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# Incidence of Ovarian Cancer by Race and Ethnicity in the United States, 1992–1997

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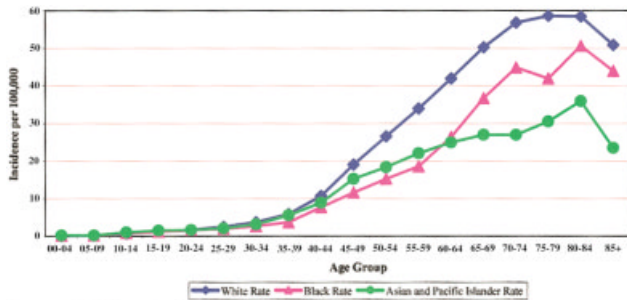
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Ovarian cancer is the fifth most common cancer among U.S. women.<sup>1</sup> An estimated 23,400 new cases were expected to be diagnosed in the U.S. in 2001. As is the case for breast and endometrial cancers, ovarian cancer is more common among women in northern and central Europe, and North America compared with Africa, South America, and Asia.<sup>2</sup> In the U.S., substantial racial and ethnic variations also are observed in the incidence of ovarian cancer. Rates reportedly are highest among non-Hispanic white and American Indian women, and are lower among Hispanic, Native Hawaiian, and Asian women.<sup>3</sup> Among white women in the U.S., there has been a gradual decline in the incidence and mortality from ovarian cancer since 1973, whereas rates among black women during this time period have been fairly stable.<sup>4</sup> The epidemiology of ovarian cancer was discussed in the article by Goodman and How.<sup>5</sup>

## MATERIALS AND METHODS

The North American Association of Central Cancer Registries (NAACCR) data file for the period 1992–1997 contains information regarding 67,746 women diagnosed with incident ovarian cancer, including 61,003 white women, 4106 black women, 187 American Indian women, and 1898 Asian/Pacific Islander women. Hispanic ( $n = 3665$ ) or Not Hispanic ( $n = 36,106$ ) identification was obtained from a subset of 40,384 women with ovarian cancer (60%). Information regarding the summary stage of the ovarian cancer at the time of diagnosis was available for 55,814 (82%) of the total cases. Cases were subdivided into women with malignant disease ( $n = 59,277$ ) and women with ovarian cancer of low malignant potential ( $n = 8469$ ). A description of the selection of these cases is described elsewhere in this supplement.<sup>5</sup>

We calculated an average annual incidence rate, which is the sum of the number of new cases of ovarian cancer reported to NAACCR between 1992–1997 divided by the sum of the annual denominators. All rates were age-adjusted by 5-year age groups, unless otherwise indicated. The 1970 U.S. population was used for age standardization. Relative percentages also were computed as the age-adjusted incidence rate for a particular subgroup (e.g., borderline malignancies) divided by the age-adjusted incidence rate for all subgroups (e.g., all malignancies), which is the approximate sum of the age-adjusted incidence rates across all subgroups combined.



Rates are per 100,000 and age-adjusted to the 1970 U.S. standard population.

**FIGURE 1.** Age-specific incidence rates for malignant ovarian cancer by race, North American Association of Central Cancer Registries (NAACCR), U.S. combined data, 1992–1997.

**RESULTS**

**Black, American Indian, Asian/Pacific Islander, White**

The overall incidence of ovarian cancer rose with increasing age up to the age of 75–84 years, before declining slightly among women ages ≥ 80–85 years. Ovarian cancer incidence in Asian/Pacific Islander women climbed more gradually than the rates for black and white women (Fig. 1). (Too few American Indian women were identified for age-specific rates to be calculated.) Among women ages 15–24 years, the incidence rates among Asian/Pacific Islander women were higher than those in white and black women. Among women age ≥ 25 years, incidence rates were highest among white women. Asian/Pacific Islander women experienced higher rates of ovarian cancer than black women up to the age of 60 years. In women age ≥ 60 years, the age-specific rates were higher among black women than among Asian/Pacific Islander women.

White women had the highest age-adjusted incidence rate for malignant ovarian cancer (13.1 per 100,000) among all racial and ethnic groups. The risk of ovarian cancer among white women was 28% higher than the risk in American Indian women, 46% higher than the risk in black women, and 56% higher than the risk in Asian/Pacific Islander women (Table 1).

The age-specific incidence of borderline ovarian cancer was somewhat different from the incidence of malignant cancer, with a more gradual increase reported with age for each racial and ethnic group (Fig. 2). The incidence among white women was similar to that among Asian/Pacific Islander women up to age 25 years, peaked at ages 45–59 years, and then declined gradually thereafter. The rate of borderline tumors increased more gradually in adulthood among Asian/Pacific Islander women than among white women, peaking at ages 70–74 years and then again after the age of 85 years. Among black women, the incidence of

**TABLE 1**  
Malignant<sup>a</sup> Ovarian Cancer Counts and Age-Adjusted Incidence Rates<sup>b</sup> by Race, Selected Areas in the U.S., 1992–1997<sup>c</sup>

Race	Count	Rate	Lower CI	Upper CI
White	53,496	13.1	13.0	13.2
Black	3589	9.0	8.7	9.3
American Indian <sup>d</sup>	81	10.2	8.0	12.7
Asian/Pacific Islander	1596	8.4	8.0	8.9
All Races <sup>e</sup>	59,277	12.6	12.5	12.7

CI: 95% confidence intervals.

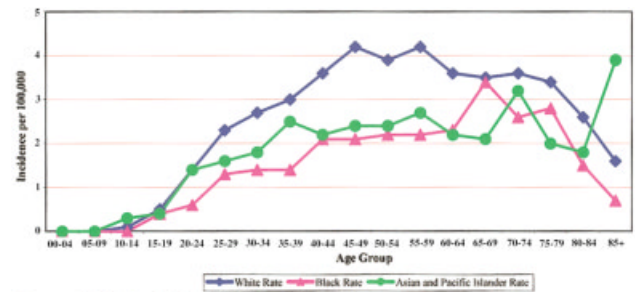
<sup>a</sup> Malignant is not equal to: 8442: serous cystadenoma; 8451: papillary cystadenoma; 8462: papillary serous cystadenoma; 8472: mucinous cystadenoma; and 8473: papillary mucinous cystadenoma.

