. Staging was not defined or not applicable for benign/borderline tumors, leukemias, and brain/central nervous system tumors.
[c] Due to space limitations, separate results are only shown for 10 AYA site groups and the remainder as "all other sites."
[d] Adjusted for age, sex, race/ethnicity, US Census region, facility type, ZIP code-based median income, and percentage of residents in ZIP code without a high school diploma.

and ill-defined sites (primarily adrenocortical carcinoma); and miscellaneous specified neoplasms (primarily Wilms tumor). These sites may be characterized as being least amenable to early detection. After stratifying by AYA site group, the RR estimates for patients with Medicaid and Medicare insurance were generally similar to those for uninsured patients.

In analyses that are not shown herein, we compared the distribution of patient characteristics and cancer sites in the NCDB and the NCI's population-based SEER 18

cancer registries, using data from diagnosis years 2007 through 2010. Patient characteristics and cancer sites were found to be quite similar, as were the observed associations between insurance status and stage at diagnosis.

## DISCUSSION

The main finding of the current study was that in a national sample of nearly 260,000 AYA patients with cancer, insurance status was a strong predictor of distant-stage disease at the time of diagnosis in multivariate models that adjusted for age, sex, race/ethnicity, facility type, ZIP code-based income and education level, and US Census region. The study is unique not only because of its large size, but because to our knowledge it is the first to examine this issue using a national sample, and the first to include all AYA cancer sites. To the best of our knowledge, Martin et al were the first to report on this issue, using data from a single institution (270 cases) and including 6 common cancer sites (leukemias, Hodgkin and non-Hodgkin lymphomas, sarcomas, brain tumors, and thyroid carcinoma).[10] More recently, Smith et al reported an association between insurance status and distant stage of disease at the time of diagnosis, using data from a state cancer registry (7343 cases), and including a single cancer site (Hodgkin lymphoma).[7] Although the association between insurance status and advanced-stage cancer has been firmly established in both national and regional cohorts comprised of older adults,[14-18] the current study is the first to our knowledge to examine the issue in a national AYA cohort. Similar to the findings from studies of older patients, we found a stronger effect of insurance status for cancer sites that are more amenable to early detection by physical examination or symptom evaluation.[14]

The hypothesis of a causal relationship between insurance status and risk of distant-stage disease at the time of diagnosis is supported by a causal pathway rooted in the structure of medical care in the United States. Diagnosis of cancer at an early stage is primarily achieved by screening and/or early detection through physical examination and symptom evaluation. Because screening is not recommended for many of the cancer sites or age groups in the AYA population (with a few notable exceptions, such as cervical cancer), the major strategies that can be used in the AYA population are physical examination and symptom evaluation. Clearly, these require regular contact with the health care system and, optimally, having regular contact with a health care team that knows the patient and his/her history so that changes from baseline can be flagged and investigated. This is not likely to occur when patients are uninsured and must seek care in settings such as emergency departments. Our observation of a substantially stronger effect of insurance for cancer sites that are more amenable to early detection versus a substantially weaker effect for sites that are less amenable to early detection supports the hypothesis of a causal relationship between insurance status and distant-stage disease at the time of diagnosis.

These data are important because they suggest a way forward for cancer control efforts in the AYA population, which has benefitted the least from the War on Cancer. Several commentators have noted that the AYA age group has historically had the highest rate of individuals without health insurance.[4] With the passage of the Patient Protection and Affordable Care Act in 2010,[19] there was renewed optimism that many uninsured AYA patients would gain access to high-quality health insurance, with all its attendant benefits.[20]

One major limitation of the current study and all other studies using a retrospective study design is the misclassification of insurance type (primary payer at diagnosis). Although the results of the current study would appear to suggest that patients receiving public insurance such as Medicaid and Medicare fare no better, or even worse, than uninsured patients, the current study findings should not be taken as evidence of such a conclusion. First, it must be emphasized that a substantial number of patients move from the uninsured category to Medicaid when they are diagnosed with cancer.[21] This is because in most states, individuals who develop serious illnesses, including cancer, can qualify for Medicaid as "medically needy," even when their income is higher than the state Medicaid eligibility limit.[22] Similarly, it must be noted that among nonelderly persons, eligibility for Medicare is based on the presence of a permanent disability, which may be a diagnosis of advanced-stage cancer. In both of the scenarios described above, Medicaid or Medicare coverage may be granted retroactively, with the eligibility date assigned as the date of diagnosis. In such cases, the advanced-stage cancer diagnosis would be the cause of the insurance status, rather than vice versa. Thus, the elevated risk of distant-stage disease at the time of diagnosis we observed among persons with Medicaid and Medicare insurance should not be taken as evidence of a causal association for these insurance types.

Another limitation of the current study is that the NCDB is not a population-based registry, although it does capture data from CoC-accredited facilities in all 50 states and the District of Columbia, representing approximately 70% of all incident cancer cases in the United

States. In comparisons with data from population-based cancer registries, we did not find evidence that the current study sample was biased with respect to patient characteristics or cancer sites, or that our observations regarding insurance and stage were due to sampling bias.

Thus, in a large national sample of AYA patients with cancer, we found a strong relationship between insurance status and risk of distant-stage disease at the time of diagnosis. We believe that this observation holds the promise of improved cancer control efforts in the AYA population, after decades in which AYA patients have experienced far less victory in the War on Cancer than their younger and older counterparts. However, the success of these efforts may be directly tied to the fate of the Medicaid expansion component of the Patient Protection and Affordable Care Act, which, at the time of this writing, remains quite unclear.[23-26]

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## CONFLICT OF INTEREST DISCLOSURES

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