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Effect Modification of the Association Between Race and Stage at Colorectal Cancer Diagnosis by Socioeconomic Status

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Abstract

Objectives—To compare risks of distant-stage colorectal cancer (CRC) diagnosis between Whites and American Indian/Alaska Natives (AI/AN) and to explore effect modification by area-based socioeconomic status (SES).

Design—Retrospective cohort study using data from the Oklahoma Central Cancer Registry.

Setting—Oklahoma.

Participants—White and AI/AN cases of CRC diagnosed in Oklahoma between 2001 and 2008 (N= 8 438). A sub-analysis was performed on the cohort of those ages 50 and older (N=7 728).

Main Outcome Measure—Risk of distant-stage CRC diagnosis stratified by SES score.

Results—Race and SES were independently associated with distant-stage diagnosis. In SES-stratified analyses, AI/ANs in the two lowest SES groups experienced increased risks in the overall cohort and among those 50 and older. In multivariable models, risks remained significant among those 50 and older in the lowest SES groups (Adjusted RR SES score of 2: 1.31, 95% CI: 1.06, 1.63 and Adjusted RR SES score of 1: 1.21, 95% CI: 1.01, 1.44).

Conclusion—SES is an effect modifier in the association between race/ethnicity and stage at CRC diagnosis. Disparities in stage at CRC diagnosis exist between AI/ANs and whites with lower estimated SES. Efforts are needed to increase CRC screening among lower SES AI/ANs.

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Keywords

healthcare disparities; cancer staging; colorectal cancer; American Indians; epidemiologic effect modifiers

Introduction

Colorectal cancer (CRC) is the second most common cause of cancer-related death in the United States (US) and will cause an estimated 50 630 US deaths in 2018.[1] These deaths have persistently been unequally distributed among racial groups. Compared to Whites, American Indians/Alaska Natives (AI/AN) experience disparities in CRC survival and mortality.[2–4] CRC screening with colonoscopy can detect precancerous lesions and cancers at earlier stages (i.e., when the tumor is smaller and localized). Because CRC prognosis is highly dependent upon the severity of disease at diagnosis, disparities in CRC mortality can be partially explained by diagnoses at later stages (i.e., when the cancer has spread to distant lymph nodes or organs).[5] Efforts to improve CRC screening access and compliance with national guidelines can improve survival, but the most efficient interventions will specifically target those at highest risk of late-stage diagnosis. While several studies demonstrated a higher proportion of AI/ANs were diagnosed at advanced CRC stages,[6,7] other studies[8,9] did not detect an association between AI/AN race and advanced diagnosis.

Developing a more robust understanding of the association between race and SES can help in targeting CRC prevention and screening resources. Although population-based cancer registries do not collect individual-level data on SES, community-level measures of SES can be used as proxy measures. Prior research has demonstrated that adjusting for community-level SES removes disparities in advanced stage CRC diagnosis for AI/ANs.[10] For example, in an analysis of South Dakota cancer registry data, all logistic regression models that adjusted for a composite socioeconomic deprivation factor estimated a non-significant association between AI/AN race and late-stage CRC diagnosis.[10] Race and SES appear to be independent predictors of stage at CRC diagnosis, but their effects may be difficult to separate. Exploring effect modification by SES allows for the identification of specific populations at high-risk of late-stage diagnosis. Effect modification by SES can be explored by examining the association between race and stage at CRC diagnosis at various levels of SES. Only a few studies have evaluated the relationship between these three variables in stratified analyses.[11–14] Two studies that stratified their results by race reported that the measures of association for advanced stage CRC were significantly higher in lower SES Hispanics compared with higher SES Hispanics, but the associations were not significant among African Americans.[13,14] No prior research examining SES as an effect modifier in the association between race and late-stage CRC diagnosis have included an AI/AN race category. Therefore, it remains unknown whether AI/ANs experience disparities in late-stage CRC diagnosis compared with Whites across levels of SES. This information would guide the distribution of resources to increase access to CRC screening. Our specific aims were to 1) compare risks of distant-stage CRC diagnosis between non-Hispanic (NH) Whites and AI/ANs and 2) explore SES as an effect modifier in the association between race/ethnicity and distant-stage CRC diagnosis.

