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Incidence of Stomach, Liver, and Colorectal Cancers by Geography and Social Vulnerability Among American Indian and Alaska Native Populations, 2010–2019

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Abstract

Social determinants of health and associated systems, policies, and practices are important drivers of health disparities. American Indian and Alaska Native (AI/AN) populations in the United States have elevated incidence rates of stomach, liver, and colorectal cancers compared with other racial/ethnic groups. In this study, we examined incidence rates of 3 types of gastrointestinal cancer among non-Hispanic AI/AN (NH-AI/AN) and non-Hispanic White (NHW) populations by geographic region and Social Vulnerability Index (SVI) score. Incident cases diagnosed during 2010–2019 were identified from population-based cancer registries linked with the Indian Health Service patient registration databases.Age-adjusted incidence rates (per 100,000 population) for stomach, liver, and colorectal cancers were compared within NH-AI/AN populations and between the NH-AI/AN and NHW populations by SVI score. Rates were higher among NH-AI/AN populations in moderate– and high–SVI-score counties in Alaska, the Southern Plains, and the East than in low-SVI counties. Incidence rates among NH-AI/AN populations were elevated when compared with NHW populations by SVI category. Results indicated that higher social

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vulnerability may drive elevated cancer incidence among NH-AI/AN populations. Additionally, disparities between NH-AI/AN and NHW populations persist even when accounting for SVI. Exploring social vulnerability can aid in designing more effective interventions to address root causes of cancer disparities among AI/AN populations.

Keywords

Alaska Natives; American Indians; cancer incidence; health disparities; social determinants of health; Social Vulnerability Index

Previous studies have shown disparities in cancer incidence rates among non-Hispanic American Indian and Alaska Native (NH-AI/AN) populations, both across different geographic regions and when compared with non-Hispanic White (NHW) populations (1, 2). These studies have highlighted leading cancers with the largest relative incidence rates among NH-AI/AN populations. When cancer incidence rates among NH-AI/AN individuals are compared with rates among NHW people, stomach cancer, colorectal cancer (CRC), and liver cancer are consistently among the leading cancers with elevated incidence (2). Cancer incidence data for NH-AI/AN populations that are aggregated nationally are likely to mask important disparities in incidence among NH-AI/AN persons (3). Geographic variation in cancer incidence could be better understood by examining community characteristics that have been associated with other chronic diseases and health inequities.

In the past, studies that examined cancer incidence among NH-AI/AN populations often focused on the potential contributions of individual behavioral risk factors (4). Increasingly, the role of social determinants of health—such as discrimination and deprivation in the economic, physical, and social environments—are being highlighted as drivers of inequities in cancer occurrence and death in the United States (5). Previous studies have suggested associations between social and economic inequality and cancer disparities (6–10) and the role of neighborhood effects in cancer prevention and screening (11–13), but integrating data sources that capture these variables with existing central cancer registry data has been challenging. The Centers for Disease Control and Prevention/Agency for Toxic Substances and Disease Registry (CDC/ATSDR) Social Vulnerability Index (SVI) uses 15 US Census variables to help local officials identify communities that may need support before, during, or after disasters (14), and it has been utilized extensively during the coronavirus disease 2019 (COVID-19) pandemic.

To date, no studies (to our knowledge) have evaluated cancer incidence rates among American Indian and Alaska Native (AI/AN) peoples by county-level SVI score. In the present study, we utilize the US Cancer Statistics AI/AN Incidence Analytic Database (USCS AIAD), which has been corrected for the racial/ethnic misclassification (15) of NH-AI/AN populations. We identify associations between SVI score and incidence rates of stomach cancer, liver cancer, and CRC among NH-AI/AN and NHW populations in the United States between 2010 and 2019. Examination of SVI score has the potential to aid in the identification of community characteristics that are drivers or equalizers of cancer risk. It may also identify areas in need of tailored policy or environmental prevention and intervention strategies for reducing health inequities among AI/AN persons.

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METHODS

Cancer cases

Cases of stomach cancer, liver cancer, and CRC, here-after called "gastrointestinal cancers," were identified from population-based registries that participate in the Centers for Disease Control and Prevention's National Program of Cancer Registries (16) or the National Cancer Institute's Surveillance, Epidemiology, and End Results (SEER) Program (17). These 3 cancers were identified as elevated-incidence cancers (cancers with the largest rate ratio (RR) when comparing the NH-AI/AN incidence rate with the NHW incidence rate) using previously published data (2). Pancreatic and esophageal cancers were not included in the present study, since rates of these cancers were not elevated in NH-AI/AN populations in the United States overall (2).

Incidence data from both the National Program of Cancer Registries and the SEER registry must meet rigorous quality control standards for each year. Analyses included malignant cancers only. During the period covered by this study (2010–2019), tumor histology, tumor behavior, and primary cancer site were classified according to the *International Classification of Disease for Oncology, Third Edition* (18).

Previous data have shown that AI/AN persons are frequently misclassified as non-AI/AN in cancer registry data, and this can lead to underestimation of their cancer incidence rates (3). To reduce this misclassification, we linked cancer registry data with the Indian Health Service (IHS) patient registration database by using previously established and validated techniques that improve the accuracy of cancer incidence estimates among AI/AN populations (3, 15). All case records from each state were linked with the IHS patient registration database. The IHS provides medical services to AI/AN people who are enrolled members of federally recognized tribes; therefore, linking cancer registry records to the patient registration database allows for the identification of AI/AN individuals who had been previously misclassified as non-AI/AN in the central cancer registry data (19). Data from both registry programs were combined to create the USCS AIAD, the analytical database used for this study (20).

These methods for addressing racial/ethnic misclassification of AI/AN cases are most effective in geographic areas that are well-served by the IHS (3). Therefore, we restricted our analyses to Purchased/Referred Care Delivery Area (PRCDA) counties, as defined by the IHS (21). These counties contain, or are located adjacent to, federally recognized tribal lands and have higher proportions of AI/AN residents than non-PRCDA counties. This use of PRCDA counties, as well as their geographic regions, has been described previously (19, 22). The USCS AIAD covered 98% of the AI/AN population living in PRCDA counties for the years included in this study (23).

Previous analyses also revealed that the updated bridged intercensal population estimates substantially overestimated AI/AN populations of Hispanic origin (24). To avoid under-estimating incidence rates in AI/AN populations, we limited all analyses to NH-AI/AN populations and chose NHWs as the reference population, consistent with prior publications

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(15). Therefore, all of the analyses in the present study were limited to non-Hispanic populations.

Social vulnerability score

We obtained county-level data on social vulnerability from the 2018 SVI, a publicly available database used to identify US communities that may be disproportionately affected by public health crises and other community-level stressors that cause morbidity and mortality (25). The 2018 SVI used contextual demographic and socioeconomic data, such as race and ethnicity, unemployment, and housing conditions, from the US Census Bureau American Community Survey 2014–2018 5-year estimates. This time period was selected to best overlap with the cancer incidence data used in this study. The 2018 SVI comprises 15 sociodemographic indicators, which are combined into 4 themes (socioeconomic status, household composition and disability, racial/ethnic minority status and language, and housing type and transportation) and a composite measure of social vulnerability (overall SVI score). Individual components of each theme have been described elsewhere (14). The "racial/ethnic minority status and language" theme represents the percentage of people in that county who are members of racial and ethnic minority groups and who speak English less well (14). While the PRCDA counties represent counties with higher proportions of AI/AN people, these counties still represent ethnically and culturally diverse populations. SVI scores are constructed using percentile ranks to measure the relative social vulnerability of US counties and census tracts on a scale of 0 to 1, with 1 representing the highest level of social vulnerability. For our study, we obtained county-level SVI scores for 648 PRCDA counties. These scores were divided into tertiles based on the distribution of SVI scores across the PRCDA counties. PRCDA counties were categorized into the following SVI tertiles: low social vulnerability (0–0.3481), moderate social vulnerability (0.3482–0.7074), and high social vulnerability (0.7075–1).