<sup>b</sup> Rates are per 100,000 and age-adjusted to the 1970 U.S. standard population.

<sup>c</sup> Source: North American Association of Central Cancer Registries file submissions as of December 1999 from Arizona, California, Colorado, Connecticut, Delaware, Hawaii, Georgia (Metro Atlanta), Florida, Idaho, Illinois, Iowa, Kentucky, Louisiana, Michigan (Metro Detroit), Minnesota, Montana, Nebraska, New Hampshire, New Jersey, New Mexico, North Carolina, Rhode Island, Utah, Washington (Seattle), West Virginia, and Wisconsin.

<sup>d</sup> American Indian includes cases from Arizona and New Mexico only.

<sup>e</sup> Total includes 435 women with other or unknown race and 80 American Indian women in areas outside Arizona and New Mexico.



Rates are per 100,000 and age-adjusted to the 1970 U.S. standard population.

**FIGURE 2.** Age-specific incidence rates for borderline ovarian cancer by race, North American Association of Central Cancer Registries (NAACCR) U.S. combined areas, 1992–1997.

borderline tumors generally was lower than that for white and Asian/Pacific Islander women until peaking at ages 65–69 years, when the incidence rate approached that of white women.

Nearly 13% (*n* = 8469) of reported ovarian cancers were borderline or of low malignant potential, with an overall age-adjusted incidence rate of 2.0 per 100,000 (Table 2). The ethnic-specific incidence rates for ovarian cancer of low malignant potential paralleled those for all ovarian cancer combined; rates were highest among white women, followed by Asian/Pacific Islander and black women. The relative percentage of these borderline tumors to the incidence of all invasive ovarian cancers combined was similar across ethnic groups, varying between 12–14%.

Serous carcinoma was the most common histologic type among all racial and ethnic groups, followed

**TABLE 2**  
**Borderline<sup>a</sup> Ovarian Cancer Counts and Age-Adjusted Incidence Rates<sup>b</sup> by Race, Selected Areas in the U.S., 1992–1997<sup>c</sup>**

Race	Count	Rate <sup>d</sup>	Lower CI	Upper CI
White	7507	2.0	2.0	2.0
Black	517	1.2	1.1	1.3
American Indian <sup>e</sup>	12	-	0.6	2.3
Asian/Pacific Islander	305	1.4	1.2	1.6
All Races <sup>f</sup>	8469	1.9	1.9	1.9

CI: 95% confidence interval.

<sup>a</sup> Borderline Malignant is equal to: 8442: serous cystadenoma; 8451: papillary cystadenoma; 8462: papillary serous cystadenoma; 8472: mucinous cystadenoma; and 8473: papillary mucinous cystadenoma.

<sup>b</sup> Rates are per 100,000 and age-adjusted to the 1970 U.S. standard population.

<sup>c</sup> Source: North American Association of Central Cancer Registries file submissions as of December 1999 from Arizona, California, Colorado, Connecticut, Delaware, Hawaii, Georgia (Metro Atlanta), Florida, Idaho, Illinois, Iowa, Kentucky, Louisiana, Michigan (Metro Detroit), Minnesota, Montana, Nebraska, New Hampshire, New Jersey, New Mexico, North Carolina, Rhode Island, Utah, Washington (Seattle), West Virginia, and Wisconsin.

<sup>d</sup> Rate is suppressed when count is  $\leq 20$ .

<sup>e</sup> American Indian includes cases from Arizona and New Mexico only.

<sup>f</sup> Total includes 114 women with other or unknown race and 14 American Indian women in areas outside Arizona and New Mexico.

by mucinous, endometrioid, and clear cell carcinomas (Table 3). The risk of serous carcinoma among white women (4.8 per 100,000) was 45% higher than among American Indian women (3.3 per 100,000) and was 92% higher than among black and Asian/Pacific Islander women (2.5 per 100,000). The rates for mucinous, endometrioid, and clear cell carcinomas were lower in black women compared with white and Asian/Pacific Islander women. The rates of sex cord and germ cell histologic types of ovarian cancer were similar among all ethnic groups for which sufficient information existed. The age-adjusted rate of unspecified cancer accounted for a larger percentage of overall ovarian malignancy among black women (4.4%) than among white women (3.1%) or Asian/Pacific Islander women (2.4%). Unspecified carcinoma and adenocarcinoma, not otherwise specified (NOS) also were relatively more common among black women as a percentage of their total ovarian cancer rate.

Histologic-specific rates of borderline ovarian tumors were found to differ substantially by racial and ethnic group (Table 4). Papillary serous cystadenoma was the most common borderline tumor among white women, followed by mucinous cystadenoma, serous cystadenoma, papillary mucinous cystadenoma, and papillary cystadenoma. Papillary serous cystadenoma also was the most common borderline tumor among black women, but mucinous cystadenoma was less common than serous cystadenoma. Mucinous cystadenoma was the most frequent borderline tumor

among Asian/Pacific Islander women with a rate of 0.8 per 100,000, which is 14% higher than the rate for this histologic type among white or black women. By contrast, the rate for papillary serous cystadenoma (0.3 per 100,000) was relatively low among Asian/Pacific Islander women and represented a far smaller percentage (21%) of borderline tumors than among white women (35%) and black women (42%).

Distant or metastatic carcinoma was the most common stage at diagnosis among all racial and ethnic groups, followed by localized and regional disease (Table 5). White women were found to have the highest rate of ovarian cancer in each stage group. However, American Indian women had the highest rate of distant stage cancer relative to their overall ovarian cancer incidence rate (72%). The lowest rate of distant cancer was found in Asian/Pacific Islander women (3.3 per 100,000); these women had the highest rate of localized cancer relative to their overall cancer incidence (1.5/5.9 = 25%). The age-adjusted rate of unstaged relative to staged cancers was considerably higher among black and white women than among Asian/Pacific Islander women.

The majority of borderline tumors were diagnosed at a localized stage, representing 71% of all tumors among white women, 64% of all tumors among black women, and 80% of all tumors among Asian/Pacific Islander women (Table 6). Distant borderline tumors, by contrast, were relatively more common among black women than among white and Asian/Pacific Islander women.

