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Impact of Affordable Care Act dependent coverage provision on cancer stage at diagnosis

By

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Master of Public Health

Global Epidemiology

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B.S.
University of Minnesota – Twin Cities
2012

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An abstract of
A thesis submitted to the Faculty of the
Rollins School of Public Health of Emory University
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Abstract

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BACKGROUND: Young adults have traditionally been found to have the highest uninsured rate of any age group. On September 23rd, 2010, the Affordable Care Act (ACA) dependent coverage provision increased the age at which dependents can remain on their parents' insurance to 26. Post-expansion studies have found the general trend in improvement of insurance uptake and health service utilization. Previous studies have shown that insurance status was associated with cancer stage at diagnosis. This study looks at this relationship in terms of the ACA dependent coverage expansion in 2010.

METHODS: Data from the Surveillance Epidemiology and End Results Program in years 2008, 2009, and 2011, were used to estimate the average difference in early stage diagnosis (stages I and II) between 19-25 and 26-29 year olds pre- and post-ACA (n=17,891) within a difference-in-differences framework. This was repeated for cancers common in young adults (n=12,477). Models controlled for sex, race and ethnicity, age at diagnosis, residence in rural/urban county, marital status at diagnosis, and county-level % persons with less than a high school education.

RESULTS: The ACA dependent expansion provision increased early stage diagnosis in 19-25 year olds by 2.11 percentage points (95% CI: -0.96 to 5.18, p-value=0.1774). After adjustment, the proportion of early stage diagnosis increase was 1.97 percentage points (95% CI: -1.12 to 5.05, p-value=0.2118). Analyzing just cancers common in AYA, the proportion of early stage diagnosis was 2.61 (95% CI: -0.53 to 5.74, p-value=0.1032), and after adjustment, 2.61 (95% CI: -0.24 to 6.08, p-value=0.0701).

CONCLUSIONS: Early stage cancer diagnosis increased in 19-25 year olds analyzing all cancers and all cancers common in young adults, although none of the estimates were statistically significant. However, there is a general trend in the increase of the proportion of early stage diagnosis in 19-25 year olds after the ACA dependent coverage expansion in 2010. Future studies with more updated data are necessary to assess the impact of coverage expansion on stage at cancer diagnosis in the target young adult population.

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Table of Contents

Background/Literature Review

Previous studies have found that young adults who have health insurance are more likely to utilize preventive health services and are diagnosed with more early-stage cancer compared to their uninsured counterparts (Lau, Adams, Park, Boscardin, & Irwin, 2014); (Robbins, Lerro, & Barr, 2014). Despite this, studies have demonstrated that young adults tend to be the age group most likely to be uninsured, when compared to other age groups (Lau, Adams, Boscardin, & Irwin, 2014). On September 23rd, 2010, as part of the Patient Protection and Affordable Care Act (ACA), a mandate was passed that required insurers to allow children to remain as dependents on their parents' insurance plans until they turn 26. Prior to this dependent coverage expansion, non-student dependents were often dropped by private insurers at age 19 and student dependents at age 23 (Anderson, Dobkin, & Gross, 2012). Studies on the impact of the mandate have indicated that insurance coverage rates have increased in eligible young adults (Cantor, Monheit, DeLia, & Lloyd, 2012). Improvement in health insurance coverage also improved uptake of preventive services (Lau, Adams, Park, et al., 2014); (Kotagal, Carle, Kessler, & Flum, 2014); (Han, Yabroff, Robbins, Zheng, & Jamal, 2014). An earlier study found that uninsurance status was associated with distant cancer diagnosis (Robbins et al., 2014). However, this has not been evaluated post the ACA dependent coverage expansion.

Importance of insurance coverage in young adults

Young adults make up the largest portion of individuals who are uninsured. According to the 2009 Census Bureau, young adults ages18-24 and 25-34 were found to have the highest uninsured rate at 30.4% and 29.1% respectively (Proctor BD DeNavas-Walt C, Smith JC, 2010). This is found to be true again in 2011, where 27.7% of 19-25 and 27.5% of 26-34 year olds were uninsured (P.B. DeNavas-Walt C, Smith JC, 2012). Not only was this age cohort the highest uninsured, Lau et al. found that in 2009, 18-25 year olds had the lowest health care utilization rate compared to all other age cohorts (72% compared to 83-88% in other age groups, $p<0.001$) (Lau, Adams, Boscardin, et al., 2014). This is concerning, as when comparing those recently uninsured (defined as insured respondents who were uninsured at any time point in the past two years) to those continually insured using household surveys that assessed indicators related to access to health care, service use, and satisfaction with care, those recently uninsured were twice as likely to not get necessary care in the past year and have no usual source of care ($p<0.01$ using χ^2 test) (Schoen & DesRoches, 2000). Additionally, those recently uninsured were more likely to have no doctor visits in the past year, tended to be less satisfied with healthcare services, and how well their doctor listened and explained ($p<0.01$ using χ^2 test for both measures) (Schoen & DesRoches, 2000). During this period, young adults are at increased risk for unintended pregnancy, sexually transmitted infections, substance abuse, and injuries, demonstrating the need for health insurance (R. W. Blum, 1995); (National Center for Health, 2009).

