Patterns in Cancer Incidence Among American Indians/Alaska Natives, United States, 1992–1999

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SYNOPSIS

Objective. Cancer is a major public health concern in American Indian and Alaska Native (AI/AN) communities. However, information on the incidence of cancer is lacking for this group. The purpose of this study is to report cancer incidence patterns for the U.S. AI/AN population.

Methods. Age-adjusted annual cancer incidence rates for 1992 through 1999 were calculated for 12 Surveillance, Epidemiology and End Results (SEER) areas, representing a sample (42%) of the U.S. AI/AN population. Trends in cancer incidence rates for the AI/AN sample were determined using standard linear regression of log-transformed rates and were compared to those of the U.S. white population.

Results. The top five incident cancers (from highest to lowest) among AI/AN males were prostate, lung and bronchus, colon and rectum, kidney and renal pelvis, and stomach cancers. Among AI/AN women, cancers of the breast, colon and rectum, lung and bronchus, endometrium, and ovary ranked highest. Four sites where cancer incidence rates are greater for AI/ANs than for whites include gallbladder (the AI/AN rate was 4.1 times the rate for white males and 2.6 times the rate for white females), liver and intrahepatic bile duct cancers (1.3 times for males and 2.3 times for females), stomach (1.2 times for males and 1.5 times for females), and kidney and renal pelvis (1.03 times for males and 1.07 times for females). The data show increasing trends for AI/AN males and females and declining trends for white males and females for colorectal, stomach, and pancreatic cancers and leukemia. Similar differences between
AI/AN rates and white rates were found for urinary bladder cancers in males and gallbladder cancer in females.

Conclusions. Analysis of SEER data allowed for the determination of disparities in cancer incidence between a sample of the U.S. AI/AN population and the white population. The findings of this study provide baseline information necessary for developing cancer prevention and intervention strategies specific to the AI/AN population to address these cancer disparities.

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According to the 2000 Census, American Indians/Alaska Natives (AI/ANs) represent approximately 0.9% of the total U.S. population.[1] The AI/AN population (consisting of people who identify as Aleuts, Eskimos, and American Indians) resides in the 50 states and Puerto Rico, with the majority living in six of the nine Census Divisions: Pacific (Alaska, California, and Washington), West (Arizona and New Mexico), West South Central (Oklahoma and Texas), South Atlantic (Florida and North Carolina), East North Central (Michigan), and Middle Atlantic (New York). People who identify as AI/AN represent more than 500 diverse tribes with different cultures, sociodemographic factors, and languages.[2-4] From 1990 to 2000, the AI/AN population increased by 26.4%,[1] and with this increase, the incidence and mortality rates of cancer for this group have changed as well. The Surveillance, Epidemiology, and End Results (SEER) Program provides a unique source of information on cancer incidence and mortality for a sample of individuals from specific racial groups: AI/AN, Asian/Pacific Islander, black, Hispanic, Hispanic white, non-Hispanic white. The SEER cancer registries include data on 41.8% of the AI/AN population in the U.S.[5] The purpose of this investigation was to examine 1992–1999 SEER annual cancer incidence rates for 18 cancer sites in AI/AN males and 20 cancer sites in AI/AN females by: (*1*) determining the rank order of cancer incidence rates adjusted to the 2000 standard population, (*2*) comparing these rates to those for white males and females, and (*3*) assessing the trends in these rates over time (1992–1999). These data may be useful in identifying cancer health disparities in the SEER population.

METHODS

We used data collected by the population-based SEER Program to analyze cancer incidence rates for samples of AI/AN and white males and females. These data consisted of cancer cases diagnosed during 1992–1999 in AI/AN and white residents of the 12 SEER geographic areas: Alaska, Atlanta (GA), Connecticut, Detroit (MI), Hawaii, Iowa, Los Angeles (CA), New Mexico, San Francisco–Oakland (CA), San Jose–Monterrey (CA), Seattle–Puget Sound (WA), and Utah. Of the 818,685 people identified as AI/AN residing in SEER areas in 1999, 32% lived in New Mexico, 21% lived in Alaska, 12% lived in Seattle–Puget Sound (WA), and 11% reside in Los Angeles (CA).[5] Approximately 1.3% of the SEER population was identified as AI/AN in 1999, while approximately 75% of the SEER population was identified as white.[5] The designation of AI/AN or white ethnicity for incident cancer cases was listed under the Expanded Races category of the SEER Registry 12 Data;[6] the source of these designations was individual medical records.