Methods

Data source and inclusion criteria

This analysis was part of a larger project to examine cancer survival among AI/ANs including cancer records diagnosed from January 1, 2001 and December 31, 2008 in Oklahoma. Incident cases of CRC were identified from the Oklahoma Central Cancer Registry (OCCR) using International Classification of Diseases for Oncology (3rd ed.) codes C18.0; C18.2-C20.9. The target population consisted of cases diagnosed and/or treated for CRC in Oklahoma during the above-mentioned time period (N=15 848). National Cancer Institute (NCI) Surveillance, Epidemiology, and End Results (SEER) Summary Staging 2000 was used, which describes tumors as in situ, localized, regional, or distant.[15] We evaluated differences between those with “distant-stage” CRC diagnoses (SEER distant stage tumors; UICC TNM T4-M1) and those with “early-stage” CRC diagnoses (SEER in situ or localized stage tumors; UICC TNM Tis, T1, T2, TXa, T3). Because of our interest in the outcome of advanced CRC diagnosis, we excluded cases diagnosed at regional stages (UICC TNM T3-T4; n=5076; 32.03%) and unknown stages (UICC TNM MX; n=1525, 9.62%).

Study variables

Individual-level data used for this analysis were race/ethnicity, sex, age, primary insurance payer, and marital status. Race/ethnicity was defined using three variables in the OCCR: primary race identification, North American Association of Central Cancer Registries Hispanic Identification Algorithm, and Indian Health Services (IHS) linkage. To reduce misclassification of AI/ANs, OCCR data were linked to the IHS database to identify AI/AN cases which may have been misclassified in the OCCR database.

The residential address at diagnosis for each patient was geocoded to a census tract (CT). For cases with 2010 CT classifications, we used the Longitudinal Tract Data Base for conversion to 2000 CT boundaries so that all cases had 2000 CT classifications. Addresses with PO boxes and rural routes were geocoded to ZIP centroids (i.e. the center of the ZIP code) rather than CTs as the exact location was unknown. An SES composite score was created from four SES measures which were each independently associated with stage at CRC diagnosis (data not shown): median household income in the CT, median house value in the CT, percentage of the population in the CT living below the federal poverty level, and the percentage of those 25 or older in the CT with at least a high school education.[16] Median household income and median house value were scaled to variables with a range from 0–1. CT-level poverty was reverse coded so that higher values corresponded to higher SES scores. Scores from the four variables were summed and divided into quartiles. Following recently published recommendations, urbanicity was defined using CT-level Rural Urban Commuting Area (RUCA) codes.[17] The study cohort contained a small number of cases (n=44; 0.5%) with addresses that were unable to geocode and did not contribute information to analyses using area-level data.

Statistical analysis

Our primary analysis included cases of all ages. To determine if the relationship differed among only those recommended for average-risk routine CRC screening, we performed a sub-analysis on cases 50 or older based on CRC screening guidelines during the study period. Risk ratios (RRs) and 95% CIs were calculated using log binomial regression models. Bivariate associations were examined between distant-stage CRC diagnosis and each covariate, and those which were significant at alpha=0.10 were controlled by inclusion in the multivariable analyses. To address the second aim, we presented results of the crude and adjusted associations between race and CRC diagnosis stratified by SES score. Analyses were performed with SAS version 9.3: SAS Institute; Cary, NC. Unless otherwise specified, we used an alpha of 0.05 to determine statistical significance.

Results

Our study population included 8 438 cases of CRC, of which 2 526 (29.9%) experienced the outcome of distant-stage CRC diagnosis. As expected from the distribution of race in Oklahoma, Whites were a majority (n=7 733; 91.6%) with smaller numbers of AI/AN (n=705, 8.4%) cases. The proportion of distant diagnosis was lower among Whites (29.5%) compared to AI/AN (34.3%) (Table 1). AI/ANs experienced elevated risks of late-stage diagnosis compared to Whites (RR: 1.16, 95% CI: 1.04, 1.29). No differences were detected between males and females. The risk of distant-stage diagnosis decreased with age. Among insurance status groups, cases with no insurance experienced the highest proportions of distant-stage diagnosis (53.7%), followed by those with Medicaid (50.6%), and both were associated with higher risks of distant-stage diagnoses compared to other categories of insurance. Those in the most rural CTs had marginally significantly increased risks of distant-stage CRC (RR=1.10, 95% CI: 1.00, 1.21). Compared with those in the highest SES category, all other groups had an increased risk of late-stage diagnosis, with an estimated 21% increase in risk for those in the lowest SES group (RR=1.21 95% CI: 1.10, 1.33).