State-level dependent coverage expansion

Prior to the federally mandated expansion in 2010, 34 states had already expanded insurance coverage to include young adults, with varying requirements for eligibility based on age limits, marital status, student status and other factors (Monheit, Cantor, DeLia, & Belloff, 2011). Monheit et al. examined pre- and post-expansion coverage changes in these states. Results indicated an increase in dependent insurance coverage (1.52-3.84 percentage points), however, this was offset by lower employer-sponsored insurance (ESI), suggesting that instead of decreasing the rate of uninsured adults, the policy was further benefiting already-insured adults, as out-of-pocket premiums and benefits were more attractive on young adults' parents' plans than their own (p-value<0.05) (Monheit et al., 2011). On the contrary, a later study by Blum et al., which included a control group for comparison, found that states that expanded eligibility not only experienced higher rates of insurance coverage, but an increase in report of a personal clinician, physical exams, and a decrease in missed care due to cost (A. B. Blum, Kleinman, Starfield, & Ross, 2012). Both studies report on expansion at the state-level and highlight the importance of studying these policies in anticipation for the federal mandate in 2010. An important difference when comparing state expansion to the federal expansion in both studies was that employers that were self-insured were exempted from state laws via the Employee Retirement Income Security Act (ERISA) (Monheit et al., 2011) (A. B. Blum et al., 2012). This has important implications for the ACA provision, as ERISA only applies at the state-level and was eliminated with federal-level expansion.

Federal-level dependent coverage expansion

At the federal level, following the ACA's implementation of extended dependent coverage, insurance uptake in young adults age 19-25 increased significantly while there was no significant change in those ages 26-34 (Benjamin D. Sommers, Buchmueller, Decker, Carey, & Kronick, 2013). Using two different sets of data (because of various survey questions and sample size), results indicated a 2.7-3.1 percentage-point increase in ACA-eligible group compared to the older control group (Benjamin D. Sommers et al., 2013). Sommers et al. used National Health Interview Survey to look at access to care, defined as delaying or not seeking care due to costs and having a consistent source of care within the past year, measured from when the policy took effect through September the following year. They noticed statistically significant differences comparing 19-25 year olds to 26-34 year olds; coverage expansion reduced the chances of delaying care and not getting care due to cost by 4 percentage points ($p<0.01$) and 2.3 percentage points respectively ($p<0.001$) (Benjamin D. Sommers et al., 2013). Having a usual source of care increased in the target population by 2.6 percentage points ($p<0.05$) (Benjamin D. Sommers et al., 2013). All analyses adjusted for race and ethnicity, sex, education, marital status, employment status, and religion, and found little effect of any of the potential confounders on the results. More recent literature by Lau et al. looked at dependent coverage expansion for young adults up to 26 years of age on preventive care services uptake (routine examination, blood pressure screening, cholesterol screening, and annual dental visit), controlling for having a usual source of care, sex, language spoken at home, race and ethnicity, income level, educational level, student status, and employment status (Lau, Adams, Park, et al., 2014). Using data one year prior to the expansion and one year after, the authors found significantly higher rates of young adults receiving all services (Lau, Adams, Park, et al., 2014). In contrast, using nationally representative data one year prior to the expansion and two years after, Han et al. found that receipt of dental checkups, blood pressure checks, and routine health checkups increased in young adults 19-25, but no change was observed in receipt of flu vaccination and Pap test (Han et al., 2014). Barbaresco et al., using BRFSS data and narrower age ranges (23-25 year olds and 27-29 year olds), found improved health care access (measured as having insurance, a primary doctor, and any foregone care because of cost) and excellent self-assessed health (overall health, mental, physical and health-related functional limitations) but not utilization of preventive care (recent flu vaccinations, well-patient checkups, and pap tests) (Barbaresco, Courtemanche, & Qi, 2014).

Another more extensive study conducted by Cantor et al. echoed similar results. The authors used regression models to estimate the impact of the provision, analyzing data from 2005-2011. The models investigated combined federal and state policy effects (the 34 states that had previously implemented expansion before the ACA). The authors wanted to explore insurance coverage, accounting not only for demographic and socio-economic status mentioned in previous studies, but also non-policy measures that could affect insurance coverage, including state unemployment rate by year, employer group coverage by parents to their young adults, and private group coverage in self-insured plans that would have to abide by federal laws (Cantor et al., 2012). Looking at state and federal-level effects, there was a 5.3 percentage point increase in non-spousal dependent coverage ($p<0.001$ for two-tailed test), 2.1 percentage point decrease in private self- or spousal- coverage ($p<0.05$), and 3.5 percentage point decrease in the uninsured in the target population ($p<0.001$ for two-tailed test) (Cantor et al., 2012). Looking at the interaction between state and federal provisions, there were statistically significant decreases in uninsured target populations. Using regression models, Cantor et al. estimated increases in dependent insurance uptake and decreases in uninsured 19-25 year olds, adjusting for factors that were not previously adjusted for.