Statistical analysis

Cancer incidence rates for gastrointestinal cancers among NH-AI/AN and NHW populations were expressed per 100,000 population and were directly age-adjusted, using 19 age groups, to the 2000 US standard population using SEER*Stat software, version 8.3.9 (26). We calculated 95% confidence intervals for age-adjusted rates and RRs on the basis of methods described by Tiwari et al. (27).

Analyses included age-adjusted incidence rates for each type of gastrointestinal cancer (stomach, colorectal, liver) by sex, region, and tertiles of overall SVI score for the NH-AI/AN and NHW populations. Analyses conducted for each SVI theme showed results similar to those for overall SVI score (data not shown). RRs were calculated to show 2 separate comparisons; 1) variation of cancer incidence within racial/ethnic groups by SVI tertile (high and moderate vs. low) and 2) variation of cancer incidence within SVI tertile by race/ethnicity (NH-AI/AN vs. NHW). The latter comparison might aid in highlighting disparities that persist, even when accounting for county-level social vulnerability. Overall incidence rates for gastrointestinal cancers within each region, for PRCDA counties with available SVI scores, were also calculated for reference.

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We mapped county-level data for overall SVI among PRCDA counties by geographic region in a choropleth map using tertile classification. All mapping was conducted using ArcMap, version 10.8 (Esri, Redlands, California).

RESULTS

The geographic distribution of overall SVI scores for PRCDA counties, by region, is shown in Figure 1. Counties with low, moderate, and high SVI scores are shown in light blue, medium blue, and dark blue, respectively. Counties in the Northern Plains have a higher density of low-SVI counties, while Alaska, the Pacific Coast, and the Southwest have a higher density of high-SVI counties. The density of AI/AN populations in PRCDA counties by region is shown in Figure 2.

Incidence rates and numbers of gastrointestinal cancer cases for the United States overall, by sex, race/ethnicity, and SVI category, are shown in Table 1. Rates of gastrointestinal cancer by geographic region, sex, race/ethnicity, and SVI category are shown in Tables 2–4 and Web Tables 1–3 (available at https://doi.org/10.1093/aje/kwad194). Geographic variations and disparities in incidence rates and counts by cancer site and SVI category are described in detail below.

Stomach cancer

Overall, among NH-AI/AN populations, 160 stomach cancers were diagnosed in low-SVI counties compared with 789 diagnosed in high-SVI counties. Among NHW populations, 10,335 stomach cancers were diagnosed in low-SVI counties compared with 8,194 in high-SVI counties (Table 1).

Regionally, rates of stomach cancer in the overall NH-AI/AN population ranged from 4.3 (low SVI, East) to 31.8 (high SVI, Alaska) (Table 2). In NH-AI/AN males, rates ranged from 4.8 (low SVI, Southern Plains) to 45.8 (high SVI, Alaska), but rates were generally lower in NH-AI/AN females than in NH-AI/AN males (Web Table 1). Rates of stomach cancer were significantly elevated in moderate- and/or high-SVI counties compared with low-SVI counties among the overall NH-AI/AN population in Alaska, the Southern Plains, and the East (RRs = 1.62–2.27). Similarly, significantly elevated rates by SVI category were observed among NH-AI/AN males in Alaska and the Southern Plains (RRs = 2.04–2.92), while no significant differences were observed by SVI in NH-AI/AN females. Rates of stomach cancer were significantly elevated in NHW populations overall in moderate- or high-SVI counties compared with low-SVI counties in the Northern Plains, Southern Plains, Pacific Coast, and Southwest (RRs = 1.06–1.25).

Across most geographic regions and SVI tertiles, rates of stomach cancer were significantly higher among NH-AI/AN populations than among NHW populations (Table 2, Web Table 1). For males, RRs ranged from 1.53 (high SVI, Southern Plains) to 3.26 (low SVI, Alaska), and for females, RRs ranged from 1.75 (high SVI, Pacific Coast) to 5.00 (moderate SVI, Alaska).

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Colorectal cancer

Among NH-AI/AN males and females in the United States overall, 1,030 CRCs were diagnosed in low-SVI counties and 3,500 were diagnosed in high-SVI counties, as compared with 70,315 and 60,373 cases among NHWs in low- and high-SVI counties, respectively (Table 1).

Incidence rates of CRC overall ranged from 23.5 to – 123.4 by SVI category (Table 3). Overall, rates of CRC were significantly elevated in high-SVI counties in Alaska (RR = 1.57) and in the East (RR = 1.78). Significantly elevated incidence rates for CRC were also observed in moderate-SVI counties in the East (RR = 1.50). Significantly lower incidence rates were observed in high-SVI counties in the Pacific Coast region (RR = 0.83). These overall results were consistent with results for males (Web Table 2). Among NH-AI/AN females, rates of CRC were significantly elevated in high-SVI counties in Alaska (RR = 1.73) and the East (RR = 1.74) and in moderate-SVI counties in the Southern Plains (RR = 1.29) as compared with low-SVI counties.

Rates of CRC were significantly elevated among NH-AI/AN populations compared with NHW populations overall across each SVI category in the Northern Plains, Alaska, the Southern Plains, and the Pacific Coast, with RRs ranging from 1.16 to 5.17, but were significantly lower among NH-AI/AN populations in high-SVI counties (RR = 0.93) in the Southwest compared with NHW populations (Table 3). Significantly elevated RRs were also observed in NH-AI/AN males and females analyzed separately as compared with NHW males and females (Web Table 2). In high-SVI counties in Alaska, rates of CRC were nearly 5 times higher among NH-AI/AN males and nearly 7 times higher in NH-AI/AN females compared with NHW populations.

Liver cancer

In total, 376 liver cancers were diagnosed among NH-AI/AN populations in low-SVI counties as compared with 1,278 in high-SVI counties. In comparison, among NHW populations, 13,459 liver cancers were diagnosed in low-SVI counties compared with 12,773 in high-SVI counties (Table 1).

Overall liver cancer incidence rates were significantly elevated in moderate-SVI counties of Alaska (RR = 1.82) and the East (RR = 1.86) and in high-SVI counties of the East (RR = 2.64) (Table 4). Liver cancer incidence rates were also significantly elevated among NH-AI/AN males in moderate-SVI (RR = 1.96) and high-SVI (RR = 2.98) counties of the East (Web Table 3). Liver cancer incidence rates were not significantly elevated by SVI category in NH-AI/AN females. Among NHW populations, rates of liver cancer were significantly elevated in moderate and high SVI tertiles in every region (RRs = 1.08–1.78) except Alaska.

Liver cancer incidence among NH-AI/AN populations was significantly higher than that among NHW populations in every region and SVI category overall (1.70–3.81), as well as in males (1.56–3.39) and females (2.08–5.18) separately (Table 4, Web Table 3).

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DISCUSSION

This study utilized cancer incidence data that had been corrected for racial/ethnic misclassification of AI/AN populations to evaluate incidence rates of stomach cancer, liver cancer, and CRC among NH-AI/AN populations by county-level social vulnerability and in comparison with NHW populations. We found significantly elevated incidence rates of these gastrointestinal cancers among NH-AI/AN persons in moderate- and high-SVI counties, particularly in Alaska, the Southern Plains, and the East. We also found that incidence rates of these cancers were significantly elevated across each SVI category when compared with NHW populations, and these disparities were sometimes further elevated depending on the SVI category, particularly for stomach cancer and CRC in Alaska.