Among those ages 50 or older, we analyzed 7 728 cases of CRC, and the percentage experiencing the outcome of distant-stage CRC diagnosis (29.2%) was similar to the entire case group (29.9%). The distribution of distant-stage diagnosis among racial groups was also similar: White (n=2 059, 28.9%) and AI/AN (n=196, 32.4%) (Table 1). Being uninsured compared to private/insurance not otherwise specified was associated with the highest risk of distant-stage diagnosis, with a RR of 1.97 (95% CI: 1.72, 2.26). Those with an SES score of 1 or 2 continued to be associated with late-stage diagnosis, but an SES score of 3 did not experience significantly increased risks of distant-stage diagnosis in this subset of the cohort.

Stratified analysis

AI/ANs experienced increased risks of distant-stage diagnosis compared to Whites in the two lowest SES groups (Table 2). These associations for AI/ANs were slightly attenuated in the adjusted models, but the association in the lowest SES group remained statistically significant (RR=1.18, 95% CI: 1.01, 1.39). Similar to the cohort of all ages, AI/ANs 50 or older in the two lowest SES groups experienced increased risks of distant-stage diagnosis,

but in this cohort, the increased risks for both groups remained significant in multivariable models, with RRs of 1.31 (95% CI: 1.06, 1.63) in SES group 2 and 1.21 (95% CI: 1.01, 1.44) in the lowest SES group (Figure 1).

Discussion and Conclusion

This analysis estimated risks of distant-stage CRC diagnosis by race/ethnicity among cases of all ages and separately among those 50 and older (those recommended for routine screening during the study period). The major conclusion is that SES is an effect modifier in the association between race/ethnicity and stage at CRC diagnosis. Although the crude association between AI/AN race and risk of distant stage diagnosis was not significant among the cohort aged 50 or older, AI/ANs with SES scores of 1 had significant unadjusted increased risks compared with Whites with SES scores of 1 in both study cohorts. Adjusting for age, primary payer at diagnosis, and marital status resulted in little change in the estimates and confidence intervals. AI/ANs with an SES score of 2 experienced the highest increase in risk of distant-stage diagnosis in the cohort of cases recommended for routine screening, with a 34% increase in distant-stage diagnosis compared with Whites with SES scores of 2. The increased risk was only slightly attenuated to 31% after adjustment for age, primary payer at diagnosis, and marital status. Among the cohort of cases of all ages, an increased risk of distant-stage diagnosis was also observed for AI/ANs in the lowest SES category, but associations among AI/ANs with an SES score of 2 became non-significant after adjustment. Results demonstrate the magnitude of racial disparities in stage at CRC diagnosis between Whites and AI/ANs differ across levels of SES, with the largest racial disparity experienced among those in the lowest SES groups.

Our study is the first to explore SES as an effect modifier while including an AI/AN comparator. Previous observational studies, although not stratified by SES, have reported racial disparities in CRC diagnosis among AI/ANs.[6,7,18] For cancers for which there is a screening test, AI/ANs in South Dakota were more likely to present with American Joint Committee on Cancer Staging (AJCC) stages III-IV cancer compared to NH Whites (45% vs 24%).[18] A study which analyzed data collected from SEER registries from 1988 to 2000 found AIs, when compared to NH Whites, had higher odds of AJCC stage III CRC (aOR=1.6, 95% CI=1.2, 2.1) and stage IV CRC (aOR=1.4, 95% CI=1.1, 2.0).[6] Another analysis of SEER data from 1992–2003 also found AI/ANs were more likely to be diagnosed with late-stage colon cancer compared to Whites (52.4% vs 45.6%).[7] AI/AN populations included in SEER data primarily include AI/ANs from Alaska and the southwestern US, thus, may differ from AI/ANs in Oklahoma regarding factors related to stage at diagnosis. Our results add to the findings of White-AI/AN CRC disparities that have already been reported.