Incidence rates were calculated for primary malignant cancers, excluding those cases obtained only from autopsy reports or death certificates. Using the direct method of standardization, annual incidence rates for the most common anatomic adult cancer sites[7] (18 cancer sites in men and 20 cancer sites in women) were adjusted by age to the 2000 U.S. population. The cancer sites included 16 male/female sites, two male-specific sites (prostate and testes), and four female-specific sites (breast, ovary, cervix, and endometrium). To calculate the standardized incidence ratio (SIR) for each anatomic cancer site and gender, we divided the age-adjusted incidence rate for AI/ANs by the age-adjusted incidence rate for the respective site in whites. The SIR allowed for a direct comparison of the overall incidence rates between the two ethnic groups. Ninety-five percent confidence intervals (CIs) of the SIRs were calculated according to the annual age-adjusted cancer rates for each site for AI/ANs and whites, based on the following formula:

$$\text{Exponentiate: } \ln R_A - \ln R_W \pm 1.96 \sqrt{\{[SE(R_A)/(R_A)]^2 + [SE(R_W)/(R_W)]^2\}}$$

where R_A is the age-adjusted incidence rate for AI/ANs, R_W is the age-adjusted incidence rate for whites, and SEs are their respective standard errors.

We determined the slopes of the incidence rates for the period 1992–1999 using standard linear regression analysis of log-transformed rates. The directions and magnitudes of the slopes (trends) of the rates were measured as the annual percent changes (APCs) of the rates, using the weighted least squares method (weighted by the number of cases). The *F*-test, with two-sided *p*-values, was used to determine if the trends were significantly different from zero, and the *Z*-test was used to assess differences in trends between AI/ANs and whites. For each anatomic cancer site, trends in cancer incidence were plotted for AI/AN and white males and females, thus allowing for visualization of the magnitude of cancer incidence across time by gender.

Standard errors (SEs) for the age-adjusted annual rates were calculated using SEER*Stat 4.1 software,[6] and other statistical analyses were conducted using Microsoft Excel for Windows 2000. The significance level for all analyses was $p<0.05$.

RESULTS

The age-adjusted cancer incidence rates for males and females for 1992–1999 are shown in Tables 1 and 2. These rates are presented along with their SEs from the highest incident cancer to the lowest incident cancer, based on the annual age-adjusted rates for the AI/AN population. Also shown are the SIRs and 95% CIs for each cancer site. A cancer site with SIR >1.0 indicates a greater cancer burden for AI/ANs than for whites.

For AI/AN males, the cancer sites with the top five incidence rates were prostate, lung and bronchus, colon and rectum, kidney and renal pelvis, and stomach. Rates were significantly lower in AI/AN males than in white males for 13 of the 18 cancer sites. Although AI/AN males had higher rates than white males of gallbladder, liver and intrahepatic bile duct, stomach, and kidney and renal pelvis cancer, the difference was statistically significant only for cancer of the gallbladder (4.1 times the rate in white males). For all sites combined, the incidence rate for AI/AN males was 49% of the rate for white males.

The five most incident cancers in AI/AN females were cancers of the breast, colon and rectum, lung and bronchus, endometrium, and ovary. These sites are in the same order as the top five sites for white females. Rates were significantly lower in AI/AN females than in white females for 14 of the 20 cancer sites. AI/AN females had higher rates than their

Table 1. Age-adjusted incidence rates[a] for cancers in AI/AN and white males, 1992–1999, by rank for AI/AN males

Rank for AI/AN males	Cancer site	AI/AN rate	SE	Rank for white males	White rate	SE	SIR	95% CI
—	All sites	277.70	6.06	—	568.25	0.79	0.49	0.47, 0.53
1	Prostate	60.66	2.98	1	172.93	0.44	0.35	0.32, 0.45
2	Lung and bronchus	51.40	2.62	2	82.91	0.30	0.62	0.56, 0.72
3	Colon and rectum	40.70	2.28	3	64.38	0.27	0.63	0.57, 0.74
4	Kidney and renal pelvis	15.60	1.41	9	15.13	0.13	1.03	0.86, 1.21
5	Stomach	13.93	1.33	11	11.65	0.12	1.20	0.99, 1.38
6	Oral cavity and pharynx	12.97	1.24	8	16.68	0.13	0.78	0.64, 0.97
7	Liver and IBD	8.13	1.05	14	6.42	0.08	1.27	0.98, 1.52
8	Pancreas	7.96	1.06	10	12.18	0.12	0.65	0.50, 0.92
9	Non-Hodgkin's lymphoma	7.83	0.96	5	24.60	0.16	0.32	0.25, 0.56
10	Urinary bladder	6.58	0.94	4	38.87	0.21	0.17	0.13, 0.45
11	Leukemia	5.29	0.72	7	16.89	0.14	0.31	0.24, 0.58
12	Esophagus	4.90	0.83	13	7.13	0.09	0.69	0.49, 1.02
13	Myeloma	3.62	0.68	15	6.53	0.09	0.55	0.38, 0.92
14	Gallbladder	3.29	0.74	18	0.80	0.03	4.11	2.63, 4.56
15	Brain and other nervous system	3.23	0.56	12	8.45	0.09	0.38	0.27, 0.72
16	Testis	2.56	0.40	16	5.91	0.07	0.43	0.32, 0.74
17	Thyroid	2.08	0.51	17	3.57	0.06	0.58	0.36, 1.06
18	Melanoma	1.30	0.34	6	22.42	0.15	0.06	0.03, 0.57