Health insurance and cancer outcomes

Thirty-four states and, in 2010, the federal government, recognized the need for young adults to be insured. As the studies above support, regardless of state or federal insurance coverage expansion for dependent adults, insurance and services uptake increased in young adults after the expansion, specifically for those ages 19-25.

Health insurance has been found to be related to other outcomes, including cancer diagnosis. Martin et al. found that having no insurance was associated with delays in cancer diagnosis (Martin et al., 2007). The authors looked at the six most common malignancies in 15-29 year olds that could be evaluated for cancer-specific symptoms or definitive diagnosis and conducted multivariate analysis, accounting for insurance status and type, cancer type and stage, patient age, gender, race and ethnicity, marital status, and zip code of residence (Martin et al., 2007). The outcome was the time between onset of cancer symptoms or when a diagnosis can be made, and time when the cancer was actually pathologically diagnosed for each individual patient. For this particular study, the types of insurance coverage were private, public, and self-pay. Self-pay patients were defined as those who had no insurance, paid with personal or private funds, and assumed 50-100% of their costs. In patients with public insurance or self-paid, the mean lagtime was 13.1 weeks longer than in patients who had private insurance (Martin et al., 2007). This relationship also held true when evaluating stage at diagnosis; that is, patients who self-paid or had public insurance were more likely to be diagnosed at a later stage. However, given the sample size, this relationship was not statistically significant.

The study above supported the inverse relationship between health insurance status and lagtime, but was conducted in just one site (University of Texas M.D. Anderson Cancer Center). A later study by Robbins et al. looked at 15-39 year olds using a national sample. The authors analyzed the sample from the National Cancer Data Base using data between 2004 and 2010 to evaluate the relationship between health insurance and distant-stage disease at diagnosis. The results showed that uninsured males were 1.51 (95% CI: 1.46, 1.55) times more likely to be diagnosed at a distant stage of disease, and for uninsured females, this was 1.86 (95% CI: 1.79, 1.94). Race was also a determinant of distant stage-at-diagnosis, with the strongest association being in Black individuals (males: 1.35 (95% CI: 1.31, 1.40), females: 1.45 (95% CI: 1.40, 1.50)) (Robbins et al., 2014). Overall though, lack of health insurance had a stronger relationship with distant-stage diagnosis. Aizer et al. reports similar results, when looking at the association between insurance status and cancer-specific outcomes among young adults. Using Surveillance Epidemiology and End Results (SEER) data from 2007 to 2009, having health insurance was statistically significantly associated with decreased presentation of metastatic disease (odds ratio (OR)=0.94, 95% confidence interval (CI): 0.75, 0.94) (Aizer et al., 2014). Results from these studies support the relationship between health insurance status and timing of cancer diagnosis. However, the relationship between insurance status and stage at cancer diagnosis has not been evaluated in light of the ACA's dependent coverage expansion.

To our knowledge, the impact of dependent coverage expansion has not been conducted on stage at cancer diagnosis. There is little information on how the expansion, via insurance and services uptake, impact stage at cancer diagnosis in young adults. Hence, we conducted a retrospective study to examine the 2010 ACA policy mandate on stage at cancer diagnosis, specifically comparing early and later stage at cancer diagnosis in young adults ages 19-25 with 26-29 year olds pre- and post-eligibility expansion. A difference-in-differences approach was utilized to evaluate changes in the age cohorts post the expansion.

Methods

Study population

Data from the Surveillance Epidemiology and End Results (SEER) Program (Surveillance, Epidemiology, and End Results (SEER) Program (www.seer.cancer.gov) SEER*Stat Database: Incidence - SEER 18 Regs Research Data + Hurricane Katrina Impacted Louisiana Cases, Nov 2013 Sub (1973-2011 varying) - Linked To County Attributes - Total U.S., 1969-2012 Counties, National Cancer Institute, DCCPS, Surveillance Research Program, Surveillance Systems Branch, released April 2014, based on the November 2013 submission.), between the years 2008-2009, and 2011 were imported to and analyzed using SAS 9.4 (SAS Institute, Cary NC) . The SEER Program collects and reports data from population-based cancer registries. Registries cover 28% of the population. Areas reporting to the SEER Program are the Alaska Native Tumor Registry, Arizona Indians, Cherokee Nation, Connecticut, Detroit, Georgia Center for Cancer Statistics, Greater Bay Area Cancer Registry, Greater California, Hawaii, Iowa, Kentucky, Los Angeles, Louisiana, New Jersey, New Mexico, Seattle-Puget Sound, and Utah.

Emory University Institutional Review Board (IRB) determined that this study does not require IRB review.

Years

Data from years 2008, 2009, and 2011 were included. The law was passed on September 23rd, 2010, therefore, to allow time for implementation and insurance enrollment, data from 2010 was omitted. The population of interest is 19-29 year olds. The exposure is dependent coverage expansion policy in 2010 (e.g. time pre-expansion versus time post-expansion), ‘treatment’ group is 19-25 year olds (for whom the policy applied), and comparison group is 26-29 year olds (for whom the policy did not apply).