Increasing compliance to national CRC screening guidelines can mitigate disparities in stage at CRC diagnosis in Oklahoma. A recent case-control study reported receipt of CRC screening with colonoscopy was associated with a 67% reduction in CRC mortality risk among screening-eligible Kaiser Permanente members.[19] Our results can guide the selection of subpopulations to target for interventions to increase screening. We demonstrated AI/ANs with lower SES are at particularly high risk of distant-stage diagnosis compared with Whites

with similar SES levels. AI/ANs with low SES may experience many barriers to CRC screening including both socioeconomic barriers (e.g., insufficient transportation, high cost, lack of insurance) and cultural barriers (e.g., lack of culturally-tailored education, historic mistrust, preference for traditional medicine).[20,21] Methods to decrease CRC screening disparities among AI/AN populations include text message reminders and patient navigation services.[22,23]

A strength of our analysis is the availability of a high-quality population-based cancer registry, which reduced the potential for selection bias in our study. In addition, Oklahoma has a relatively high AI/AN population compared to the US (9% v. 1%).[24] This allowed us to quantify disparities between Whites and AI/ANs, a population not included in similar publications focused on disparities in stage at diagnosis of CRC.[11,25,26] There are also several limitations in the current study. As this analysis of a larger project, more recent data beyond year 2008 were not available. SES should be explored as an effect modifier in the association between race and CRC stage at diagnosis in the era of the Affordable Care Act (ACA) due to improvements in health insurance access and the requirement for most public and private insurers to cover preventive services recommended by the United States Preventive Services Task Force.[27] These changes may have reduced disparities in CRC screening access between high and low SES individuals. According to data from the 2008–2013 National Health Interview Survey, the prevalence of CRC screening among adults with private or Medicare insurance increased the most among those with the lowest annual incomes (<$35,000), from 53.5% in 2008 to 59.4% in 2013 (prevalence difference=5.9; 95% CI: 1.8, 10.2).[28] However, it is unknown whether changes in access to CRC screening after the ACA occurred equally between low SES Whites and low SES AI/ANs. If screening disparities remained between Whites and AI/ANs with low SES, it is likely that SES would remain an effect modifier in the association between race late-stage diagnosis in more recent data.

We did not have individual-level measurements of SES and therefore used area-based indicators of SES to create a composite score. However, the use of area-based SES measures in analyses of cancer registry data is a widely used proxy measure of SES in the absence of individual measurements. In addition, there is potential for racial misclassification in our study due to methods used by cancer registry databases to collect information on race/ethnicity.[5] Race/ethnicity in OCCR may not be determined by self-identification but rather by provider observation. Linking cancer registry data with IHS data can reduce misclassification of AI/ANs considerably, which was noted as a limitation in Cueto et al. (2011), but is a strength of this study.[5,7] Another limitation is that the use of different cancer staging systems and categorizations of “early” and “late” stage diagnoses in similar analyses prevents direct comparison of results between studies. Our study is different from many studies that used AJCC or UICC TNM Classification of Malignant Tumors or that combined SEER regional and distant stages into the late-stage category. We elected to exclude cases diagnosed at regional stages to narrow our focus to the risk of more advanced diagnosis. This may have allowed us to detect an association between race and distant-stage CRC diagnosis in stratified analyses that would be non-significant had we included regional cases in our “distant-stage” category. Categorization of regional diagnoses into a “late-stage” group can dilute associations between exposures and advanced disease diagnosis. Finally, we

did not have information on screening rates, healthcare access, behavioral factors (e.g., smoking status), or family health history, which may have further explained the increased risks for AI/ANs and AAs in specific SES groups.

Through partnership with the Oklahoma Area Tribal Epidemiology Center (OKTEC), this analysis provides critical information in understanding cancer health disparities among AI/ANs in Oklahoma. The implications of our findings were developed with the assistance of co-authors from the OKTEC (C.S., T.D.). Through partnerships with tribes, tribal health systems, and the urban Indian health centers, the OKTEC can expand current efforts to promote CRC screening in the Oklahoma Area AI/AN population through the Tribal Epidemiology Centers Public Health Infrastructure program. Our study demonstrated that disparities in stage at CRC diagnosis exist between AI/ANs and Whites in groups with lower estimated SES, even after adjustment for confounders. These results warrant targeted efforts to increase CRC screening among underserved Oklahoma populations, especially AI/ANs with lower SES.