[a]Incidence rates per 100,000, standardized to 2000 population

AI/AN = American Indian/Alaska Native

SE = standard error

SIR = standardized incidence ratio (ratio of AI/AN rate to white rate)

CI = confidence interval

IBD = intrahepatic bile duct

white counterparts for four cancers: gallbladder (2.6 times the rate in white females), liver and intrahepatic bile duct or IBD (2.3 times), stomach (1.5 times), and kidney and renal pelvis (1.07 times). For all sites combined, the AI/AN female cancer incidence rate was 53% of the rate for white females.

APCs, representing eight-year trends in cancer incidence rates from 1992 to 1999, are shown for AI/AN and white males and females in Tables 3 and 4. AI/AN males (Table 3) had a significantly increasing trend for pancreatic cancer, and this trend was also significantly different from the trend in white males. Although not statistically significant, increasing trends can be seen in colon and rectum, stomach, and urinary bladder cancer and leukemia for AI/AN males, while white males had significantly decreasing trends for these same cancer sites. Additionally, incidence rates for liver and esophagus cancer decreased significantly in AI/AN males compared to the rates of their white counterparts; the rates for these two sites increased significantly in white males.

AI/AN females had significantly increasing trends in thyroid cancer incidence from 1992 to 1999 (Table 4). Although not statistically significant, increasing rates of colon and rectum, stomach, gallbladder, and pancreatic cancer and leukemia can be seen for AI/AN females and an apparent decrease for white females. Further, the rates of breast, lung and bronchus, and kidney and renal pelvis cancer and melanoma showed a decline in AI/AN females (non-significant when compared to white females except for melanoma), and a significant increase (except for lung and bronchial cancer) in white females.

Stomach cancer trends differed significantly between AI/AN women and white women, with an increasing trend in AI/AN women and a decreasing trend in white women. Melanoma trends also significantly differed, with a decreasing trend in AI/AN women and an increasing trend in white women.

The annual cancer incidence rates and trends for the top 10 AI/AN cancer sites and cancer of the gallbladder are shown in the Figure for both AI/ANs and whites for 1992–1999. These plots show whether the rates for AI/ANs differ from those for whites and highlight trends in the annual rates for each group during the study period. For liver and IBD cancers (see Figure), the rates for AI/AN males were greater than those for white males; however, in later years of the study they appeared to be similar. The rates for cancer of the gallbladder in AI/AN males and females (see Figure) were greater than those for whites for most of the study period, thus indicating the burden of this cancer in the AI/AN population. Among AI/AN males, the rate of this cancer appeared to decrease over time, but the opposite was true for AI/AN females. Conversely, the disparities in stomach cancer became more apparent for both males and females in later study years. For pancreatic cancer (see Figure), AI/AN rates were less than those for whites in the early 1990s for both genders; however, in the latter years of the study period, they appeared to be similar to the rates of whites.

Table 2. Age-adjusted incidence rates[a] for cancers in AI/AN and white females, 1992–1999, by rank for AI/AN females