The results of this study provide new context for the existing cancer incidence literature. This study suggests that SVI may contribute to elevated cancer incidence rates in certain regions, for certain cancers such as stomach cancer and CRC. This study confirms geographic variation in rates of gastrointestinal cancers in AI/AN populations and further suggests that disparities persist between NH-AI/AN and NHW populations, regardless of county-level SVI. Through the inclusion of the SVI as a measure in this study, we can potentially generate hypotheses for these disparities in incidence and allow for the development of more focused efforts to reduce cancer risk and improve access to preventive health care at the community level for these populations.

To date, cancer incidence literature has largely focused on the prevalence of, and disparities in, risk factors typically measured at the level of the individual. *Helicobacter pylori* infection, dietary intake of smoked and preserved foods, and occupational exposures have been linked with stomach cancer (28); alcohol use, chronic viral hepatitis, cirrhosis, and nonalcoholic fatty liver disease have been linked with liver cancer (29); and obesity, dietary intake of red and processed meat, lack of physical activity, commercial tobacco use, and alcohol use have been linked with CRC (30). The literature linking individual risk factors to incidence of these cancers is robust; therefore, we aim to discuss some of the potential upstream community characteristics and environmental factors that may contribute to the varying incidence of these cancers and their related risk factors.

H. pylori, the built environment, water access, and stomach cancer

While rates of stomach cancer have been declining generally in the US population and in many populations worldwide (31), the incidence of stomach cancer among NH-AI/AN populations remains elevated, with rates as high as 31.8 per 100,000 population in high-SVI counties in Alaska (32–34). The present study provides evidence that community-level social vulnerability may be linked to stomach cancer incidence among NH-AI/AN populations, particularly in Alaska and the Southern Plains. Additionally, rates of stomach cancer are higher among NH-AI/AN populations than among NHW populations in most regions, regardless of county-level SVI score.

One of the primary risk factors for stomach cancer is *H. pylori* infection. *H. pylori* colonization of the stomach produces an inflammatory response that results in a 1%–2% lifetime risk of developing gastric cancer (35). The prevalence of *H. pylori* in AI/AN peoples

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is quite high, particularly when compared with the prevalence reported in the general US population (33). Previous research has shown that access to modern water services and plumbing decreases the risk of developing gastrointestinal infections such as *H. pylori* (36). AI/AN households are 19 times more likely than White households to lack indoor plumbing (37).

H. pylori infection is also associated with living in more rural settings and in crowded or multigenerational households (38). Crowding leads to close contact between household members, which also increases transmission of communicable diseases such as *H. pylori* infection. Of AI/AN households living in tribal areas, 16% experience overcrowding as compared with 2% of all US households (39). Socioeconomic status and the built environment have been strongly linked with *H. pylori* infection and stomach cancer in AI/AN populations (36).

Despite the well-established link, *H. pylori* infection is not a singular cause of gastric cancer (40). Screening for *H. pylori* infection is not recommended, and treatment is difficult due to high reinfection rates, especially among Alaska Native populations (41). While the development of methods to improve water sources and housing infrastructure are important steps in addressing underlying causes of elevated *H. pylori* transmission (41), future efforts to address gastric cancer incidence among AI/AN populations might require a multifactorial approach, because other factors may be affecting stomach cancer incidence.

Liver cancer and hepatitis C infection

The incidence of liver cancer has increased in most populations in the United States in the last 2 decades (42). The present study confirms previous findings that showed significantly elevated liver cancer incidence in NH-AI/AN populations (43). Hepatitis C virus infection is strongly linked with liver cancer risk, and studies show that AI/AN populations are disproportionately affected by hepatitis C virus infection (44). Hepatitis C virus infection has been linked with prescription opioid use and opioid use disorder (45). A previous study suggested a link between social vulnerability and opioid use (46). One study found associations between liver cancer rates and community characteristics related to minority population composition, age distribution, and the proportion of the population employed in the agricultural industry (47). In our study, liver cancer incidence rates were elevated among NH-AI/AN persons compared with NHWs, regardless of county-level SVI, indicating that other factors may be contributing to these disparities. Obesity and alcohol consumption have also been linked with liver cancer incidence (29, 48) and are also influenced by community characteristics (49, 50). Additionally, access to hepatitis C virus testing and treatment could also vary according to community characteristics and could affect observed disparities in liver cancer incidence (44, 51). The social determinants associated with these important risk factors may not be fully captured by the SVI. Further studies may provide additional evidence linking community characteristics and their associations with liver cancer disparities to the prevalence of important liver cancer risk factors.

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Screening adherence, socioeconomic status, and CRC

The present study suggests that the impact of social vulnerability on CRC incidence rates was strongest in Alaska and in the East, particularly when comparing the rates of CRC between NH-AI/AN and NHW populations by SVI score. Previous studies have shown an association between socioeconomic indicators at the neighborhood and individual levels and low CRC screening adherence (11), as well as challenges across the continuum of CRC care (52). According to IHS administrative data from 2021, only 27.9% of eligible AI/AN populations were up to date with CRC screening (53).

Geographic barriers in access to care have been shown to affect health and health disparities (12, 54). In Alaska, access to health care might be exceptionally challenging. The population is extremely diverse, and transportation is difficult, with only 14% of municipalities being connected to a road system (41). While new CRC screening guidelines have been implemented in Alaska Tribal health systems to begin screening at age 40 years in order to address the increased risk of CRC for Alaska Native adults (55), geographic barriers in access to care may hinder the effectiveness of these more targeted recommendations. In other areas such as the East, where elevated incidence of CRC was also observed, different geographic barriers might exist. While less remote, the East region covers a large geographic area, with only a few facilities in this area that offer purchased/referred care, many of which are in New England. South Carolina, being comprised entirely of PRCDA counties, only has 1 IHS, Tribal, and Urban Indian (ITU) health-care facility (56). This may also contribute to difficulties in accessing care for AI/AN persons living in those areas.

There are potential mechanisms for addressing the barriers related to place and transportation, including the implementation of alternative screening methods. Fecal occult blood tests, fecal immunohistochemical tests, and take-home multitarget stool DNA tests have been proposed as effective alternatives to direct visualization tests for CRC screening (57). The use of direct mailing of fecal immunohistochemical tests to eligible community members has been shown to be an effective, population-based approach with which to increase CRC screening among AI/AN populations (58). However, even with the use of these alternative screening methods, access to follow-up care may remain a challenge (58). Additional activities, such as patient navigation, targeted outreach, and training of midlevel providers, have also been successfully implemented to address these barriers and improve CRC screening rates (59). Future prevention and intervention strategies aimed at reducing CRC incidence in AI/AN communities might consider wider implementation of these strategies.

Limitations

Several limitations of this study should be acknowledged. First, the SVI data used for the present study were from 2018 and did not completely overlap with the study period (2010–2019), but these were the most recent data available at the time of our study. Second, we used SVI data aggregated at the county level for our analyses; however, there may be differences within counties related to the association between SVI and cancer outcomes that we were not able to evaluate because we were not able to conduct analyses at finer geographic levels. Third, SVI score may not include all pertinent determinants of health

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and may not adequately represent difficult-to-measure factors, such as the impacts of racism and other forms of systemic discrimination (60). Fourth, PRCDA counties do not represent all AI/AN populations. While efforts to address racial/ethnic misclassification in these data have been conducted, the linkages with the IHS patient registration database only applied to those AI/AN persons living in PRCDA counties who are members of federally recognized tribes and have accessed care through the IHS. Additionally, because these analyses were limited to non-Hispanic AI/AN populations, these results may not be generalizable to Hispanic AI/AN populations. Fifth, the ecological nature of the study design limits causal inference. Further study may aid in understanding the differential impact of SVI on cancer incidence by cancer type seen in this study. Finally, the present study was limited by small case counts for certain cancers and SVI categories.