Demographics

Demographic characteristics were included to look at the distribution across the different age groups. Sex and race and ethnicity were included. Race and ethnicity was categorized as non-

Hispanic white, non-Hispanic black, non-Hispanic other, and Hispanic. All observations were diagnosed with cancer between ages 19-29. Residence in rural or urban county were reported. Rural/urban classification was derived from the United States Department of Agriculture. Marital status was reported, with not married including those who are divorced, separated, single (never married), unmarried or domestic partner, or widowed. Insurance status was aggregated. Insured included insured by any Medicaid, insured, and insured/no specifics. Uninsured and insurance status unknown were also reported.

County-level socio-economic status attributes for the county in which each individual lived (% persons below poverty, median household income, % < high school education) were derived from the Census American Community Survey. All continuous variables were categorized based on their respective quartiles.

Cancers

SEER presents different coding schemes to identify cancers. The “AYA Site Recode” scheme was used, adapted specially for tumors of adolescents and young adults (AYA) (Barr, Holowaty, & Birch, 2006). All cancers diagnosed in an individual are reported by SEER, but only observations of first primary cancers were included in the final data set. All others were omitted (n=646). It is likely that individuals who have subsequent or recurrent cancer already have insurance, and would not appropriately represent situations where insurance coverage is the motivating factor behind early stage diagnosis. Stage at diagnosis was coded as 0-IV, according to the American Joint Committee on Cancer (AJCC), as reported by SEER. Cancers with non-standard staging schemes and cancers diagnosed at stage 0 were excluded from analysis. Because of difficulty in distinguishing in situ from invasive bladder cancers, bladder cancer at stage 0 were included in stage I/II grouping (n=93). Bleyer et al. found that among 20-39 year olds (females and males), breast cancer, melanoma, thyroid cancer, testis cancer, Non-Hodgkin lymphoma, uterine cervix cancer, Hodgkin lymphoma, colorectal cancer, central nervous system tumors, soft tissue sarcoma (excluding Kaposi sarcoma), oral cavity cancer, and lung cancer make up 79% of cancers in young adults (A. Bleyer & Barr, 2009). Cancers that were not of these common ones were excluded in the analysis for cancer common in young adults (n=1,080).

Analysis

To evaluate average differences in early-stage cancer diagnosis between the two age groups pre- and post-ACA, we used a difference-in-differences (DID) binomial regression framework.

The difference-in-differences model is given by:

$$Y = \beta_0 + \beta_1 Younger + \beta_2 Post + \beta_3 (Younger * Post) + \sum \beta_i X_i + e$$

Y is the binary outcome of interest, early stage at cancer diagnosis (stages I and II versus stages III and IV).

β_1 captures differences in treatment and comparison groups prior to policy change.

β_2 captures differences post versus pre among the referent group (26-29 year olds).

β_i captures fixed effects of confounders.

e is an individual specific error term and is assumed to be independent and identically distributed.

$\beta_3$is the difference-in-differences coefficient. It estimates

$$\hat{\beta}_3 = \left(\bar{y}_{B,2} - \bar{y}_{B,1}\right) - \left(\bar{y}_{A,2} - \bar{y}_{A,1}\right),$$

that is, the difference in changes over time where $B = 19 - 25\ year\ olds$, $A = 26 - 29\ year\ olds$, $2 = 2011$, and $1 = 2008$-9. β_3 estimates the effect of treatment on the treated.

To estimate the difference-in-difference coefficient, treatment, post, and interaction variables were fitted in a binary linear probability model. Limitations of this model include inherent heteroskedasticity and that predictions can fall out of the [0,1] range.

A key assumption of the difference-in-differences method is that both treatment (19-25 year olds) and comparison groups (26-29 year olds) have a common trend in the outcome variable before the treatment (ACA dependent coverage expansion, in this case). Because 26-29 year olds share similar risk factors for cancer and experience similar insurance coverage challenges as 19-25 year olds, it is a plausible comparison group. The difference-in-differences framework is useful in this analysis because of two possible trends that can affect the outcome, time and treatment (policy change). Any external time trend that would affect average stage at cancer diagnosis in 26-29 year olds also applies to 19-25 year olds. However, dependent expansion only affected young adults up to age 26. Therefore, deducting out this time trend gives the difference-in-differences coefficient, which estimates the true impact of dependent coverage expansion on early stage at cancer diagnosis (Albuoy, 2005); (Conley & Taber, 2010); (Wooldridge, 2007)

Assumptions of the difference-in-differences estimator are that the model is correctly specified, the error term on average is zero, and that the error term is uncorrelated with other variables in the equation (Albuoy, 2005).