Rank for AI/AN males	Cancer site	AI/AN rate	SE	Rank for white females	White rate	SE	SIR	95% CI
—	All sites	224.21	4.48	—	424.40	0.60	0.53	0.51, 0.57
1	Breast	59.37	2.23	1	137.00	0.35	0.43	0.40, 0.51
2	Colon and rectum	30.8	1.73	2	46.11	0.19	0.67	0.60, 0.78
3	Lung and bronchus	23.31	1.51	3	51.12	0.21	0.46	0.40, 0.58
4	Endometrium	10.61	0.94	4	25.99	0.15	0.41	0.34, 0.58
5	Ovary	10.19	0.93	5	18.08	0.13	0.56	0.47, 0.74
6	Kidney and renal pelvis	8.11	0.86	13	7.59	0.08	1.07	0.87, 1.28
7	Cervix uteri	7.68	0.77	10	9.57	0.09	0.80	0.66, 1.00
8	Stomach	7.65	0.85	16	5.16	0.06	1.48	1.19, 1.70
9	Pancreas	6.25	0.79	11	9.47	0.09	0.66	0.51, 0.91
10	Non-Hodgkin's lymphoma	6.06	0.72	6	15.88	0.12	0.38	0.30, 0.61
11	Liver and IBD	5.82	0.76	18	2.52	0.05	2.31	1.78, 2.57
12	Thyroid	5.61	0.62	12	9.27	0.09	0.61	0.49, 0.82
13	Gallbladder	4.05	0.64	20	1.57	0.04	2.58	1.88, 2.89
14	Oral cavity and pharynx	3.61	0.57	14	6.72	0.08	0.54	0.39, 0.85
15	Leukemia	3.54	0.51	9	9.79	0.09	0.36	0.27, 0.64
16	Myeloma	2.74	0.50	17	4.16	0.06	0.66	0.46, 1.02
17	Urinary bladder	1.85	0.45	8	9.82	0.09	0.19	0.12, 0.67
18	Brain and other nervous system	1.65	0.34	15	5.92	0.07	0.28	0.19, 0.68
19	Melanoma	1.59	0.35	7	14.91	0.11	0.11	0.07, 0.54
20	Esophagus	1.30	0.35	19	1.94	0.04	0.67	0.39, 1.20

[a]Incidence rates per 100,000, standardized to 2000 population

AI/AN = American Indian/Alaska Native

SE = standard error

SIR = standardized incidence ratio (ratio of AI/AN rate to white rate)

CI = confidence interval

IBD = intrahepatic bile duct

Increases in pancreatic and stomach cancer rates occurred in AI/ANs during the latter years of the study period, while the comparable rates for whites were level or declining.

DISCUSSION

The present study investigated 1992–1999 cancer incidence rates and trends for the AI/AN and white populations, using data obtained from the SEER Program at the National Cancer Institute. Overall, for all cancer sites combined, the AI/AN male and female incidence rates were lower than the comparable overall white male and female rates. These differences appear to be due to lower rates among AI/ANs for major cancers such as prostate, lung and bronchus, colon and rectum, and breast cancer.

One way to measure the cancer burden in a population is the rank order of its cancer incidence rates,[8] as shown for AI/ANs in Tables 1 and 2. The leading cancers for AI/AN males and females are not necessarily the leading cancers for white males and females. For example, the fourth and fifth leading causes of cancer in AI/AN males were cancers of the kidney and renal pelvis and the stomach. These cancers ranked ninth and 11th in white males. Liver cancer was the seventh leading cancer for AI/AN males, whereas it ranked 14th in white males. For AI/AN females in this study, the seventh leading cause of cancer was cancer of the cervix, which ranked 10th in white females. Liver and IBD cancer was the 11th leading cancer for AI/AN females, and the 18th leading cancer for white females. Stomach cancer was the eighth leading cause of cancer in AI/AN females, and ranked 16th for white females. Finally, kidney and renal pelvis cancers ranked sixth for AI/AN females and 13th for white females. Identifying the cancers important to the AI/AN population is the first step in determining its cancer burden and tailoring cancer control strategies for its needs.

Cancer disparities can be measured by comparing the incidence rates of a selected population relative to those of the majority white population.[8] Although AI/ANs in general had lower cancer incidence rates than whites, there were some cancer sites for which the AI/AN rates were elevated relative to those of the white population. These sites include cancers of the gallbladder (SIR=4.1 for males and SIR=2.6 for females), liver and IBD (SIR=1.3 for males and SIR=2.3 for females), stomach (SIR=1.2 for males and SIR=1.5 for females), and kidney and renal pelvis (SIR=1.03 for males and SIR=1.07 for females). Although it is difficult to distinguish between the influences of environment and heredity on cancer risk, there is research evidence that the AI/AN population as a whole is predisposed to the genetic factors that cause gallstones, and thus its members may have a genetic predisposition for gallbladder and kidney cancers.[9] Inadequate food preservation and *H. pylori* infection have

Table 3. Annual percentage changes (APCs) in cancer incidence rates for AI/AN and white males, 1992–1999