Conclusions and future work

The present study highlights disparities in incidence rates of stomach cancer, liver cancer, and CRC in certain geographic regions between NH-AI/AN and NHW populations unrelated to measures of community-level social vulnerability. The SVI does not directly measure the root causes of inequities, such as historical and intergenerational trauma, racism, and other forms of discrimination. Other community-level risk factors, such as environmental and occupational exposures and pollution, which have been linked to gastrointestinal cancer incidence, could also be explored (61, 62). Different approaches in study design and measurement would be needed to examine such root causes. The present study also highlights the importance of evaluating disparities in cancer incidence within certain populations, instead of only comparing rates across populations. The variation of cancer incidence within NH-AI/AN populations by geographic region and measures of social vulnerability further supports the importance of disaggregating AI/AN data for a more complete understanding of elevated cancer incidence in these populations (15). Interventions related to improved access to health care and transportation, as well as programs and efforts that target improved infrastructure and built environments, can be tested. Exploring social vulnerability and cancer incidence is an important first step in better understanding cancer disparities and their root causes among AI/AN persons in order to design interventions to address these differences.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Abbreviations:

AI/AN	American Indian and Alaska Native
CRC	colorectal cancer
IHS	Indian Health Service

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NH-AI/AN	non-Hispanic American Indian and Alaska Native
NHW	non-Hispanic White
PRCDA	Purchased/Referred Care Delivery Area
RR	rate ratio
SEER	Surveillance, Epidemiology, and End Results
SVI	Social Vulnerability Index
USCS AIAD	US Cancer Statistics AI/AN Incidence Analytic Database

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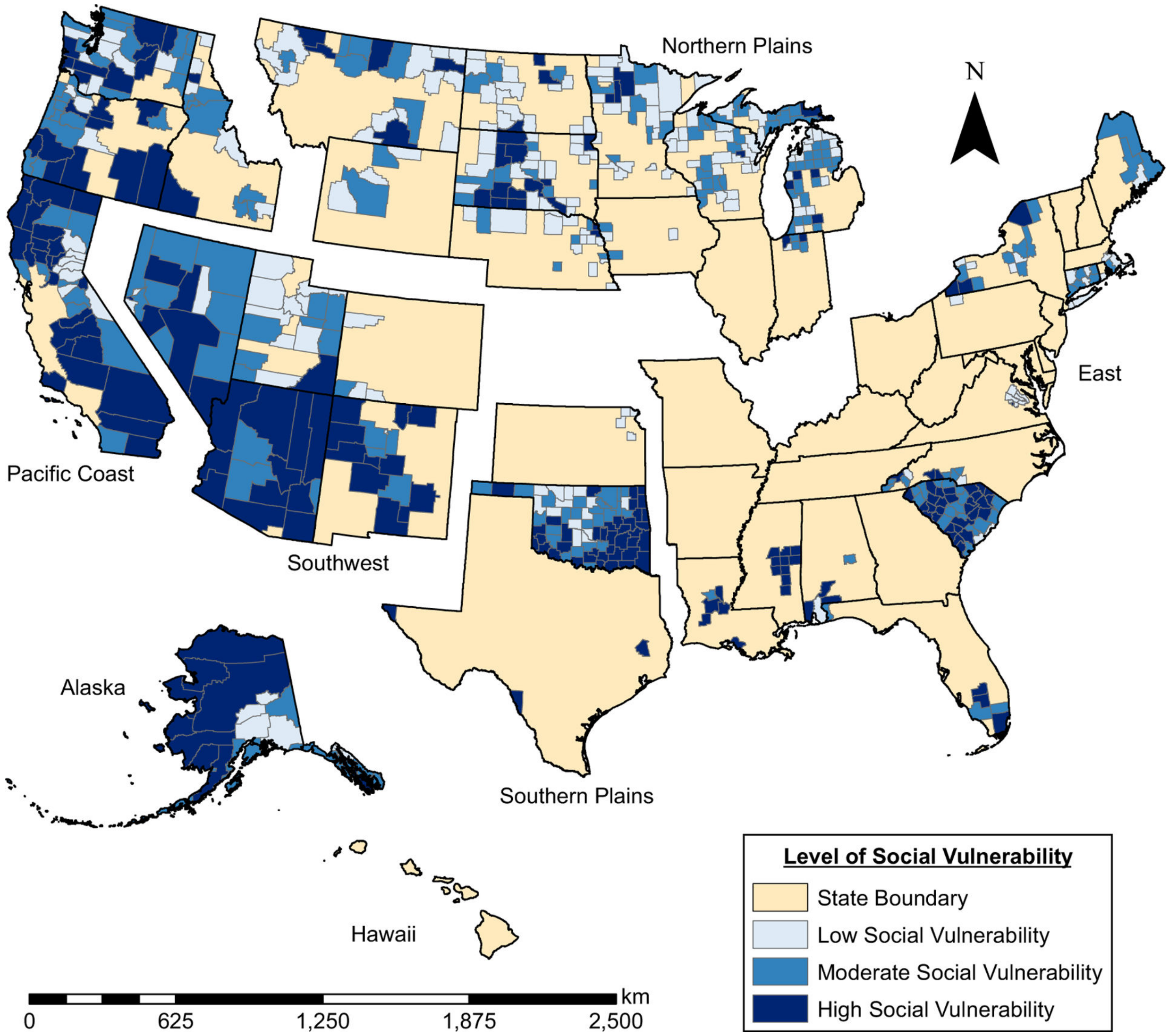

Figure 1.

Levels of social vulnerability (as assessed by the CDC/ATSDR 2018 Social Vulnerability Index (SVI)) in Purchased/Referred Care Delivery Area counties, by region, United States, 2018. SVI scores were categorized into tertiles as follows: low social vulnerability, SVI scores 0–0.3481; moderate social vulnerability, SVI scores 0.3482–0.7074; high social vulnerability, SVI scores 0.7075–1. ATSDR, Agency for Toxic Substances and Disease Registry; CDC, Centers for Disease Control and Prevention.