### Hispanic, Not Hispanic

Age-specific incidence rates for ovarian cancer among Hispanic women rose more gradually than rates among women who were not Hispanic, peaking at ages 80–84 years. Among patients ages 10–29 years, incidence rates among Hispanic women were higher than rates among women who were not Hispanic, whereas among women age  $\geq 30$  years, the incidence rates among Hispanic women were lower than rates among women who were not Hispanic (Fig. 3).

The age-adjusted incidence rate for malignant ovarian cancer among Hispanic women (9.4 per 100,000) was 28% lower than among women who were not Hispanic (13.0 per 100,000) (Table 7).

The age-specific incidence of borderline tumors was higher among Hispanics than among women who were not Hispanic until ages 25–29 years, when the rates converged (Fig. 4). The incidence of borderline tumors peaked among Hispanic women at ages 45–49 years and then again at ages 70–74 years. Among women who were not Hispanic, the incidence of borderline tumors peaked at ages 55–59 years.

**TABLE 3**  
**Malignant<sup>a</sup> Ovarian Cancer Counts and Age-Adjusted Incidence Rates<sup>b</sup> by Histology and Race, Selected Areas in the U.S., 1992–1997<sup>c</sup>**

IARC histology	White				Black				American Indian <sup>d</sup>				Asian/Pacific Islander				All races <sup>e</sup>			
	Count	Rate	Lower CI	Upper CI	Count	Rate	Lower CI	Upper CI	Count	Rate <sup>f</sup>	Lower CI	Upper CI	Count	Rate <sup>f</sup>	Lower CI	Upper CI	Count	Rate	Lower CI	Upper CI
Carcinoma	48,406	11.9	11.8	12.0	2969	7.5	7.2	7.8	70	8.9	6.9	11.4	1421	7.5	7.1	7.9	53,314	11.4	11.3	11.5
Serous carcinoma	18,720	4.8	4.7	4.8	991	2.5	2.4	2.7	27	3.3	2.2	4.9	463	2.5	2.3	2.7	20,363	4.5	4.4	4.6
Mucinous carcinoma	4775	1.2	1.2	1.2	340	0.8	0.7	0.9	6	—	0.3	1.7	199	1.0	0.9	1.1	5374	1.2	1.1	1.2
Endometrioid carcinoma	5887	1.5	1.5	1.6	279	0.7	0.6	0.8	15	—	1.0	3.2	217	1.1	0.9	1.2	6467	1.4	1.4	1.5
Clear cell carcinoma	1923	0.5	0.5	0.5	76	0.2	0.1	0.2	3	—	0.1	1.1	137	0.7	0.6	0.8	2162	0.5	0.5	0.5
Adenocarcinoma, NOS	11,994	2.7	2.7	2.8	847	2.2	2.0	2.3	7	—	0.4	2.0	281	1.6	1.4	1.8	13,224	2.7	2.6	2.7
Other specified carcinomas	1176	0.3	0.3	0.3	85	0.2	0.2	0.3	2	—	0.0	1.1	35	0.2	0.1	0.3	1308	0.3	0.3	0.3
Unspecified carcinoma	3931	0.8	0.8	0.9	351	0.9	0.8	1.0	10	—	0.6	2.5	89	0.5	0.4	0.6	4416	0.8	0.8	0.9
Sex cord-stromal tumors	599	0.2	0.1	0.2	145	0.3	0.3	0.4	2	—	0.0	1.0	19	—	0.1	0.2	779	0.2	0.2	0.2
Germ cell tumors	1039	0.4	0.3	0.4	161	0.4	0.3	0.4	3	—	0.1	0.9	79	0.4	0.3	0.5	1304	0.4	0.3	0.4
Other specified tumor	1426	0.3	0.3	0.4	133	0.4	0.3	0.4	2	—	0.0	1.0	41	0.2	0.2	0.3	1612	0.3	0.3	0.4
Unspecified tumor	2026	0.4	0.4	0.4	181	0.4	0.4	0.5	4	—	0.1	1.3	36	0.2	0.1	0.3	2268	0.4	0.4	0.4
Total	53,496	13.1	13.0	13.2	3589	9.0	8.7	9.3	81	10.2	8.0	12.7	1596	8.4	8.0	8.9	59,277	12.6	12.5	12.7

IARC: International Agency for Research on Cancer; CI: 95% confidence interval; NOS: not otherwise specified.

<sup>a</sup> Malignant is not equal to: 8442: serous cystadenoma; 8451: papillary cystadenoma; 8462: papillary serous cystadenoma; 8472: mucinous cystadenoma; and 8473: papillary mucinous cystadenoma.

<sup>b</sup> Rates are per 100,000 and age-adjusted to the 1970 U.S. standard population.

<sup>c</sup> Source: North American Association of Central Cancer Registries file submissions as of December 1999 from Arizona, California, Colorado, Connecticut, Delaware, Hawaii, Georgia (Metro Atlanta), Florida, Idaho, Illinois, Iowa, Kentucky, Louisiana, Michigan (Metro Detroit), Minnesota, Montana, Nebraska, New Hampshire, New Jersey, New Mexico, North Carolina, Rhode Island, Utah, Washington (Seattle), West Virginia, and Wisconsin.

<sup>d</sup> American Indian cases from Arizona and New Mexico only.

<sup>e</sup> Totals include 435 women with other or unknown race and 80 American Indian women in areas outside Arizona and New Mexico.

<sup>f</sup> Rate is suppressed when count is ≤20.