Cancer site	*AI/AN male APC*	*SE*	*White male APC*	*SE*
All sites	−2.13	1.96	−2.41[a]	0.59
Pancreas	13.06[a,b]	6.59	−0.46	0.40
Leukemia	13.01	8.30	−2.04[a]	0.80
Urinary bladder	7.90	10.97	−0.55[a]	0.28
Melanoma	4.91	16.13	2.95[a]	0.67
Testis	4.40	11.70	1.12	0.75
Stomach	3.29	6.46	−2.27[a]	0.30
Brain and other nervous system	2.53	8.25	−0.64	0.84
Colon and rectum	0.34	3.61	−1.14[a]	0.53
Non-Hodgkin's lymphoma	−0.16	5.36	−0.80	0.69
Thyroid	−0.71	11.79	1.64	1.05
Oral cavity and pharynx	−1.44	4.88	−2.65[a]	0.41
Kidney and renal pelvis	−2.42	3.73	0.52	0.57
Lung and bronchus	−3.30	3.20	−2.55[a]	0.25
Prostate	−5.75	2.98	−4.70[a]	1.75
Gallbladder	−5.94	11.07	−1.53	2.86
Esophagus	−9.00[b]	4.46	1.86[a]	0.66
Liver and IBD	−9.97[b]	6.03	3.88[a]	1.02

NOTE: Rates could not be calculated for AI/AN males for oral cavity and pharynx, gallbladder, larynx, thyroid, Hodgkin's disease, and multiple myeloma.

[a]APC significantly different from zero, $p<0.05$.

[b]APC for AI/AN males significantly different from APC for white males, $p<0.05$.

AI/AN = American Indian/Alaska Native

APC = annual percentage change

SE = standard error

IBD = intrahepatic bile duct

Table 4. Annual percentage changes (APCs) in cancer incidence rates for AI/AN and white females, 1992–1999

Cancer site	*AI/AN female APC*	*SE*	*White female APC*	*SE*
All sites	0.57	0.97	0.36	0.22
Stomach	10.89[b]	5.90	−0.99	0.75
Thyroid	10.05[a]	4.97	4.24[a]	0.46
Endometrium	5.40	5.66	0.14	0.35
Pancreas	4.75	11.88	−0.76	0.48
Non-Hodgkin's lymphoma	4.49	3.07	0.88[a]	0.39
Colon and rectum	3.26	3.61	−0.43	0.44
Gallbladder	2.60	11.46	−3.44[a]	1.13
Leukemia	0.81	4.68	−1.36	0.97
Myeloma	0.69	12.63	−1.64	1.11
Liver and IBD	0.61	9.47	5.24[a]	0.86
Breast	−1.22	2.25	1.04[a]	0.25
Cervix uteri	−3.17	4.95	−2.20[a]	0.58
Lung and bronchus	−4.06	2.80	0.15	0.34
Ovary	−5.19	6.57	−0.88[a]	0.28
Kidney and renal pelvis	−7.17	5.66	0.98[a]	0.38
Oral cavity and pharynx	−8.70	8.64	−1.70[a]	0.81
Melanoma	−20.70[b]	10.63	3.09[a]	0.70

NOTE: Rates could not be calculated for AI/AN females for oral cavity and pharynx, esophagus, liver, larynx, urinary bladder, Hodgkin's disease, multiple myeloma, brain or other nervous system, and endometrium.

[a]APC significantly different from zero, $p<0.05$.

[b]APC for AI/AN females significantly different from APC for white females, $p<0.05$.