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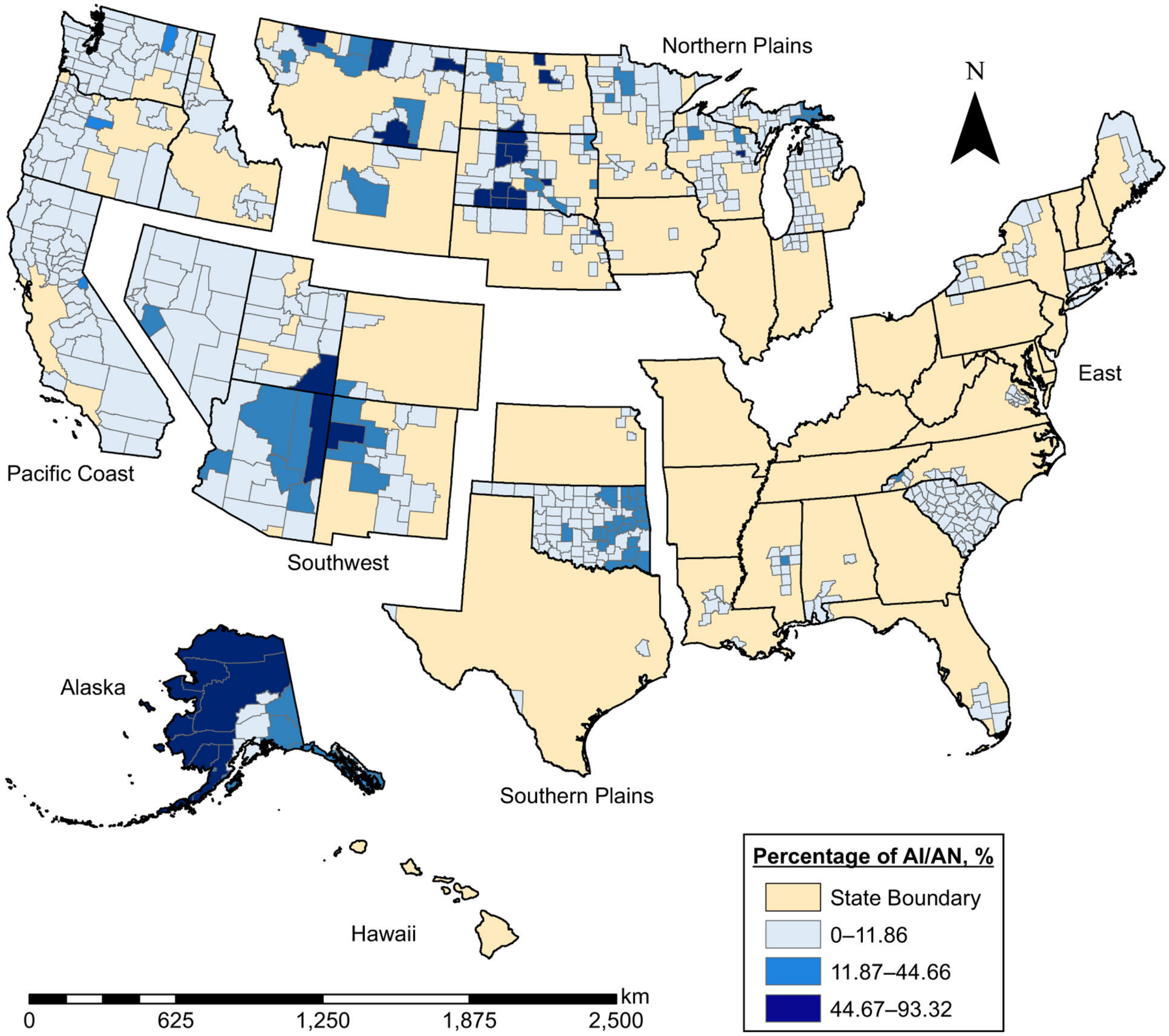

Figure 2.

Density of American Indian/Alaska Native (AI/AN) populations in Purchased/Referred Care Delivery Area counties according to CDC/ATSDR 2018 Social Vulnerability index data, by region, United States, 2018. The percentage of the population that was AI/AN was categorized using Jenks natural breaks classification (63) as follows: 0%–11.86%, 11.87%–44.66%, and 44.67%–93.32%. ATSDR, Agency for Toxic Substances and Disease Registry; CDC, Centers for Disease Control and Prevention.

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Table 1.

Overall Incidence Rates of Leading Gastrointestinal Cancers in Non-Hispanic American Indian/Alaska Native and non-Hispanic White Populations in PRCDA Counties, by Social Vulnerability Index[a] Category and Sex, United States, 2010–2019

Sex, Cancer Type, and County SVI Tertile	Racial/Ethnic Group										NH-AI/ANs vs. NHWs	
	NH-AI/AN					NHW						
	No. of Cases	IR (per 100,000 Population)	95% CI	RR	95% CI	No. of Cases	IR (per 100,000 Population)	95% CI	RR	95% CI	RR[b]	95% CI
Both sexes												
Stomach cancer												
Low	160	7.9	6.7, 9.4	1.00	Referent	10,335	5.0	4.9, 5.1	1.00	Referent	1.59	1.34, 1.88
Moderate	402	9.1	8.2, 10.1	1.15	0.94, 1.40	16,241	5.2	5.1, 5.3	1.04[c]	1.02, 1.07	1.75	1.57, 1.94
High	789	11.2	10.4, 12.0	1.41[c]	1.18, 1.70	8,194	5.0	4.9, 5.1	1.01	0.98, 1.04	2.23	2.06, 2.40
All counties[d]	1,351	10.1	9.5, 10.6			34,770	5.1	5.0, 5.2			1.98	1.87, 2.09
CRC												
Low	1,030	51.0	47.8, 54.5	1.00	Referent	70,315	34.8	34.5, 35.0	1.00	Referent	1.47	1.37, 1.57
Moderate	2,430	53.9	51.7, 56.2	1.06	0.98, 1.14	108,166	35.7	35.4, 35.9	1.03[c]	1.02, 1.04	1.51	1.45, 1.58
High	3,500	47.2	45.6, 48.9	0.93[c]	0.86, 1.00	60,373	38.2	37.8, 38.5	1.10[c]	1.09, 1.11	1.24	1.19, 1.28
All counties	6,960	49.9	48.7, 51.1			238,854	36.0	35.8, 36.1			1.39	1.35, 1.42
Liver cancer												
Low	376	16.4	14.7, 18.3	1.00	Referent	13,459	6.2	6.1, 6.3	1.00	Referent	2.66	2.37, 2.96
Moderate	925	18.8	17.6, 20.2	1.15[c]	1.01, 1.31	22,110	6.8	6.7, 6.9	1.10[c]	1.08, 1.13	2.77	2.58, 2.97
High	1,278	16.5	15.5, 17.4	1.00	0.89, 1.14	12,773	7.5	7.4, 7.7	1.22[c]	1.19, 1.25	2.18	2.06, 2.32
All counties	2,579	17.3	16.6, 18.0			48,342	6.8	6.7, 6.8			2.55	2.44, 2.65
Males												
Stomach cancer												
Low	91	10.2	8.0, 12.8	1.00	Referent	6,828	7.1	7.0, 7.3	1.00	Referent	1.43	1.12, 1.80
Moderate	220	11.5	9.9, 13.3	1.12	0.85, 1.49	10,577	7.4	7.2, 7.5	1.03	1.00, 1.06	1.56	1.34, 1.81
High	473	15.2	13.8, 16.7	1.49[c]	1.16, 1.94	5,502	7.2	7.0, 7.4	1.01	0.97, 1.04	2.12	1.91, 2.33
All counties	784	13.3	12.3, 14.3			22,907	7.2	7.2, 7.3			1.83	1.70, 1.98
CRC												