**TABLE 4**  
**Borderline<sup>a</sup> Ovarian Cancer Counts and Age-Adjusted Incidence Rates<sup>b</sup> by Race, Selected Areas in the U.S., 1992–1997<sup>c</sup>**

Borderline low malignant potential	White				Black				American Indian <sup>d</sup>				Asian/Pacific Islander				All races <sup>e</sup>			
	Count	Rate	Lower CI	Upper CI	Count	Rate <sup>f</sup>	Lower CI	Upper CI	Count	Rate <sup>f</sup>	Lower CI	Upper CI	Count	Rate <sup>f</sup>	Lower CI	Upper CI	Count	Rate	Lower CI	Upper CI
Serous cystadenoma	1901	0.5	0.5	0.5	138	0.3	0.3	0.4	4	—	0.1	1.1	57	0.3	0.2	0.4	2131	0.5	0.5	0.5
Papillary cystadenoma	165	0.0	0.0	0.1	14	—	0.0	0.1	1	—	0.0	0.8	3	—	0.0	0.1	186	0.0	0.0	0.0
Papillary serous cystadenoma	2661	0.7	0.7	0.7	237	0.5	0.5	0.6	4	—	0.1	1.2	75	0.3	0.2	0.4	3024	0.7	0.7	0.7
Mucinous cystadenoma	2572	0.7	0.7	0.7	120	0.3	0.2	0.3	3	—	0.1	1.1	160	0.8	0.6	0.9	2899	0.7	0.6	0.7
Papillary mucinous cystadenoma	208	0.1	0.0	0.1	8	—	0.0	0.0	0	—	0.0	0.6	10	—	0.0	0.1	229	0.0	0.0	0.1
Total	7507	2.0	2.0	2.0	517	1.2	1.1	1.3	12	—	0.6	2.3	305	1.4	1.2	1.6	8469	1.9	1.9	1.9

CI: 95% confidence interval.

<sup>a</sup> Borderline Malignant is equal to: 8442: serous cystadenoma; 8451: papillary cystadenoma; 8462: papillary serous cystadenoma; 8472: mucinous cystadenoma; and 8473: papillary mucinous cystadenoma.

<sup>b</sup> Rates are per 100,000 and age-adjusted to the 1970 U.S. standard population.

<sup>c</sup> Source: North American Association of Central Cancer Registries file submissions as of December 1999 from Arizona, California, Colorado, Connecticut, Delaware, Hawaii, Georgia (Metro Atlanta), Florida, Idaho, Illinois, Iowa, Kentucky, Louisiana, Michigan (Metro Detroit), Minnesota, Montana, Nebraska, New Hampshire, New Jersey, New Mexico, North Carolina, Rhode Island, Utah, Washington (Seattle), West Virginia, and Wisconsin.

<sup>d</sup> American Indian cases from Arizona and New Mexico only.

<sup>e</sup> Row totals include 114 women with other or unknown race and American Indian women outside Arizona and New Mexico.

<sup>f</sup> Rate is suppressed when count is ≤20.

Hispanic women had a lower rate of borderline tumors (1.7 per 100,000) compared with women who were not Hispanic (2.0 per 100,000) (Table 8).

Serous carcinoma was the most common histologic type of malignant ovarian cancer among women,

regardless of Hispanic ethnicity (Table 9). The rate of unspecified tumor was similar in the two ethnic groups. The risk of serous carcinoma was 38% lower among Hispanic women than among women who were not Hispanic. The rates for all histologic subtypes

**TABLE 5**  
**Malignant<sup>a</sup> Ovarian Cancer Counts and Age-Adjusted Incidence Rates<sup>b</sup> by Summary Stage<sup>c</sup> and Race, Selected Areas in the U.S., 1992–1997<sup>d</sup>**

Stage	White				Black				American Indian <sup>e</sup>				Asian/Pacific Islander				All races <sup>f</sup>			
	Count	Rate	Lower CI	Upper CI	Count	Rate	Lower CI	Upper CI	Count	Rate <sup>g</sup>	Lower CI	Upper CI	Count	Rate	Lower CI	Upper CI	Count	Rate	Lower CI	Upper CI
Localized	9175	2.3	2.3	2.4	612	1.4	1.3	1.5	9	—	0.5	2.1	378	1.5	1.4	1.7	10,288	2.2	2.2	2.3
Regional	6352	1.5	1.5	1.6	429	1.0	0.9	1.1	7	—	0.4	1.9	166	0.7	0.6	0.8	7019	1.5	1.4	1.5
Distant	28,244	6.6	6.6	6.7	2036	4.8	4.6	5.0	58	7.3	5.5	9.5	748	3.3	3.1	3.6	31,288	6.3	6.3	6.4
Unstaged	4,575	0.9	0.9	1.0	387	0.9	0.8	1.0	7	—	0.4	1.9	76	0.3	0.3	0.4	5116	0.9	0.9	1.0
Total	48,346	11.5	11.4	11.6	3464	8.1	7.8	8.3	81	10.2	8.0	12.7	1368	5.9	5.6	6.2	53,711	10.9	10.8	11.0

CI: 95% confidence interval.

<sup>a</sup> Malignant is not equal to: 8442: serous cystadenoma; 8451: papillary cystadenoma; 8462: papillary serous cystadenoma; 8472: mucinous cystadenoma; and 8473: papillary mucinous cystadenoma.

<sup>b</sup> Rates are per 100,000 and age-adjusted to the 1970 U.S. standard population.

<sup>c</sup> Excludes data from Minnesota for 1992–1994 and California outside the Los Angeles and Greater Bay Area for 1994–1997.

<sup>d</sup> Source: North American Association of Central Cancer Registries file submissions as of December 1999 from Arizona, California, Colorado, Connecticut, Delaware, Hawaii, Georgia (Metro Atlanta) Florida, Idaho, Illinois, Iowa, Kentucky, Louisiana, Michigan (Metro Detroit) Minnesota, Montana, Nebraska, New Hampshire, New Jersey, New Mexico, North Carolina, Rhode Island, Utah, Washington (Seattle) West Virginia, and Wisconsin.

<sup>e</sup> American Indian cases from Arizona and New Mexico only.

<sup>f</sup> Totals include 383 women with other or unknown race and 69 American Indian women in areas outside Arizona and New Mexico.

<sup>g</sup> Rate is suppressed when count is ≤20.

**TABLE 6**  
**Borderline<sup>a</sup> Ovarian Cancer Counts and Age-Adjusted Incidence Rates<sup>b</sup> by Summary Stage<sup>c</sup> and Race, Selected Areas in the U.S., 1992–1997<sup>d</sup>**

Stage	White				Black				American Indian <sup>e</sup>				Asian/Pacific Islander				All Races <sup>f</sup>			
	Count	Rate	Lower CI	Upper CI	Count	Rate	Lower CI	Upper CI	Count	Rate <sup>g</sup>	Lower CI	Upper CI	Count	Rate <sup>g</sup>	Lower CI	Upper CI	Count	Rate	Lower CI	Upper CI
Localized	4949	1.2	1.2	1.3	335	0.7	0.6	0.8	8	—	0.3	1.7	222	0.8	0.7	0.9	5590	1.2	1.1	1.2
Regional	553	0.1	0.1	0.2	54	0.1	0.1	0.1	2	—	0.0	0.9	19	—	0.0	0.1	642	0.1	0.1	0.1
Distant	863	0.2	0.2	0.2	85	0.2	0.1	0.2	2	—	0.0	0.9	28	0.1	0.1	0.1	987	0.2	0.2	0.2
Unstaged	239	0.1	0.1	0.1	30	0.1	0.0	0.1	0	—	0.0	0.6	5	—	0.0	0.0	288	0.1	0.1	0.1
Total	6604	1.7	1.6	1.7	504	1.1	1.0	1.2	12	—	0.6	2.3	274	1.0	0.9	1.1	7507	1.6	1.5	1.6

CI: 95% confidence interval.