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Implications for Policy and Practice

- National guidelines recommend routine screening for colorectal cancer (CRC) starting in middle-age adulthood.
- Our study demonstrated American Indians/Alaska Natives in the lowest socioeconomic status (SES) groups had increased risks of distant-stage CRC diagnosis relative to Whites in the lowest SES groups.
- Improving screening access may reduce disparities in stage at CRC diagnosis in Oklahoma. Culturally sensitive interventions should be prioritized.
- Efforts are needed to further explore SES as an effect modifier in the association between race and stage at CRC diagnosis over time as changes have occurred in national health insurance laws.

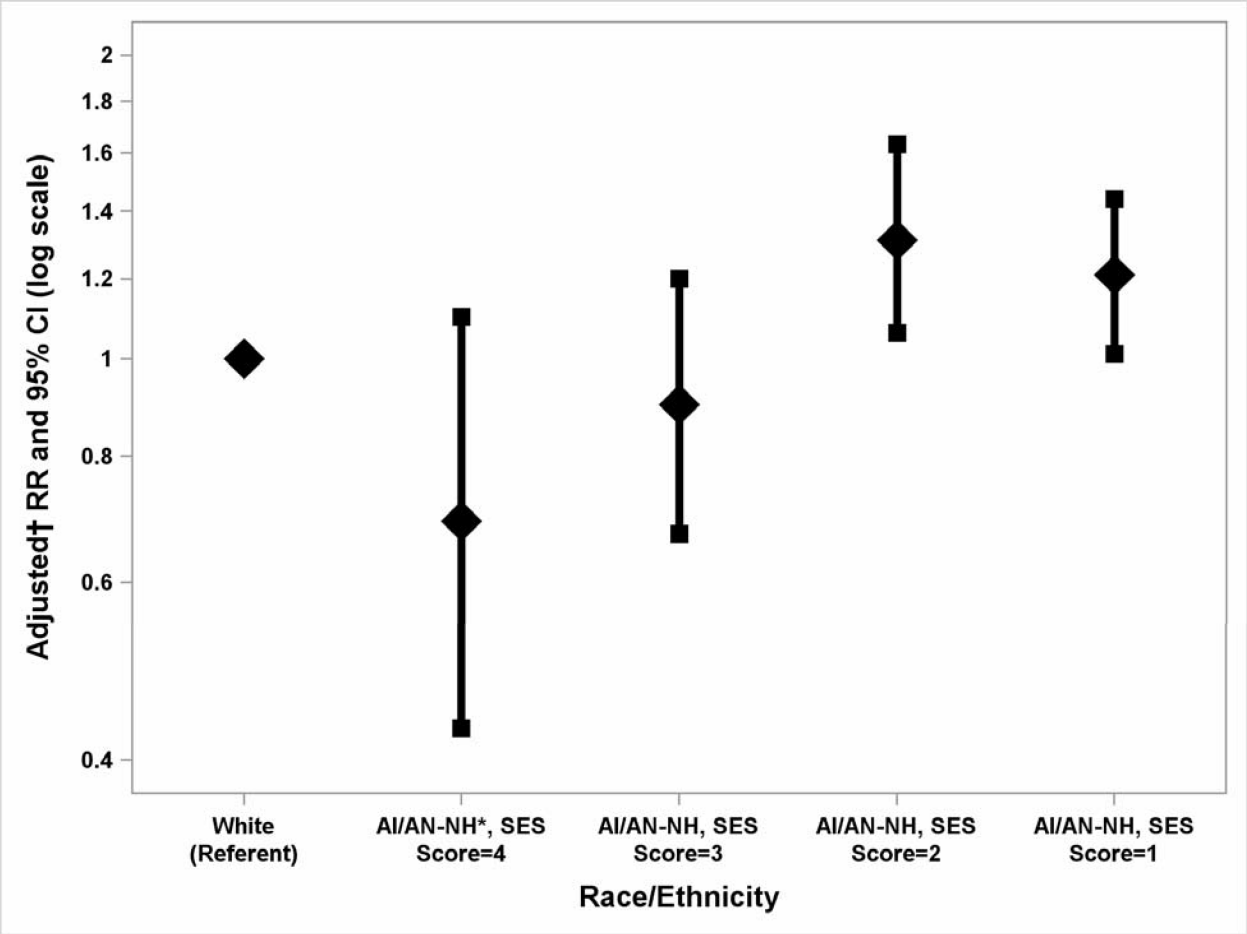

Figure 1.