Sex, Cancer Type, and County SVI Tertile	Racial/Ethnic Group: NH-AI/AN					NHW					NH-AI/ANs vs. NHWs	
	No. of Cases	IR (per 100,000 Population)	95% CI	RR	95% CI	No. of Cases	IR (per 100,000 Population)	95% CI	RR	95% CI	RR[b]	95% CI
Low	539	58.0	52.7, 63.7	1.00	Referent	36,539	39.1	38.7, 39.5	1.00	Referent	1.48	1.35, 1.63
Moderate	1,253	61.6	57.9, 65.5	1.06	0.95, 1.19	56,339	40.2	39.9, 40.6	1.03[c]	1.01, 1.04	1.53	1.44, 1.63
High	1,803	53.6	51.0, 56.3	0.92	0.83, 1.03	32,459	43.6	43.1, 44.1	1.11[c]	1.10, 1.13	1.23	1.17, 1.29
All counties	3,595	56.7	54.8, 58.8			125,337	40.7	40.4, 40.9			1.40	1.35, 1.45
Liver cancer												
Low	256	23.0	20.1, 26.3	1.00	Referent	9,726	9.4	9.2, 9.6	1.00	Referent	2.45	2.13, 2.80
Moderate	633	27.7	25.4, 30.1	1.20[c]	1.03, 1.41	16,098	10.5	10.3, 10.6	1.11[c]	1.08, 1.14	2.65	2.43, 2.88
High	839	23.4	21.8, 25.1	1.02	0.87, 1.19	9,286	11.4	11.2, 11.7	1.22[c]	1.18, 1.25	2.05	1.90, 2.21
All counties	1,728	24.8	23.5, 26.0			35,110	10.3	10.2, 10.5			2.39	2.27, 2.52
Females												
Stomach cancer												
Low	69	6.4	4.9, 8.2	1.00	Referent	3,507	3.2	3.1, 3.3	1.00	Referent	2.02	1.55, 2.58
Moderate	182	7.4	6.3, 8.6	1.16	0.86, 1.57	5,664	3.4	3.3, 3.5	1.07[c]	1.03, 1.12	2.18	1.86, 2.54
High	316	8.1	7.2, 9.1	1.27	0.97, 1.69	2,692	3.2	3.0, 3.3	0.99	0.94, 1.05	2.58	2.28, 2.90
All counties	567	7.6	7.0, 8.3			11,863	3.3	3.2, 3.3			2.33	2.14, 2.55
CRC												
Low	491	45.5	41.4, 49.9	1.00	Referent	33,776	30.9	30.6, 31.3	1.00	Referent	1.47	1.34, 1.61
Moderate	1,177	47.8	45.0, 50.8	1.05	0.94, 1.18	51,827	31.6	31.3, 31.9	1.02[c]	1.01, 1.04	1.51	1.42, 1.61
High	1,697	42.2	40.2, 44.3	0.93	0.84, 1.03	27,914	33.3	32.9, 33.7	1.08[c]	1.06, 1.09	1.27	1.20, 1.33
All counties	3,365	44.4	42.9, 46.0			113,517	31.8	31.6, 32.0			1.40	1.35, 1.45
Liver cancer												
Low	120	10.6	8.7, 12.8	1.00	Referent	3,733	3.3	3.2, 3.4	1.00	Referent	3.21	2.62, 3.89
Moderate	292	11.5	10.2, 13.0	1.08	0.86, 1.37	6,012	3.5	3.5, 3.6	1.07[c]	1.02, 1.12	3.25	2.86, 3.67
High	439	10.6	9.6, 11.7	1.00	0.81, 1.25	3,487	4.0	3.8, 4.1	1.20[c]	1.14, 1.26	2.67	2.40, 2.95
All counties	851	10.9	10.2, 11.7			13,232	3.6	3.5, 3.6			3.06	2.84, 3.29

Abbreviations: ATSDR, Agency for Toxic Substances and Disease Registry; CDC, Centers for Disease Control and Prevention; CI, confidence interval; CRC, colorectal cancer; IR, incidence rate; NH-AI/AN, non-Hispanic American Indian and Alaska Native, NHW, non-Hispanic White; PRCDA, Purchased/Referred Care Delivery Area; RR, rate ratio; SVI, Social Vulnerability Index.

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[a]CDC/ATSDR 2018 SVI scores were categorized into tertiles as follows: low social vulnerability, SVI scores 0–0.3481; moderate social vulnerability, SVI scores 0.3482–0.7074; high social vulnerability, SVI scores 0.7075–1.

[b]All RRs comparing incidence rates among NH-AI/ANs with those among NHWs were statistically significant for both individual SVI groups and “all counties.”

[c]The RR comparing the incidence rate for the “moderate” or “high” SVI category with that for the “low” SVI category was statistically significant ($P < 0.05$) within each racial/ethnic group.

[d]The “all counties” group represents rates in all 2018 PRCDA counties with an overall SVI 2018 score. The total number of PRCDA counties for these years of data was 651. The total number used for analysis was 648.

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Table 2.

Incidence Rates of Stomach Cancer in Non-Hispanic American Indian/Alaska Native and Non-Hispanic White Populations in PRCDA Counties, by Social Vulnerability Index[a] Category and Region, United States, 2010–2019

Region and County SVI Tertile	Racial/Ethnic Group										NH-AI/ANs vs. NHWs	
	NH-AI/AN					NHW						
	No. of Cases	IR (per 100,000 Population)	95% CI	RR	95% CI	No. of Cases	IR (per 100,000 Population)	95% CI	RR	95% CI	RR	95% CI
Northern Plains												
Low	60	9.7	7.2, 12.7	1.00	Referent	2,485	4.3	4.1, 4.5	1.00	Referent	2.27[b]	1.68, 2.98
Moderate	50	7.5	5.4, 10.0	0.77	0.50, 1.17	2,060	5.0	4.8, 5.2	1.17[c]	1.10, 1.24	1.50[b]	1.08, 2.01
High	68	9.0	6.9, 11.6	0.93	0.63, 1.37	407	5.2	4.7, 5.8	1.22[C]	1.09, 1.36	1.73[b]	1.29, 2.26
All counties[d]	178	8.7	7.4, 10.2			4,952	4.6	4.5, 4.8			1.89[b]	1.60, 2.21
Alaska												
Low	25	16.7	10.5, 25.0	1.00	Referent	93	5.0	4.0, 6.3	1.00	Referent	3.31[b]	1.96, 5.31
Moderate	57	16.3	12.2, 21.4	0.98	0.59, 1.69	131	4.6	3.8, 5.6	0.92	0.68, 1.24	3.53[b]	2.50, 4.93
High	106	31.8	25.8, 38.8	1.91[c]	1.20, 3.18	7	4.5	1.6, 11.0	0.89	0.31, 2.26	7.08[b]	2.81, 20.50
All counties	188	22.6	19.3, 26.2			231	4.8	4.2, 5.5			4.71[b]	3.82, 5.81
Southern Plains												
Low	22	5.1	3.1, 7.8	1.00	Referent	320	4.1	3.6, 4.6	1.00	Referent	1.24	0.75, 1.93
Moderate	100	10.0	8.0, 12.2	1.97[c]	1.21, 3.33	843	4.5	4.2, 4.8	1.10	0.96, 1.26	2.21[b]	1.76, 2.75
High	128	8.2	6.8, 9.8	1.62[c]	1.01, 2.71	657	4.9	4.5, 5.3	1.19[c]	1.04, 1.37	1.68[b]	1.37, 2.04
All counties	250	8.4	7.4, 9.6			1,820	4.6	4.3, 4.8			1.85[b]	1.61, 2.13
Pacific Coast												
Low	39	7.0	4.9, 9.8	1.00	Referent	2,875	4.8	4.6, 5.0	1.00	Referent	1.46[b]	1.01, 2.05
Moderate	67	7.3	5.5, 9.4	1.03	0.67, 1.62	3,694	4.9	4.7, 5.1	1.02	0.97, 1.08	1.48[b]	1.12, 1.91
High	81	5.9	4.6, 7.3	0.83	0.55, 1.29	3,969	5.1	4.9, 5.2	1.06[c]	1.01, 1.11	1.15	0.90, 1.45
All counties	187	6.5	5.6, 7.6			10,538	4.9	4.8, 5.0			1.32[b]	1.13, 1.54
East												
Low	10	4.3	2.0, 8.1	1.00	Referent	4,353	5.9	5.7, 6.1	1.00	Referent	0.73	0.34, 1.36