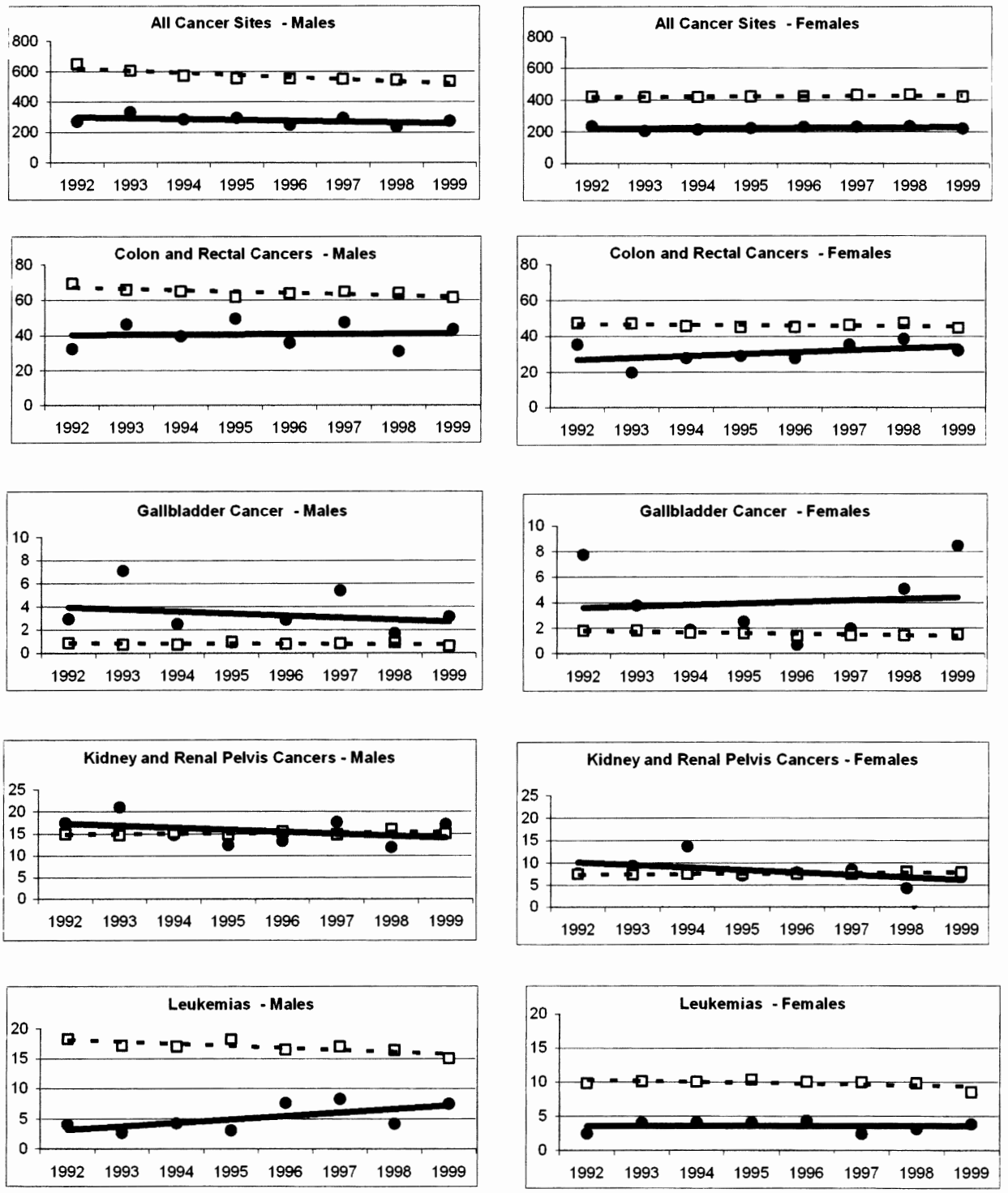
AI/AN = American Indian/Alaska Native

APC = annual percentage change

SE = standard error

IBD = intrahepatic bile duct

Figure. Trends in incidence rates for selected cancers for American Indian/Alaska Native and white males and females, Surveillance, Epidemiology and End Results (SEER) Program, 1992–1999



NOTES: American Indians/Alaska Natives (AI/ANs) are represented by bold circles/solid lines and whites by open squares/dashed lines. Data for all cancer sites are followed by data for non–gender-specific cancer sites in alphabetical order, followed by data for gender-specific sites.