Two difference-in-differences analyses were conducted. The first explored early stage diagnosis in all cancers of the final dataset. The second analysis includes only common cancers in young adults, identified by Bleyer et al. (A. Bleyer & Barr, 2009). Both analyses controlled for common covariates controlled for in similar studies, specifically sex, race/ethnicity, absolute age at diagnosis, , residence in urban/rural areas, marital status at diagnosis, and county-level percentage of the population having less than a high school education (Robbins et al., 2014); (Barbaresco et al., 2014); (B. D. Sommers & Kronick, 2012).

Results

The raw dataset extracted from SEER had 17,891 observations. Cancers that did not have a standard staging scheme, had missing or unknown stages, or were identified as occult were excluded (n=4,274). In situ carcinomas (stage 0) were excluded from the dataset (n=12). Cancers diagnosed at stages I/II, identified as "early stage diagnosis" were compared with stages III/IV, identified as "late stage diagnosis". Observations with missing stage at diagnosis were omitted (n=1,866). The final dataset with all stage-able cancers reported had 13,141 observations. Cancers common in young adults were further identified (n=12,061).

Demographic distribution

Sex, race/ethnicity, marital status, residence in a rural/urban county, marital status, insurance status, and county-level % with less than a high school education and % living below poverty, and median income were reported based on age group and diagnosis year (Table 1). All demographic characteristics except for marital status are comparable in 2008-9 and 2011. That is, 19-29 year olds are less likely to be married in 2011 than 19-29 year olds in 2008-9.

Comparing 19-25 and 26-29 year olds in 2008-9, 26-29 year olds were more likely to be females (p-value<0.0001), live in urban areas (p-value<0.0144), be married (p-value<0.0001), and be insured (p-value=0.0358). Comparing the younger and older age groups in 2011, 26-29 year olds were more likely to be female (p-value<0.0001) and married (p-value<0.0001), however, as expected, insurance status was not statistically significant (p-value=0.9751).

Distribution of early stage diagnosis

Figure 1 presents the percentage of early stage diagnosis of all cancers in 19-25 year olds and 26-29 year olds in 2008-9 and 2011. In 2008-9, the proportion of 19-25 year olds diagnosed at early stage was roughly 2.45 percentage points lower than that of 26-29 year olds. In 2011, this difference has decreased to 0.34 percentage points. From 2008-9 to 2011, the proportion of early stage diagnosis in 19-25 year olds increased by 0.97 percentage points and decreased by 1.14 percentage points in 26-29 year olds.

Figure 2 presents the same data, but after exclusion of cancers uncommon in young adults. From 2008-9 to 2011, the proportion of early stage diagnosis in 19-25 year olds increased by 1.32 percentage points and decreased by 1.29 percentage points in 26-29 year olds. This data is also presented in Table 2.

Table 2 presents the distribution of cancer stage at diagnosis by age and year group. The proportion of early stage diagnosis increased in 19-25 year olds with all cancers or only common cancers although not statistically significant (p-value= 0.3799, p-value=0.2417 respectively), while 26-29 year olds experienced decreases in early stage diagnosis (p-value=0.3026, p-value=0.2567), which were also non-significant.

The difference-in-differences coefficient β_3 is presented in Table 3. By 2011, the policy's effect had increased the chance of 19-25 year olds getting diagnosed with cancer at an early stage by 2.11 percentage points (95% CI: -0.96 to 5.18, p-value=0.1774). After adjustment, the proportion of early stage diagnosis increase was 1.97 (95% CI: -1.12 to 5.05, p-value=0.2118). When analyzing just cancers common in AYA, proportion of early stage diagnosis was 2.61 (95% CI: -0.53 to 5.74, p-value=0.1032), and after adjustment, 2.61 (95% CI: -0.24 to 6.08, p-value=0.0701). All analyses converged.

Figure 1. All AYA cancers.