<sup>a</sup> Borderline Malignant is equal to: 8442: serous cystadenoma; 8451: papillary cystadenoma; 8462: papillary serous cystadenoma; 8472: mucinous cystadenoma; and 8473: papillary mucinous cystadenoma.

<sup>b</sup> Rates are per 100,000 and age-adjusted to the 1970 U.S. standard population.

<sup>c</sup> Excludes data from Minnesota for 1992–1994 and California outside the Los Angeles and Greater Bay Area for 1994–1997.

<sup>d</sup> Source: North American Association of Central Cancer Registries file submissions as of December 1999 from Arizona, California, Colorado, Connecticut, Delaware, Hawaii, Georgia (Metro Atlanta), Florida, Idaho, Illinois, Iowa, Kentucky, Louisiana, Michigan (Metro Detroit), Minnesota, Montana, Nebraska, New Hampshire, New Jersey, New Mexico, North Carolina, Rhode Island, Utah, Washington (Seattle), West Virginia, and Wisconsin.

<sup>e</sup> American Indian cases from Arizona and New Mexico only.

<sup>f</sup> Totals include 100 women with other or unknown race and 13 American Indian women in areas outside Arizona and New Mexico.

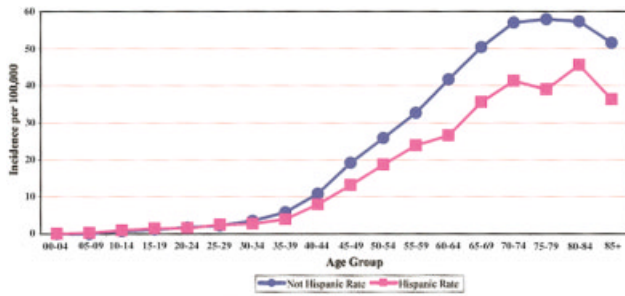
<sup>g</sup> Rate is suppressed when count is ≤20.

of malignant tumors were lower among Hispanic women than among women who were not Hispanic, with the exception of germ cell tumors.

Papillary serous cystadenoma was the most common histologic type of borderline tumor among Hispanic women and women who were not Hispanic, followed by mucinous cystadenoma and serous cystadenoma (Table 10).

Hispanic women had a lower rate of localized,

regional, and distant stages of malignant ovarian cancer compared with women who were not Hispanic (Table 11). Hispanic women also had a lower rate of unstaged ovarian cancer. Distant cancer was the most common stage at diagnosis in both Hispanic women and women who were not Hispanic. The rate of distant malignant ovarian cancer relative to the overall rate was similar in Hispanic women (62%) and women who were not Hispanic (60%).



Rates are per 100,000 and age-adjusted to the 1970 U.S. standard population.

**FIGURE 3.** Age-specific incidence rates for malignant ovarian cancer by Hispanic ethnicity, North American Association of Central Cancer Registries (NAACCR) U.S. combined areas, 1992–1997.

**TABLE 7**  
Malignant<sup>a</sup> Ovarian Cancer Counts and Age-Adjusted Incidence Rates<sup>b</sup> by Hispanic Ethnicity<sup>c</sup>, Selected Areas in the U.S., 1992–1997<sup>d</sup>

Ethnicity	Count	Rate	Lower CI	Upper CI
Hispanic	2978	9.4	9.0	9.7
Not Hispanic	31,715	13.0	12.9	13.2
Total <sup>e</sup>	35,218	12.8	12.6	12.9

CI: 95% confidence interval.

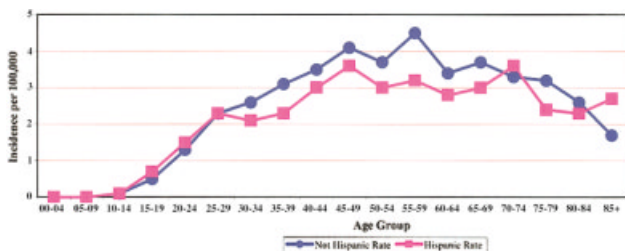
<sup>a</sup> Malignant is not equal to: 8442: serous cystadenoma; 8451: papillary cystadenoma; 8462: papillary serous cystadenoma; 8472: mucinous cystadenoma; and 8473: papillary mucinous cystadenoma.

<sup>b</sup> Rates are per 100,000 and age-adjusted to the 1970 U.S. standard population.

<sup>c</sup> Includes cases from Arizona, California, Colorado, Connecticut, Florida, Illinois, New Mexico, Utah, and Washington (Seattle) only.

<sup>d</sup> Source: North American Association of Central Cancer Registries file submissions as of December 1999 from Arizona, California, Colorado, Connecticut, Delaware, Hawaii, Georgia (Metro Atlanta), Florida, Idaho, Illinois, Iowa, Kentucky, Louisiana, Michigan (Metro Detroit), Minnesota, Montana, Nebraska, New Hampshire, New Jersey, New Mexico, North Carolina, Rhode Island, Utah, Washington (Seattle), West Virginia, and Wisconsin.

<sup>e</sup> Total includes 525 with unknown Hispanic ethnicity.



Rates are per 100,000 and age-adjusted to the 1970 U.S. standard population.

**FIGURE 4.** Age-specific incidence rates for borderline ovarian cancer by Hispanic ethnicity, North American Association of Central Cancer Registries (NAACCR) U.S. combined areas, 1992–1997.

The relative percentage of localized borderline tumors was 75% among Hispanic women and 73% among women who were not Hispanic (Table 12). The relative percentages of regional and distant borderline tumors also were similar between Hispanic women and women who were not Hispanic.