Region and County SVI Tertile	Racial/Ethnic Group										NH-AI/ANs vs. NHWs	
	NH-AI/AN					NHW						
	No. of Cases	IR (per 100,000 Population)	95% CI	RR	95% CI	No. of Cases	IR (per 100,000 Population)	95% CI	RR	95% CI	RR	95% CI
Moderate	44	8.2	5.8, 11.1	1.9	0.92, 4.32	7,400	6.0	5.8, 6.1	1.01	0.97, 1.05	1.37	0.98, 1.86
High	36	9.8	6.7, 13.7	2.27[c]	1.08, 5.26	2,075	5.6	5.4, 5.9	0.95	0.90, 1.00	1.74[b]	1.19, 2.45
All counties	90	7.8	6.3, 9.7			13,828	5.9	5.8,6.0			1.33[b]	1.06,1.65
Southwest												
Low	—[e]	—		—		209	3.4	3.0, 3.9	1.00	Referent	—	
Moderate	84	8.8	6.9, 11.1	—		2,113	4.3	4.1, 4.5	1.25[c]	1.08, 1.45	2.07[b]	1.61, 2.61
High	370	13.6	12.2, 15.1	—		1,079	4.1	3.8, 4.4	1.20[c]	1.03, 1.40	3.32[b]	2.93, 3.76
All counties	454	12.6	11.4, 13.8			3,401	4.1	4.0, 4.3			3.03[b]	2.74, 3.36

Abbreviations: ATSDR, Agency for Toxic Substances and Disease Registry; CDC, Centers for Disease Control and Prevention; CI, confidence interval; IR, incidence rate; NH-AI/AN, non-Hispanic American Indian and Alaska Native; NHW, non-Hispanic White; PRCDA, Purchased/Referred Care Delivery Area; RR, rate ratio; SVI, Social Vulnerability Index.

[a]CDC/ATSDR 2018 SVI scores were categorized into tertiles as follows: low social vulnerability, SVI scores 0–0.3481; moderate social vulnerability, SVI scores 0.3482–0.7074; high social vulnerability, SVI scores 0.7075–1.

[b]The RR comparing the incidence rate among NH-AI/ANs with that among NHWs was statistically significant ($P < 0.05$) for that SVI group or “all counties”.

[c]The RR comparing the incidence rate for the “moderate” or “high” SVI category with that for the “low” SVI category was statistically significant ($P < 0.05$) within each racial/ethnic group.

[d]The “all counties” group represents rates in all 2018 PRCDA counties with an overall SVI 2018 score. The total number of PRCDA counties for these years of data was 651. The total used for analysis was 648. Counts only include cells that have not been suppressed.

[e]Counts of fewer than 6 cases are suppressed; total counts only include unsuppressed cells.

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Table 3.

Incidence Rates of Colorectal Cancer in Non-Hispanic American Indian and Alaska Native and Non-Hispanic White Populations in PRCDA Counties, by Social Vulnerability Index[a] Category and Region, United States, 2010–2019

Region and County SVI Tertile	Racial/Ethnic Group										NH-AI/ANs vs. NHWs	
	NH-AI/AN					NHW						
	No. of Cases	IR (per 100,000 Population)	95% CI	RR	95% CI	No. of Cases	IR (per 100,000 Population)	95% CI	RR	95% CI	RR	95% CI
Northern Plains												
Low	332	50.7	45.0, 56.8	1.00	Referent	17,564	31.0	30.5, 31.5	1.00	Referent	1.63[b]	1.45, 1.83
Moderate	371	55.7	49.8, 62.1	1.10	0.94, 1.29	14,784	36.9	36.3, 37.5	1.19[c]	1.16, 1.22	1.51[b]	1.35, 1.68
High	394	51.4	46.1, 57.1	1.01	0.87, 1.19	2,769	36.5	35.1, 38.0	1.18[c]	1.13, 1.23	1.41[b]	1.25, 1.57
All counties[d]	1,097	52.5	49.2, 55.9			35,117	33.7	33.3, 34.0			1.56[b]	1.46, 1.66
Alaska												
Low	126	78.6	64.6, 94.6	1.00	Referent	665	35.4	32.6, 38.5	1.00	Referent	2.22[b]	1.79, 2.72
Moderate	281	85.1	74.8, 96.2	1.08	0.86, 1.37	1,047	36.7	34.4, 39.2	1.04	0.93, 1.15	2.32[b]	2.01, 2.67
High	398	123.4	111.0, 136.8	1.57[c]	1.27, 1.96	34	23.9	14.5, 37.0	0.67	0.41, 1.05	5.17[b]	3.29, 8.62
All counties	805	99.5	92.4, 107.1			1,746	36.0	34.2, 37.8			2.77[b]	2.53, 3.03
Southern Plains												
Low	212	58.6	50.3, 67.8	1.00	Referent	2,546	32.8	31.5, 34.1	1.00	Referent	1.79[b]	1.53, 2.08
Moderate	710	68.6	63.4, 74.2	1.17	0.99, 1.39	7,113	39.2	38.2, 40.1	1.19[c]	1.14, 1.25	1.75[b]	1.61, 1.90
High	1,036	62.6	58.7, 66.6	1.07	0.91, 1.26	5,383	40.8	39.7, 41.9	1.24[c]	1.18, 1.30	1.53[b]	1.43, 1.64
All counties	1,958	64.0	61.0, 67.0			15,042	38.4	37.8, 39.1			1.66[b]	1.58, 1.75
Pacific Coast												
Low	280	52.4	46.0, 59.4	1.00	Referent	20,186	34.6	34.2, 35.1	1.00	Referent	1.51[b]	1.33, 1.72
Moderate	453	48.5	43.9, 53.4	0.93	0.79, 1.09	25,696	34.9	34.5, 35.4	1.01	0.99, 1.03	1.39[b]	1.25, 1.53
High	590	43.6	40.0, 47.5	0.83[c]	0.72, 0.97	28,728	37.7	37.2, 38.1	1.09[c]	1.07, 1.11	1.16[b]	1.06, 1.26
All counties	1,323	46.9	44.3, 49.6			74,610	35.9	35.6, 36.1			1.31[b]	1.23, 1.38
East												
Low	58	23.5	17.7, 30.6	1.00	Referent	27,515	38.4	37.9, 38.9	1.00	Referent	0.61[b]	0.46, 0.80

Region and County SVI Tertile	Racial/Ethnic Group										NH-AI/ANs vs. NHWs	
	NH-AI/AN					NHW						
	No. of Cases	IR (per 100,000 Population)	95% CI	RR	95% CI	No. of Cases	IR (per 100,000 Population)	95% CI	RR	95% CI	RR	95% CI
Moderate	211	35.3	30.5, 40.6	1.50[c]	1.11, 2.06	44,091	36.5	36.2, 36.9	0.95[c]	0.94, 0.97	0.97	0.83, 1.11
High	159	41.9	35.4, 49.2	1.78[c]	1.30, 2.47	14,977	41.6	41.0, 42.3	1.08[c]	1.06, 1.11	0.97	0.85, 1.18
All counties	428	35.0	31.6, 38.6			86,583	37.9	37.6, 38.2			0.97	0.83, 1.02
Southwest												
Low	22	44.2	26.6, 68.4	1.00	Referent	1,839	29.6	28.3, 31.0	1.00	Referent	1.49	0.90, 2.32
Moderate	404	42.5	38.1, 47.2	0.96	0.61, 1.62	15,435	32.2	31.7, 32.7	1.09[c]	1.03, 1.14	1.32[b]	1.18, 1.47
High	923	31.4	29.4, 33.6	0.71	0.46, 1.19	8,482	33.9	33.1, 34.7	1.14[c]	1.09, 1.20	0.93[b]	0.86, 1.00
All counties	1,349	34.0	32.2, 36.0			25,756	32.5	32.1, 32.9			1.05	0.99, 1.11

Abbreviations: ATSDR, Agency for Toxic Substances and Disease Registry; CDC, Centers for Disease Control and Prevention; CI, confidence interval; IR, incidence rate; NH-AI/AN, non-Hispanic American Indian and Alaska Native, NHW, non-Hispanic White; PRCDA, Purchased/Referred Care Delivery Area; RR, rate ratio; SVI, Social Vulnerability Index.