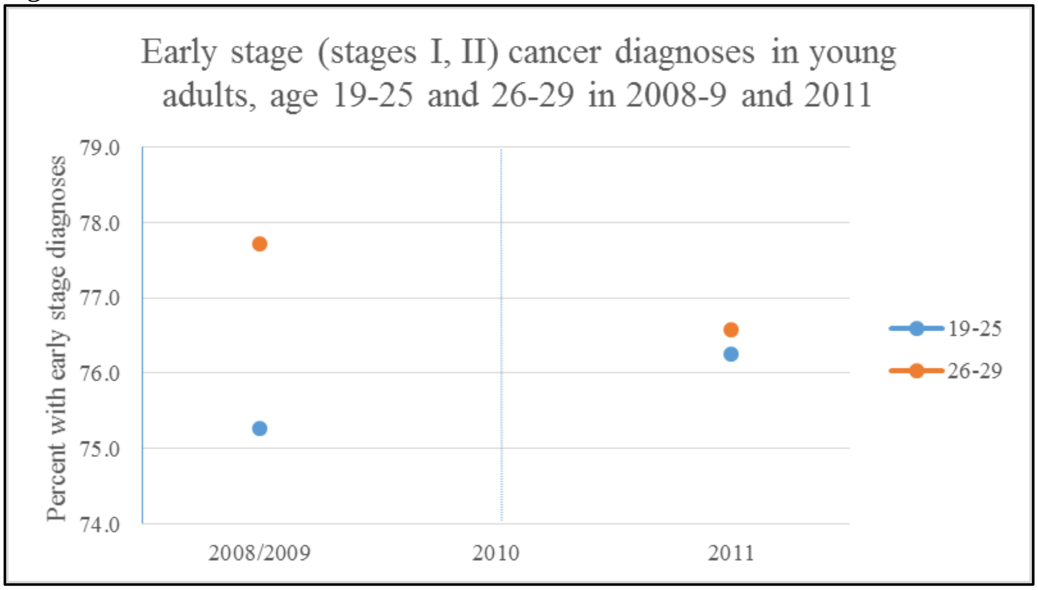

Figure 2. Only common AYA cancers.

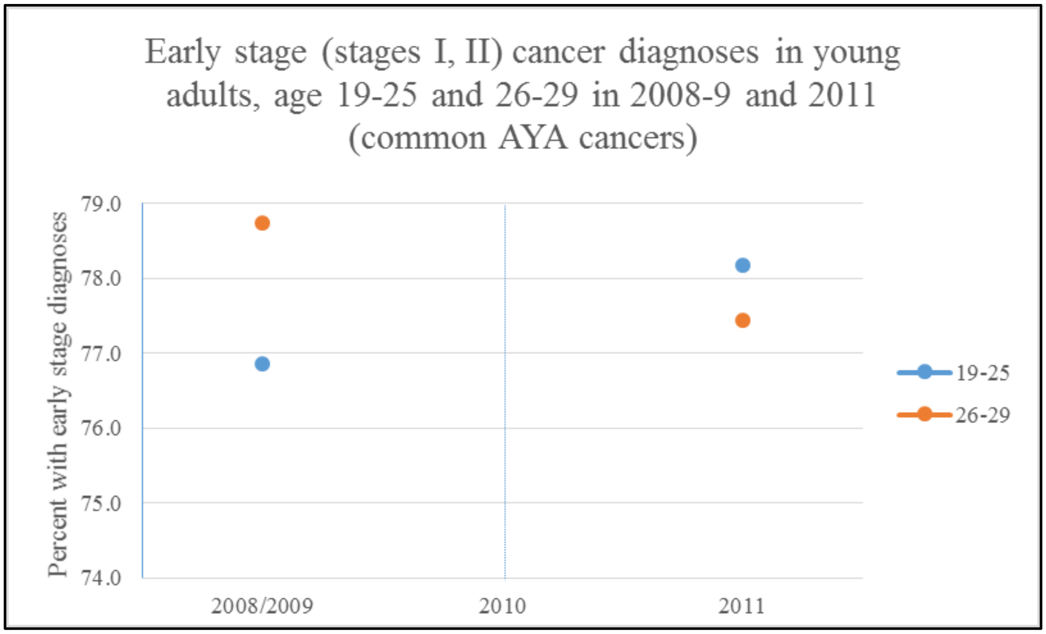

Table 1. Characteristics of 18-29 year olds with first primary cancer diagnosis between in 2008, 2009, and 2011 reported to SEER registries