**TABLE 8**  
Borderline<sup>a</sup> Ovarian Cancer Counts and Age-Adjusted Incidence Rates<sup>b</sup> by Hispanic Ethnicity<sup>c</sup>, Selected Areas in the U.S., 1992–1997<sup>d</sup>

Ethnicity	Count	Rate	Lower CI	Upper CI
Hispanic	687	1.7	1.6	1.9
Not Hispanic	4391	2.0	1.9	2.0
Total <sup>e</sup>	5166	2.0	1.9	2.0

CI: 95% confidence interval.

<sup>a</sup> Borderline Malignant is equal to: 8442: serous cystadenoma; 8451: papillary cystadenoma; 8462: papillary serous cystadenoma; 8472: mucinous cystadenoma; and 8473: papillary mucinous cystadenoma.

<sup>b</sup> Rates are per 100,000 and age-adjusted to the 1970 U.S. standard population.

<sup>c</sup> Includes cases from Arizona, California, Colorado, Connecticut, Florida, Illinois, New Mexico, Utah, and Washington (Seattle) only.

<sup>d</sup> Source: North American Association of Central Cancer Registries file submissions as of December 1999 from Arizona, California, Colorado, Connecticut, Delaware, Hawaii, Georgia (Metro Atlanta), Florida, Idaho, Illinois, Iowa, Kentucky, Louisiana, Michigan (Metro Detroit), Minnesota, Montana, Nebraska, New Hampshire, New Jersey, New Mexico, North Carolina, Rhode Island, Utah, Washington (Seattle), West Virginia, and Wisconsin.

<sup>e</sup> Total includes 88 with unknown Hispanic ethnicity.

**DISCUSSION**

This analysis confirms previous reports<sup>2–4,6–8</sup> that white women in the U.S. are at a substantially higher risk for ovarian cancer compared with women of other racial and ethnic groups, especially women of Asian/Pacific Islander ancestry. Ethnic-specific incidence patterns in this analysis of data from 1992–1997 were somewhat lower than those reported by the Surveillance, Epidemiology, and End Results (SEER) program for the years 1988–1992.<sup>3</sup> For example, the ovarian cancer rate among white women in the SEER program was 15.8 per 100,000 and that among black women was 10.2 per 100,000 compared with NAACCR rates of 13.1 per 100,000 and 9.0 per 100,000, respectively, for white and black women.

The rate of ovarian cancer among American Indians in New Mexico was 17.5 per 100,000 for 1988–1992<sup>2</sup> compared with 10.2 per 100,000 between 1992–1997 for American Indians in New Mexico and Arizona combined. This dramatic decline in ovarian cancer incidence could be artifactual, resulting from tribal differences in the rates of ovarian cancer between these two states. Although based on a small number of cases, this decline nonetheless should be monitored to determine whether it reflects a real change in community behavior, such as heightened acceptance of oral contraceptive pills, or an increased prevalence of oophorectomy or tubal ligation.

To our knowledge, few analytic studies have been conducted to explain the increased risk of ovarian cancer among white women compared with other racial and ethnic groups.<sup>6–10</sup> Combining data from seven case-control studies, John et al.<sup>6</sup> reported that reproductive factors could account for only 9–16% of



**TABLE 9**  
**Malignant<sup>a</sup> Ovarian Cancer Counts, and Age-Adjusted Incidence Rates<sup>b</sup> by Histology and Hispanic Ethnicity<sup>c</sup>, Selected Areas in the U.S., 1992–1997<sup>d</sup>**

IARC histology	Hispanic				Not Hispanic				Total <sup>e</sup>			
	Count	Rate	Lower CI	Upper CI	Count	Rate	Lower CI	Upper CI	Count	Rate	Lower CI	Upper CI
Carcinoma	2558	8.3	7.9	8.6	28,706	11.8	11.6	11.9	31,743	11.5	11.4	11.7
Serous carcinoma	890	2.9	2.7	3.1	11,024	4.7	4.6	4.8	12,094	4.5	4.5	4.6
Mucinous carcinoma	322	1.0	0.8	1.1	2762	1.2	1.1	1.2	3129	1.2	1.1	1.2
Endometrioid carcinoma	294	0.9	0.8	1.1	3427	1.5	1.4	1.5	3783	1.4	1.4	1.5
Clear cell carcinoma	93	0.3	0.2	0.4	1129	0.5	0.5	0.5	1251	0.5	0.5	0.5
Adenocarcinoma, NOS	621	2.1	1.9	2.2	7151	2.7	2.7	2.8	7885	2.7	2.6	2.8
Other specified carcinomas	93	0.3	0.2	0.3	690	0.3	0.3	0.3	792	0.3	0.3	0.3
Unspecified carcinoma	245	0.8	0.7	0.9	2523	0.9	0.9	0.9	2809	0.9	0.9	0.9
Sex cord-stromal tumors	48	0.1	0.1	0.2	379	0.2	0.2	0.2	440	0.2	0.2	0.2
Germ cell tumors	203	0.5	0.4	0.5	600	0.4	0.3	0.4	814	0.4	0.4	0.4
Other specified tumors	70	0.2	0.2	0.3	909	0.4	0.3	0.4	984	0.4	0.3	0.4
Unspecified tumors	99	0.3	0.3	0.4	1121	0.3	0.3	0.4	1237	0.3	0.3	0.4
Ovary	2978	9.4	9.0	9.7	31,715	13.0	12.9	13.2	35,218	12.8	12.6	12.9

IARC: International Agency for Research on Cancer; CI: 95% confidence interval; NOS: not otherwise specified.

<sup>a</sup> Malignant is not equal to: 8442: serous cystadenoma; 8451: papillary cystadenoma; 8462: papillary serous cystadenoma; 8472: mucinous cystadenoma; and 8473: papillary mucinous cystadenoma.

<sup>b</sup> Rates are per 100,000 and age-adjusted to the 1970 U.S. standard population.

<sup>c</sup> Includes cases from Arizona, California, Colorado, Connecticut, Florida, Illinois, New Mexico, Utah, and Washington (Seattle) only.