Adjusted risk ratios and 95% confidence intervals for distant-stage colorectal cancer diagnosis among all cases and cases ages 50 and older, by SES composite score; Oklahoma, 2001–2008

†Adjusted for age, primary payer at diagnosis, and marital status

*Non-Hispanic

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Table 1.

Early and distant stage colorectal cancer diagnoses among all cases and cases ages 50 or older; Oklahoma 2001–2008.

	All cases (N=8438)			Cases 50 or older (N=7728)		
Variable	**Early stage n (%)**	**Distant stage n (%)**	**Crude RR (95% CI)***	**Early stage n (%)**	**Distant stage n (%)**	**Crude RR (95% CI)***
Race/Ethnicity						
White, NH†	5449 (70.5)	2284 (29.5)	1.00	5064 (71.1)	2059 (28.9)	1.00
AI/AN, NH	463 (65.7)	242 (34.3)	**1.16 (1.04, 1.29)**	409 (67.6)	196 (32.4)	1.12 (0.99, 1.26)
Sex						
Female	2855 (70.5)	1197 (29.5)	1.00	2640 (71.1)	1073 (28.9)	1.00
Male	3057 (69.7)	1329 (30.3)	0.97 (0.91, 1.04)	2833 (70.6)	1182 (29.4)	0.98 (0.92, 1.05)
Age Group						
Less than 40	109 (58.3)	78 (41.7)	**1.36 (1.14, 1.64)**	-	-	
40–49	330 (63.1)	193 (36.9)	**1.21 (1.06, 1.37)**	-	-	
50–59	910 (66.0)	468 (34.0)	**1.11 (1.01, 1.23)**	910 (66.0)	468 (34.0)	**1.11 (1.01, 1.23)**
60–69	1377 (69.4)	607 (30.6)	1.00	1377 (69.4)	607 (30.6)	1.00
70–79	1781 (73.1)	656 (26.9)	**0.88 (0.80, 0.97)**	1781 (73.1)	656 (26.9)	**0.88 (0.80, 0.97)**
80 and above	1405 (72.8)	524 (27.2)	**0.89 (0.80, 0.98)**	1405 (72.8)	524 (27.2)	**0.89 (0.80, 0.98)**
Primary Payer						
Private, NOS‡	1696 (71.3)	682 (28.7)	1.00	1379 (72.2)	532 (27.8)	1.00
Uninsured	144 (46.3)	167 (53.7)	**1.87 (1.66, 2.11)**	106 (45.1)	129 (54.9)	**1.97 (1.72, 2.26)**
Medicaid	133 (49.4)	136 (50.6)	**1.76 (1.54, 2.02)**	108 (54.6)	90 (45.5)	**1.63 (1.38, 1.93)**
Medicare	3618 (72.2)	1393 (27.8)	0.97 (0.90, 1.05)	3597 (72.2)	1382 (27.8)	1.00 (0.92, 1.09)
Government-other	206 (73.1)	76 (27.0)	0.94 (0.77, 1.15)	187 (73.6)	67 (26.4)	0.95 (0.76, 1.18)
Unknown	115 (61.5)	72 (38.5)	**1.34 (1.11, 1.63)**	96 (63.6)	55 (36.4)	**1.31 (1.05, 1.63)**
Marital Status						
Married	3375 (71.8)	1327 (28.2)	1.00	3077 (72.2)	1185 (27.8)	1.00
Unmarried	2034 (67.2)	991 (32.8)	**1.16 (1.08, 1.24)**	1921 (68.4)	888 (31.6)	**1.14 (1.06, 1.22)**
Unknown	503 (70.8)	208 (29.3)	1.04 (0.92, 1.17)	475 (72.3)	182 (27.7)	1.00 (0.87, 1.14)
Urbanicity§						
1 (most urban)	3054 (70.7)	1267 (29.3)	1.00	2804 (71.2)	1135 (28.8)	1.00