		2008-2009 (n=8,711)				Chi square p-value[6]	2011 (n=4,430)				Chi square p-value[7]	Chi square p-value[8]
	(n=13,141)	19-25 (n=4,424)		26-29 (n=4,287)			19-25 (n=2,269)		26-29 (n=2,161)			
	n (%)	n	%	n	%		n	%	n	%		
Sex						<0.0001					<0.0001	0.3910
Male	5,642 (42.93)	2,047	46.27	1,670	38.95		1,058	46.63	867	40.12		
Female	7,499 (57.07)	2,377	53.73	2,617	61.05		1,211	53.37	1,294	59.88		
Race/ethnicity						0.6275					0.3477	0.5402
Non-Hispanic White	7,945 (60.46)	2,695	60.92	2,593	60.49		1,364	60.11	1,293	59.83		
Non-Hispanic Black	1,073 (8.17)	369	8.34	353	8.23		174	7.67	177	8.19		
Non-Hispanic Other	1,314 (10.00)	415	9.38	438	10.22		222	9.78	239	11.06		
Hispanic	2,809 (21.38)	945	21.36	903	21.06		509	22.43	452	20.92		
Rural[1]						0.0144					0.7883	0.4176
Rural	12,176 (92.78)	4,133	93.57	3,949	92.22		2,096	92.42	1,988	92.63		
Urban	948 (7.22)	284	6.43	333	7.78		172	7.58	159	7.37		
Marital status						<0.0001					<0.0001	<0.0001
Married	3,602 (29.51)	754	18.1	1,769	44.65		308	14.74	771	38.76		
Not married[4]	8,604 (70.49)	3,412	81.9	2,193	55.35		1,781	85.26	1,218	61.24		
Insurance status[5]						0.0358					0.9751	0.6726
Insured	11,400 (86.75)	3,821	86.37	3,731	87.03		1,982	87.35	1,866	86.35		
Uninsured	1,063 (8.09)	389	8.79	322	7.51		181	7.98	171	7.91		
Unknown	678 (5.16)	214	4.84	234	5.46		106	4.67	124	5.74		
% < High school education (quartiles)[2]						0.5794					0.2469	0.5961
<=10.99	3,428 (26.09)	1,148	25.95	1,144	26.69		583	25.69	553	25.59		
11-14.27	3,193 (24.30)	1,060	23.96	1,047	24.43		532	23.45	554	25.64		
14.28-20.76	3,483 (26.51)	1,208	27.31	1,116	26.04		594	26.18	565	26.15		
20.77-42.63	3,036 (23.11)	1,008	22.78	979	22.84		560	24.68	489	22.63		
% < Persons below poverty (quartiles)[2]						0.2663					0.9958	0.2483
<=10.88	3,385 (25.76)	1,138	25.72	1,114	25.99		581	25.61	552	25.54		
10.89-13.86	3,508 (26.70)	1,214	27.44	1,135	26.48		590	26.00	569	26.33		
13.87-17.12	3,433 (26.13)	1,181	26.70	1,107	25.83		588	25.91	557	25.78		
17.13-44.90	2,814 (21.42)	891	20.14	930	21.70		510	22.48	483	22.35		
Median income (quartiles)[2]						0.0764					0.0557	0.4536
Between $21,170 and $51,350	3287 (25.02)	1,046	23.64	1,100	25.66		559	24.64	582	26.93		
Between $51,351 and $57,540	3,322 (25.28)	1,157	26.15	1,038	24.22		614	27.06	513	23.74		
Between $57,541 and $69,010	3,255 (24.77)	1,105	24.98	1,073	25.03		552	24.33	525	24.29		
Between $69,011 and $106,430	3,276 (24.93)	1,116	25.23	1,075	25.08		544	23.98	541	25.03		
Cancer types						0.4653					0.8397	0.5417
Common cancers[3]	12,061 (91.78)	4,065	91.89	3,921	91.46		2,089	92.07	1,986	91.90		
Non-common cancers	1,080 (8.22)	359	8.11	366	8.54		180	7.93	175	8.10		

[1] County-level rural/urban attributes from United States Department of Agriculture External Web Site Policy
[2] County-level attributes were extracted from 2008-2012 Census American Community Survey
[3] Common cancers are: breast cancer, melanoma, thyroid cancer, testis cancer, Non-Hodgkin lymphoma, uterine cervix cancer, Hodgkin lymphoma, colorectal cancer, central nervous system tumors, soft tissue sarcoma (excluding Kaposi sarcoma), oral cavity cancer, and lung cancer, as identified by Bleyer, A. and R. Barr (2009). "Cancer in young adults 20 to 39 years of age: overview." Semin Oncol 36(3): 194-206.
[4] Not married includes those who are divorced, separated, single (never married), unmarried or domestic partner, or widowed.
[5] Chi-square comparison for insurance status excluded "Unknown" observations.
[6] Chi-square comparisons are between 19-25 and 26-29 year olds in 2008-9.
[7] Chi-square comparisons are between 19-25 and 26-29 year olds in 2011.
[8] Chi-square comparisons are between years 2008-9 and 2011.

Table 2. Distribution of stage at cancer diagnosis by age and year group

		2008-2009 (n=10,234)				2011 (n=5,235)			
		19-25 (n=5,199)		26-29 (n=5,035)		19-25 (n=2,673)		26-29 (n=2,562)	
	n (%)	n	%	n	%	n	%	n	%
All cancers (n=13,141)									
Early stage	10,047 (76.46)	3,330	75.27	3,332	77.72	1,730	76.25	1,655	76.58
Late stage	3,094 (23.54)	1,094	24.73	955	22.28	539	23.75	506	23.42
Common cancers (n=12,477)[2]									
Early stage	9,702 (77.76)	3,124	76.85	3,087	78.73	1,633	78.17	1,538	77.44
Late stage	2,775 (22.24)	941	23.15	834	19.45	456	21.83	448	22.56

[1] Bladder cancer stage 0 added to stage I/II for analysis (n=93)
[2] Common cancers are: breast cancer, melanoma, thyroid cancer, testis cancer, Non-Hodgkin lymphoma, uterine cervix cancer, Hodgkin lymphoma, colorectal cancer, central nervous system tumors, soft tissue sarcoma (excluding Kaposi sarcoma), oral cavity cancer, and lung cancer, as identified by Bleyer, A. and R. Barr (2009). "Cancer in young adults 20 to 39 years of age: overview." Semin Oncol 36(3): 194-206.