[a] CDC/ATSDR 2018 SVI scores were categorized into tertiles as follows: low social vulnerability, SVI scores 0–0.3481; moderate social vulnerability, SVI scores 0.3482–0.7074; high social vulnerability, SVI scores 0.7075–1.

[b] The RR comparing the incidence rate among NH-AI/ANs with that among NHWs was statistically significant ($P < 0.05$) for that SVI group or “all counties.”

[c] The RR comparing the incidence rate for the “moderate” or “high” SVI category with that for the “low” SVI category was statistically significant ($P < 0.05$) within each racial/ethnic group.

[d] The “all counties” group represents rates in all 2018 PRCDA counties with an overall SVI 2018 score. The total number of PRCDA counties for these years of data was 651. The total number used for analysis was 648. Counts only include cells that have not been suppressed.

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Table 4.

Incidence Rates of Liver Cancer in Non-Hispanic American Indian/Alaska Native and Non-HispanicWhite Populations in PRCDA Counties, by Social Vulnerability Index[a] Category and Region, United States, 2010–2019

Region and County SVI Tertile	Racial/Ethnic Group										NH-AI/ANs vs. NHWs	
	NH-AI/AN					NHW						
	No. of Cases	IR (per 100,000 Population)	95% CI	RR	95% CI	No. of Cases	IR (per 100,000 Population)	95% CI	RR	95% CI	RR	95% CI
Northern Plains												
Low												
Moderate	118	17.8	14.4, 21.6	1.00	Referent	2,803	4.7	4.5, 4.8	1.00	Referent	3.81[b]	3.08, 4.66
High	117	16.6	13.5, 20.1	0.93	0.70, 1.24	2,417	5.6	5.4, 5.9	1.21[c]	1.14, 1.28	2.95[b]	2.40, 3.60
All counties[d]	109	14.2	11.5, 17.3	0.80	0.60, 1.07	460	5.8	5.2, 6.3	1.23[c]	1.11, 1.37	2.46[b]	1.95, 3.08
Alaska	344	16.1	14.3, 18.0			5,680	5.1	5.0, 5.2			3.15[b]	2.79, 3.54
Low	22	11.6	7.1, 18.0	1.00	Referent	150	6.7	5.6, 7.9	1.00	Referent	1.74[b]	1.03, 2.81
Moderate	74	21.1	16.3, 26.8	1.82[c]	1.09, 3.17	265	8.1	7.1, 9.2	1.22	0.98, 1.52	2.60[b]	1.95, 3.43
High	47	14.5	10.4, 19.6	1.25	0.72, 2.25	9	4.2	1.8, 9.7	0.63	0.27, 1.51	3.49[b]	1.37, 8.44
All counties	143	16.6	13.8, 19.7			424	7.5	6.7, 8.3			2.22[b]	1.80, 2.72
Southern Plains												
Low	62	14.5	11.0, 18.9	1.00	Referent	456	5.5	5.0, 6.0	1.00	Referent	2.65[b]	1.97, 3.51
Moderate	212	18.4	15.9, 21.2	1.26	0.93, 1.74	1,303	6.7	6.4, 7.1	1.23[c]	1.10, 1.37	2.73[b]	2.33, 3.18
High	323	18.2	16.2, 20.4	1.25	0.94, 1.70	1,060	7.7	7.3, 8.2	1.41[c]	1.26, 1.58	2.36[b]	2.06, 2.68
All counties	597	17.8	16.4, 19.4			2,819	6.8	6.6, 7.1			2.62[b]	2.38, 2.87
Pacific Coast												
Low	148	22.3	18.6, 26.6	1.00	Referent	4,602	7.1	6.9, 7.4	1.00	Referent	3.12[b]	2.60, 3.72
Moderate	246	21.9	19.1, 25.0	0.98	0.79, 1.23	6,284	7.8	7.6, 8.0	1.09[c]	1.05, 1.14	2.81[b]	2.45, 3.21
High	300	19.7	17.4, 22.2	0.88	0.71, 1.10	6,380	7.7	7.5, 7.9	1.08[c]	1.04, 1.13	2.55[b]	2.25, 2.88
All counties	694	21.0	19.4, 22.7			17,266	7.6	7.5, 7.7			2.76[b]	2.55, 3.00
East												
Low	19	6.4	3.8, 10.2	1.00	Referent	5,184	6.8	6.6, 7.0	1.00	Referent	0.94	0.56, 1.50

Region and County SVI Tertile	Racial/Ethnic Group										NH-AI/ANs vs. NHWs	
	NH-AI/AN					NHW						
	No. of Cases	IR (per 100,000 Population)	95% CI	RR	95% CI	No. of Cases	IR (per 100,000 Population)	95% CI	RR	95% CI	RR	95% CI
Moderate	74	11.9	9.2, 15.1	1.86[c]	1.08, 3.30	8,906	7.0	6.8, 7.1	1.02	0.99, 1.06	1.70[b]	1.32, 2.16
High	66	16.8	12.9, 21.7	2.64[c]	1.52, 4.72	2,994	7.8	7.5, 8.1	1.15[c]	1.10, 1.20	2.16[b]	1.64, 2.78
All counties	159	12.2	10.3, 14.3			17,084	7.0	6.9, 7.2			1.73[b]	1.46, 2.04
Southwest												
Low	7	13.7	5.1, 29.0	1.00	Referent	264	4.0	3.5, 4.5	1.00	Referent	3.46[b]	1.28, 7.39
Moderate	202	21.4	18.3, 24.8	1.56	0.72, 4.22	2,935	5.7	5.5, 6.0	1.45[c]	1.27, 1.65	3.72[b]	3.18, 4.34
High	433	14.6	13.2, 16.1	1.06	0.50, 2.87	1,870	7.1	6.7, 7.4	1.78[c]	1.56, 2.04	2.07[b]	1.85, 2.30
All counties	642	16.2	15.0, 17.6			5,069	6.0	5.8, 6.2			2.71[b]	2.48, 2.95

Abbreviations: ATSDR, Agency for Toxic Substances and Disease Registry; CDC, Centers for Disease Control and Prevention; CI, confidence interval; IR, incidence rate; NH-AI/AN, non-Hispanic American Indian and Alaska Native, NHW, non-Hispanic White; PRCDA, Purchased/Referred Care Delivery Area; RR, rate ratio; SVI, Social Vulnerability Index.

[a] CDC/ATSDR 2018 SVI scores were categorized into tertiles as follows: low social vulnerability, SVI scores 0–0.3481; moderate social vulnerability, SVI scores 0.3482–0.7074; high social vulnerability, SVI scores 0.7075–1.

[b] The RR comparing the incidence rate among NH-AI/ANs with that among NHWs was statistically significant ($P < 0.05$) for that SVI group or “all counties.”

[c] The RR comparing the incidence rate for the “moderate” or “high” SVI category with that for the “low” SVI category was statistically significant ($P < 0.05$) within each racial/ethnic group.

[d] The “all counties” group represents rates in all 2018 PCRDA counties with an overall SVI 2018 score. The total number of PRCDA counties for these years of data was 651. The total used for analysis was 648. Counts only include cells that have not been suppressed.

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