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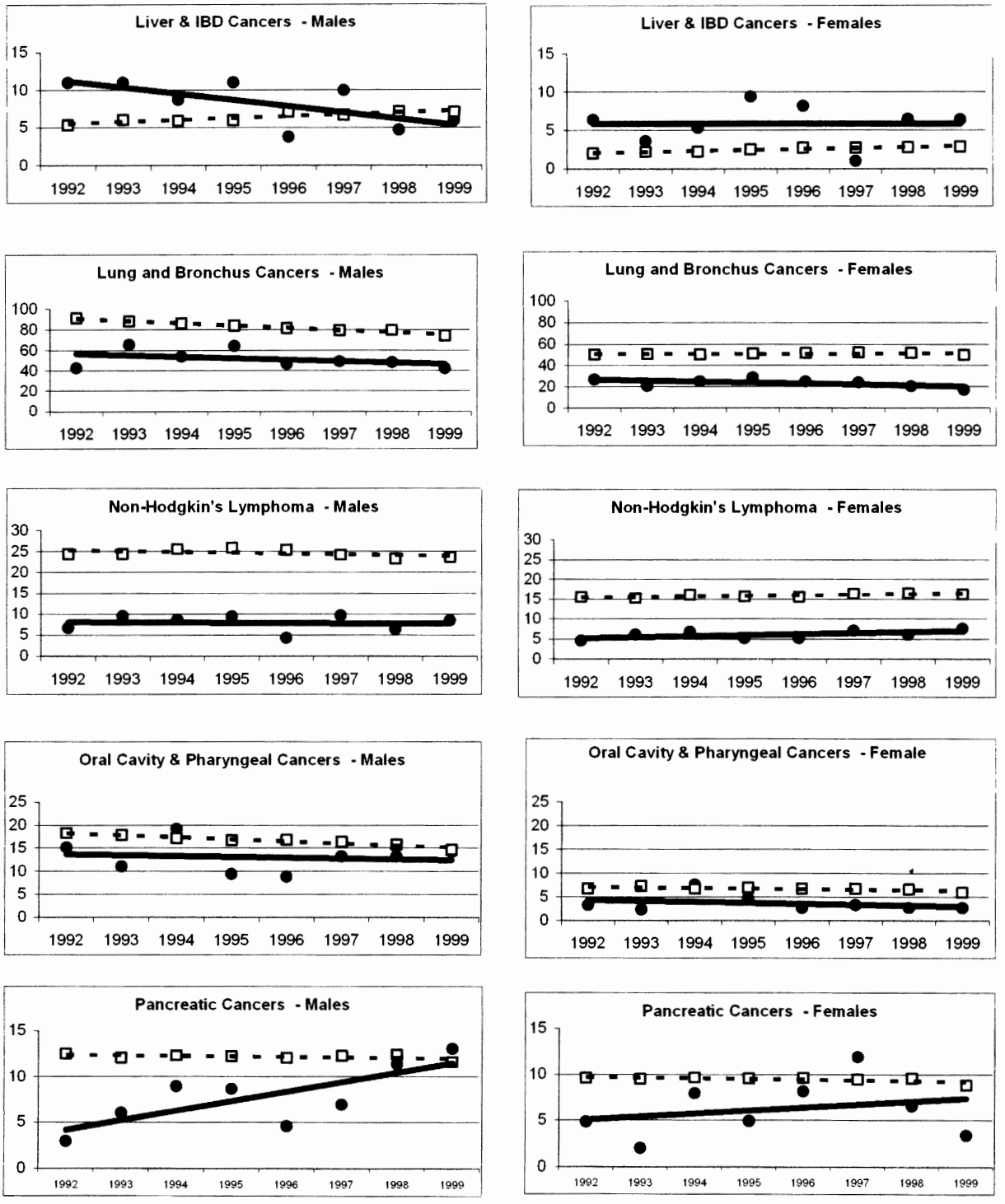
Figure (continued). Trends in incidence rates for selected cancers for American Indian/Alaska Native and white males and females, Surveillance, Epidemiology and End Results (SEER) Program, 1992–1999



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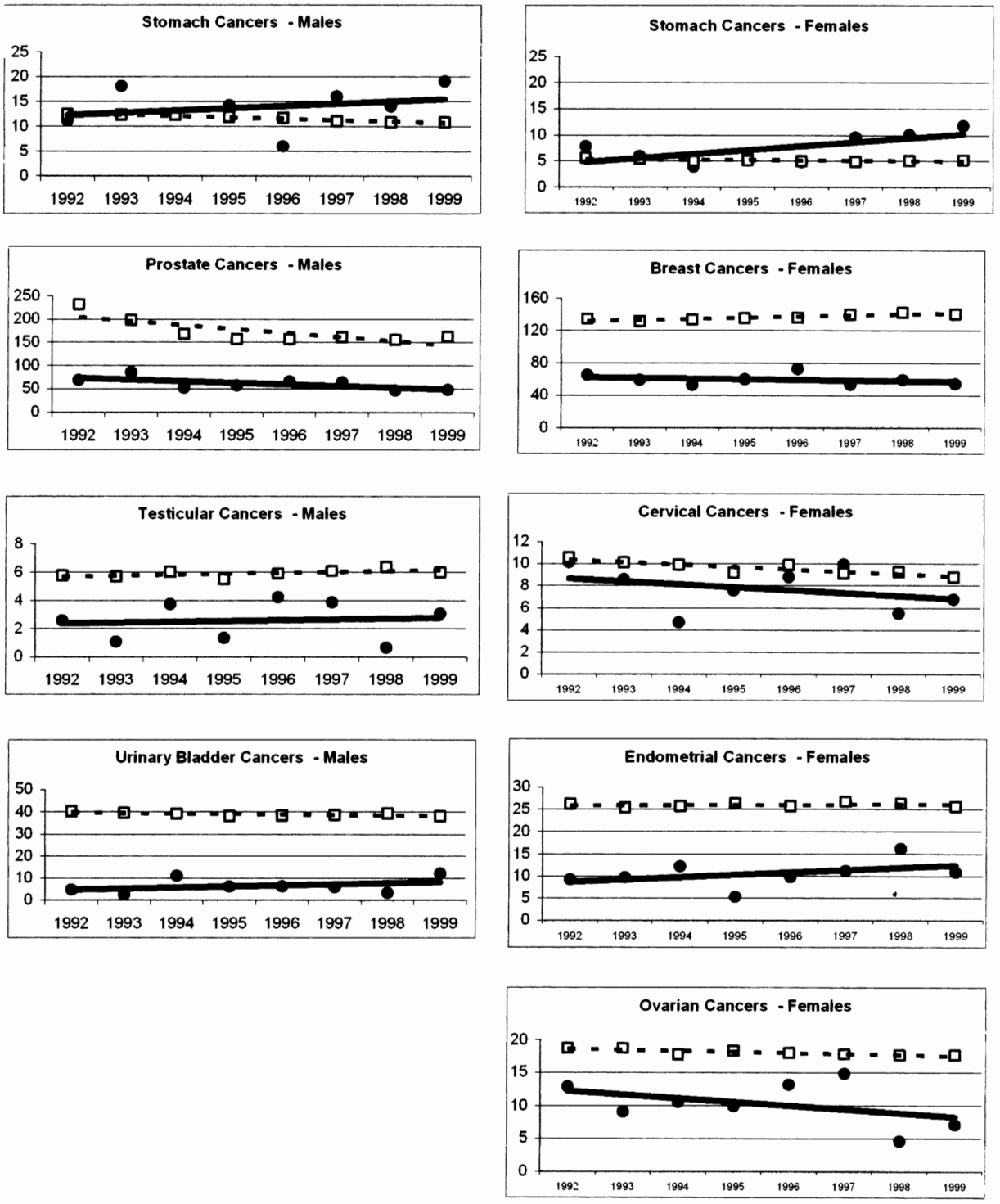