Table 3. Difference-in-differences effects of the Affordable Care Act dependent coverage expansion on early stage diagnosis for adults ages 19-25 and 26-29

	Adults ages 19-25 with early stage cancer diagnosis before 2010 (%)[1]	Percentage-point change, before (2008-9) versus after (2011) PPACA dependent coverage expansion[2]		Difference in percentage-point change between age groups (95% CI)	p-value for between-group difference
		Adults ages 19-25	Adults ages 26-29		
All cancers (n=13,141					
Early stage diagnosis	75.27	0.974	-1.138	2.11 (-0.96 to 5.18)	0.1774
All cancers, after adjustment[3] (n=12,194)					
Early stage diagnosis	75.27	0.857	-1.110	1.97 (-1.12 to 5.05)	0.2118
Common cancers[4], (n=12,061)					
Early stage diagnosis	76.85	1.320	-1.288	2.61 (-0.53 to 5.74)	0.1032
Common cancers[4], after adjustment[3] (n=11,554)					
Early stage diagnosis	76.85	1.452	-1.469	2.92 (-0.24 to 6.08)	0.0701

[1] Bladder cancer stage 0 added to stage I/II for analysis (n=93)
[2] Expansion was on September 23rd, 2010
[3] Models adjusted for sex, race and ethnicity, absolute age at diagnosis, residence in rural/urban county, marital status at diagnosis, and % <high school education
[4] Common cancers are: breast cancer, melanoma, thyroid cancer, testis cancer, Non-Hodgkin lymphoma, uterine cervix cancer, Hodgkin lymphoma, colorectal cancer, central nervous system tumors, soft tissue sarcoma (excluding Kaposi sarcoma), oral cavity cancer, and lung cancer, as identified by Bleyer, A. and R. Barr (2009). "Cancer in young adults 20 to 39 years of age: overview." Semin Oncol 36(3): 194-206.

Discussion

Analyzing all cancers, the Affordable Care Act (ACA) dependent coverage expansion increased the proportion of early stage diagnosis in 19-25 year olds by 2.1 percentage points from 2008-9 to 2011, although not statistically significant. After adjustment, this percentage point decreased to 2.0. Analyzing just cancers common in the adolescents and young adults (AYA) population, the policy increased the proportion of early stage diagnosis by 2.6 percentage points, also not statistically significant, and after adjustment, this was 2.9. There is a general trend in increase of the proportion of early stage cancer diagnosis in 19-25 year olds after the policy implementation.

Many of the common cancers in young adults have early symptoms (W. A. Bleyer, 2002). These symptoms are checked for during physical exams (W. A. Bleyer, 2002) and symptom evaluation; this is likely the pathway through which the ACA dependent coverage expansion improved the early diagnosis of cancer in the targeted young adults. This may also explain why excluding non-common cancers resulted in stronger difference-in-differences estimates. It is especially important for young adults to have insurance/access to care to be able to catch cancers at early stage.

Results, although non-significant, are consistent with previous studies on health insurance status and cancer outcomes. Martin et al., looking at 15-29 year olds newly diagnosed with cancer between 2001 and 2003, found that not having insurance was associated with more advanced stage. Robbins et al., looking at nationally representative data, found similar results as Marin et al. (Robbins et al., 2014). Results of this study indicate a general increase in early stage cancer diagnosis in 19-25 year olds after ACA dependent coverage expansion.

In terms of insurance status, 26-29 year olds were more likely to be insured in 2008-9 compared to 19-25 year olds (p-value=0.0358) however, this was non-significant in 2011 (p-value=0.9751). This suggests a general trend in increasing insured 19-25 year olds, as reported by previous studies (Cantor et al., 2012).

Limitations

The most recent data available from SEER post policy was just one year (2011 data). Follow-up data was short. However, there is indication of a positive trend of the proportion of early stage cancer diagnosis in 19-25 year olds. The impact of ACA-dependent coverage expansion on cancer stage at diagnosis warrants further monitoring with updated data.

Socio-economic status measures (% persons below poverty, median household income, and %< high school education) were all county-level attributes. Individual-level data was not available, which may have affected outcome estimates.

This study has implications for future ACA provisions, notably Medicaid expansion, where individuals under 65 years old with incomes up to 133 percent of the federal poverty line may become eligible for Medicaid (health insurance coverage) (Ku, 2010). As cancer incidence is associated with age and insurance status is associated with early stage diagnosis as reported by other studies ((Robbins et al., 2014); (Aizer et al., 2014); (Rosenberg, Kroon, Chen, Li, & Jones, 2014)), it is likely that early stage diagnosis would be associated with Medicaid expansion as well. In fact, Medicaid expansion may have a bigger impact on early diagnosis of cancer than the dependent expansion provision because there are not as many screening services applicable to this age group (only pap test is applicable, but the use may have decreased in this period because of a change in guidelines), while Medicaid expansion will likely increase people’s access to breast, colorectal, and cervical cancer screening at older age, which will help in catching cancer at an early stage.

Future areas of research can expand on the type of insurance coverage and stage at cancer diagnosis. Rosenberg et al. used SEER data and found that patients who had non-private insurance tended to have more advanced-stage disease and die quickly compared to their privately insured counterparts (Rosenberg et al., 2014). Disregarding the type of insurance, other studies can look at the ACA on other cancer outcomes such as receipt of treatment and prognosis, and mortality.

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