<sup>d</sup> Source: North American Association of Central Cancer Registries file submissions as of December 1999 from Arizona, California, Colorado, Connecticut, Delaware, Hawaii, Georgia (Metro Atlanta), Florida, Idaho, Illinois, Iowa, Kentucky, Louisiana, Michigan (Metro Detroit), Minnesota, Montana, Nebraska, New Hampshire, New Jersey, New Mexico, North Carolina, Rhode Island, Utah, Washington (Seattle), West Virginia, and Wisconsin.

<sup>e</sup> Total includes 613 with unknown Hispanic ethnicity.

**TABLE 10**  
**Borderline<sup>a</sup> Ovarian Cancer Counts and Age-Adjusted Incidence Rates<sup>b</sup> by Histology and Hispanic Ethnicity<sup>c</sup>, Selected Areas in the U.S., 1992–1997<sup>d</sup>**

IARC histology	Hispanic				Not Hispanic				Total <sup>e</sup>			
	Count	Rate <sup>f</sup>	Lower CI	Upper CI	Count	Rate	Lower CI	Upper CI	Count	Rate	Lower CI	Upper CI
Serous cytadenoma	192	0.5	0.4	0.6	1065	0.5	0.4	0.5	1284	0.5	0.5	0.5
Papillary cytadenoma	18	—	0.0	0.1	92	0.0	0.0	0.1	112	0.0	0.0	0.1
Papillary serous cystadenoma	262	0.6	0.6	0.7	1611	0.7	0.7	0.8	1906	0.7	0.7	0.8
Mucinous cystadenoma	194	0.5	0.4	0.6	1507	0.7	0.6	0.7	1725	0.7	0.6	0.7
Papillary mucinous cystadenoma	21	0.1	0.0	0.1	116	0.0	0.0	0.1	139	0.1	0.0	0.1
Total	687	1.7	1.6	1.9	4391	2.0	1.9	2.0	5166	2.0	1.9	2.0

IARC: International Agency for Research on Cancer; CI: 95% confidence interval.

<sup>a</sup> Borderline Malignant is equal to: 8442: serous cystadenoma; 8451: papillary cystadenoma; 8462: papillary serous cystadenoma; 8472: mucinous cystadenoma; and 8473: papillary mucinous cystadenoma.

<sup>b</sup> Rates are per 100,000 and age-adjusted to the 1970 U.S. standard population.

<sup>c</sup> Includes cases from Arizona, California, Colorado, Connecticut, Florida, Illinois, New Mexico, Utah, and Washington (Seattle) only.

<sup>d</sup> Source: North American Association of Central Cancer Registries file submissions as of December 1999 from Arizona, California, Colorado, Connecticut, Delaware, Hawaii, Georgia (Metro Atlanta), Florida, Idaho, Illinois, Iowa, Kentucky, Louisiana, Michigan (Metro Detroit), Minnesota, Montana, Nebraska, New Hampshire, New Jersey, New Mexico, North Carolina, Rhode Island, Utah, Washington (Seattle), West Virginia, and Wisconsin.

<sup>e</sup> Total includes 88 cases with unknown Hispanic ethnicity.

<sup>f</sup> Rate is suppressed when count is ≤20.

the difference in the risk of ovarian cancer noted between white and black women in the U.S. In a recent population-based case-control study in Pittsburgh, Pennsylvania, Ness et al.<sup>7</sup> found that black women were more likely than white women to have experi-

enced five or more pregnancies and undergone a hysterectomy, and less likely to have a family history of ovarian cancer. Although the risk for ovarian cancer in Asian/Pacific Islander women in the current analysis was lower than that in white American women, this

**TABLE 11**  
**Malignant<sup>a</sup> Ovarian Cancer Counts and Age-Adjusted Incidence Rates<sup>b</sup> by Summary Stage<sup>c</sup> and Hispanic Ethnicity<sup>d</sup>, Selected Areas in the U.S., 1992–1997<sup>e</sup>**

Stage	Hispanic				Not Hispanic				Total <sup>f</sup>			
	Count	Rate	Lower CI	Upper CI	Count	Rate	Lower CI	Upper CI	Count	Rate	Lower CI	Upper CI
Localized	540	1.3	1.2	1.4	5003	2.1	2.0	2.1	5639	2.0	1.9	2.0
Regional	243	0.6	0.6	0.7	3192	1.3	1.2	1.3	3505	1.2	1.2	1.2
Distant	1506	4.3	4.1	4.6	16,395	6.4	6.3	6.5	18,655	6.3	6.2	6.3
Unstaged	237	0.7	0.6	0.8	2629	0.9	0.9	0.9	2924	0.9	0.9	0.9
Total <sup>f</sup>	2526	6.9	6.6	7.2	27,719	10.6	10.5	10.8	30,723	10.3	10.2	10.5

CI: 95% confidence interval.

<sup>a</sup> Malignant is not equal to: 8442: serous cystadenoma; 8451: papillary cystadenoma; 8462: papillary serous cystadenoma; 8472: mucinous cystadenoma; and 8473: papillary mucinous cystadenoma.

<sup>b</sup> Rates are per 100,000 and age-adjusted to the 1970 U.S. standard population.

<sup>c</sup> Excludes data from Minnesota for 1992–1994 and California, except the Los Angeles and Greater Bay Area for 1994–1997.

<sup>d</sup> Includes cases from Arizona, California, Colorado, Connecticut, Florida, Illinois, New Mexico, Utah, and Washington (Seattle) only.

<sup>e</sup> Source: North American Association of Central Cancer Registries file submissions as of December 1999 from Arizona, California, Colorado, Connecticut, Delaware, Hawaii, Georgia (Metro Atlanta), Florida, Idaho, Illinois, Iowa, Kentucky, Louisiana, Michigan (Metro Detroit), Minnesota, Montana, Nebraska, New Hampshire, New Jersey, New Mexico, North Carolina, Rhode Island, Utah, Washington (Seattle), West Virginia, and Wisconsin.

<sup>f</sup> Totals include 478 women with unknown Hispanic ethnicity.