NOTES: American Indians/Alaska Natives (AI/ANs) are represented by bold circles/solid lines and whites by open squares/dashed lines. Data for all cancer sites are followed by data for non–gender-specific cancer sites in alphabetical order, followed by data for gender-specific sites.

been shown to increase AI/ANs' risk of stomach cancer.[9,10] A high rate of cirrhosis associated with chronic alcohol consumption is responsible for elevated mortality among American Indians[11] and may contribute to their relatively higher incidence of liver cancer.[9]

Another way to measure cancer disparities is to compare trends in incidence rates in the selected population with those in the white population. Declining trends may be associated with public awareness campaigns, early detection, and medical interventions—for example, declines in lung cancer associated with smoking cessation efforts, in cervical cancer with routine Pap smears, in breast cancer with adherence to mammography and adjuvant therapies, in colorectal cancer with the various colorectal cancer screening modalities (e.g., sigmoidoscopy and colonoscopy), in stomach cancer with treatment for certain bacterial infections, and perhaps in some cases of prostate cancer with prostate specific antigen testing. However, for male and female AI/ANs, declines in incidence rates were not seen for all of these cancers. Rates for stomach cancer and colorectal cancer rose for male and female AI/ANs, thus indicating the need for more cancer control activities in these areas.

Findings from the 1997 Behavioral Risk Factor Surveillance System (BRFSS) indicate that 25% of AI/ANs reported not having health insurance. AI/ANs were more likely than whites to have poor access to health care, to have poor health status,[12] and to be of low socioeconomic status.[13] These conditions add to cancer disparities. The same problems exist for AI/ANs residing on reservations.[14,15]

The SEER AI/AN rates predominantly reflect the cancer rates for AI/ANs in the West (those living on reservations covered by the New Mexico registry and in urban areas in California covered by the San Francisco–Oakland, San Jose–Monterey, and Los Angeles registries). The results obtained from the SEER program may not be generalizable to all AI/ANs in the United States because of regional differences and tribal or intertribal variation.[10,16,17] Few SEER registries exist in geographic areas such as the Midwest, South or Northeast, where tribal representation may be different. Nonetheless, the data presented here provide a general overview of the cancer burden of AI/ANs in the SEER Program. Furthermore, this study does not address the issues of cancer survival. Five-year cancer survival in American Indians is the poorest of that of any major racial/ethnic group.[16,18]

The findings of this study demonstrate that cancer incidence rates, ranks, and trends vary dramatically for AI/ANs and whites in the U.S. These results should be used for the development of targeted interventions to increase awareness of cancer prevention and control practices among AI/ANs.[19] Further, studies are needed to assess the rates of cancer in AI/AN populations residing in different regions of the U.S. to determine possible tribal and/or regional variation.

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