Variable	All cases (N=8438)			Cases 50 or older (N=7728)		
	Early stage n (%)	Distant stage n (%)	Crude RR (95% CI)*	Early stage n (%)	Distant stage n (%)	Crude RR (95% CI)*
2	1325 (70.2)	563 (29.8)	1.02 (0.94, 1.10)	1242 (70.9)	509 (29.1)	1.01 (0.92, 1.10)
3	775 (70.0)	332 (30.0)	1.02 (0.92, 1.13)	719 (70.8)	297 (29.2)	1.01 (0.91, 1.13)
4 (most rural)	730 (67.7)	348 (32.3)	**1.10 (1.00, 1.21)**	683 (69.4)	301 (30.6)	1.06 (0.95, 1.18)
SES Composite§						
4, highest	1573 (73.0)	582 (27.0)	1.00	1434 (73.0)	530 (27.0)	1.00
3	1502 (70.0)	643 (30.0)	**1.11 (1.01, 1.22)**	1407 (71.2)	568 (28.8)	1.07 (0.96, 1.18)
2	1482 (69.7)	644 (30.2)	**1.12 (1.02, 1.23)**	1375 (70.3)	581 (29.7)	**1.10 (1.00, 1.22)**
1, lowest	1327 (67.4)	641 (32.6)	**1.21 (1.10, 1.33)**	1232 (68.6)	563 (31.4)	**1.16 (1.05, 1.28)**

Sources: Oklahoma Central Cancer Registry; 2000 Census; 2005 American Community Survey

*Risk ratios (and 95% confidence intervals) for distant stage CRC diagnosis

†NH=Non-Hispanic

‡NOS=not otherwise specified; Group includes private insurance and insurance not otherwise specified (type of insurance unknown)

§Unable to geocode n=44 (0.5%) for all cases; n=38 (0.5%) among cases 50 or older

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Table 2.

Sample sizes, crude and adjusted risk ratios (and 95% CIs) for distant-stage colorectal cancer diagnosis among all cases and cases ages 50 and older, by SES composite score; Oklahoma, 2001–2008.

	All cases (N=8394)				Cases 50 or older (N=7690)			
SES Score	**4 (high)**	**3**	**2**	**1 (low)**	**4 (high)**	**3**	**2**	**1 (low)**
Race/Ethnicity	**N (%)**	**N (%)**	**N (%)**	**N (%)**	**N (%)**	**N (%)**	**N (%)**	**N (%)**
White, NH*	2065 (26.8)	1983 (25.8)	1955 (25.4)	1697 (22.0)	1889 (26.6)	1835 (25.9)	1806 (25.5)	1563 (22.0)
AI/AN, NH	90 (13.0)	162 (23.3)	171 (24.6)	271 (39.1)	75 (12.6)	140 (23.5)	150 (25.1)	232 (38.9)
Crude	**RR (95% CI)**	**RR (95% CI)**	**RR (95% CI)**	**RR (95% CI)**	**RR (95% CI)**	**RR (95% CI)**	**RR (95% CI)**	**RR (95% CI)**
White, NH	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AI/AN, NH	0.82 (0.55, 1.21)	0.99 (0.77, 1.26)	**1.28 (1.05, 1.57)**	**1.24 (1.05, 1.46)**	0.68 (0.42, 1.10)	0.89 (0.66, 1.19)	**1.34 (1.08, 1.65)**	**1.21 (1.01, 1.46)**
Adjusted†								
White, NH	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AI/AN, NH	0.81 (0.55, 1.20)	0.99 (0.77, 1.26)	1.20 (0.97, 1.48)	**1.18 (1.01, 1.39)**	0.69 (0.43, 1.10)	0.90 (0.67, 1.20)	**1.31 (1.06, 1.63)**	**1.21 (1.01, 1.44)**

Sources: Oklahoma Central Cancer Registry; 2000 Census; 2005 American Community Survey

Unable to geocode n=44 (0.5%) for all cases; n=38 (0.5%) among cases 50 or older

*Non-Hispanic

†Adjusted for age, primary payer at diagnosis, and marital status