**TABLE 12**  
**Borderline<sup>a</sup> Ovarian Cancer Counts and Age-Adjusted Incidence Rates<sup>b</sup> by Summary Stage<sup>c</sup> and Hispanic Ethnicity<sup>d</sup>, Selected Areas in the U.S., 1992–1997<sup>e</sup>**

Stage	Hispanic				Not Hispanic				Total <sup>f</sup>			
	Count	Rate <sup>g</sup>	Lower CI	Upper CI	Count	Rate	Lower CI	Upper CI	Count	Rate	Lower CI	Upper CI
Localized	442	0.9	0.8	1.0	2762	1.1	1.1	1.2	3255	1.1	1.1	1.2
Regional	51	0.1	0.1	0.1	329	0.1	0.1	0.1	391	0.1	0.1	0.1
Distant	63	0.1	0.1	0.2	577	0.2	0.2	0.3	648	0.2	0.2	0.2
Unstaged	15	-	0.0	0.1	79	0.0	0.0	0.0	98	0.0	0.0	0.0
Total <sup>f</sup>	571	1.2	1.1	1.3	3747	1.5	1.5	1.6	4392	1.5	1.5	1.5

CI: 95% confidence interval.

<sup>a</sup> Borderline Malignant is equal to: 8442: serous cystadenoma; 8451: papillary cystadenoma; 8462: papillary serous cystadenoma; 8472: mucinous cystadenoma; and 8473: papillary mucinous cystadenoma.

<sup>b</sup> Rates are per 100,000 and age-adjusted to the 1970 U.S. standard population.

<sup>c</sup> Excludes data from Minnesota for 1992–1994 and California, except the Los Angeles and Greater Bay Area for 1994–1997.

<sup>d</sup> Includes cases from Arizona, California, Colorado, Connecticut, Florida, Illinois, New Mexico, Utah, and Washington (Seattle) only.

<sup>e</sup> Source: North American Association of Central Cancer Registries file submissions as of December 1999 from Arizona, California, Colorado, Connecticut, Delaware, Hawaii, Georgia (Metro Atlanta), Florida, Idaho, Illinois, Iowa, Kentucky, Louisiana, Michigan (Metro Detroit), Minnesota, Montana, Nebraska, New Hampshire, New Jersey, New Mexico, North Carolina, Rhode Island, Utah, Washington (Seattle), West Virginia, and Wisconsin.

<sup>f</sup> Totals include 74 women with unknown Hispanic ethnicity.

<sup>g</sup> Rate is suppressed when count is ≤20.

was true only after the age of 25 years. Herrinton et al.<sup>8</sup> reported that premenopausal Asian-American women (age < 50 years) tended to have relatively higher ovarian cancer rates than postmenopausal Asian-American women when compared with white women of the same menopausal status. Age-specific incidence rates in the NAACCR dataset were found to be lower among black women than among Asian/Pacific Islander women up to the age of 60 years, suggesting age-specific differences in risk factors between race

groups. Premenopausal ovarian cancer is more likely to have a genetic basis,<sup>11</sup> but nonhereditary factors may play a more important role in explaining these age-related incidence patterns.

Ovarian cancer incidence rates among Hispanic women were reported to be lower than among women who were not Hispanic. The rate of ovarian cancer in Hispanic women (9.4 per 100,000) was comparable to that calculated for Hispanics in the SEER program (11.4 per 100,000)<sup>3</sup> and California (9.0–9.9 per 100,000)

and New Mexico (8.6 per 100,000),<sup>2</sup> but was substantially higher than the rate among Hispanics in Puerto Rico (5.2 per 100,000) and the majority of Latin American countries.<sup>2</sup> California contributed nearly 56% of the Hispanic cases in the NAACCR file, leading us to anticipate good concordance between our rates and the Hispanic ovarian cancer incidence in this state. The birth rate among Hispanic women reportedly is higher than among non-Hispanic women and this would reduce the risk of ovarian cancer.<sup>12</sup> However, the lower incidence of ovarian cancer among Hispanic women compared with women who were not Hispanic must be evaluated with some caution because the large percentage of missing data regarding Hispanic ethnicity reduces the representativeness of these data. Nevertheless, it is reassuring that the overall incidence rate for the subgroup of women with Hispanic identifiers (12.8 per 100,000) was similar to the rate in the entire sample, including those women with unknown Hispanic ethnicity (12.6 per 100,000).

The histologic distribution of malignant ovarian cancer was consistent with distributions reported in other case series.<sup>13</sup> Serous carcinomas were relatively more common among white women and clear cell and endometrioid carcinomas were relatively more common among Asian/Pacific Islanders compared with other racial and ethnic groups. Differences in histologic patterns suggest heterogeneity in risk factors, such as genetic predisposition, for epithelial ovarian cancer occurring among these populations. The *PTEN* tumor suppressor gene has been linked to the malignant transformation of benign endometrial cysts to endometrioid and clear cell carcinomas of the ovary.<sup>14</sup> Histologic and molecular genetic studies also have provided evidence that endometrioid and clear cell carcinomas may arise through malignant transformation of endometriotic lesions.<sup>15</sup> An inverse relation between tubal ligation and ovarian cancer risk may be limited to these histologic types,<sup>16</sup> although we have no data concerning ethnic-specific rates for this procedure. These observations indicate a unique pathogenesis of ovarian cancer in Asian/Pacific Islander women.

The high percentage of black women with unspecified tumors suggests that these women may not be receiving the same level of diagnostic service as women of other races or ethnicities. The relatively high incidence of germ cell tumors among Hispanic women compared with non-Hispanic women has not to our knowledge been observed previously and may result from ethnic differences in early-age or maternal exposures.

Metastatic disease was the most common stage at diagnosis for all ethnic groups, but particularly for American Indian women, among whom approximately 63% of age-adjusted ovarian cancer was diagnosed at a distant stage, underscoring the need to

provide state-of-the-art gynecology and oncology services to Native Americans. By contrast, Asian/Pacific Islander women were found to have the highest proportion of localized ovarian cancer (approximately 33%), indicating that these groups may have different risk factors or proportionately higher and earlier access to health services and diagnostic workup.

Women with epithelial tumors of low malignant potential (borderline) were diagnosed at younger ages and less advanced stages compared with women with malignant tumors. The race- and ethnic-specific incidence of borderline tumors closely paralleled that of malignant tumors, implying common risk factors. Indeed, epidemiologic studies support the notion that the etiology of borderline tumors and malignant tumors is similar.<sup>17</sup> Of interest in our analysis were the substantial racial and ethnic variations in the histology of borderline tumors. The rate of mucinous cystadenoma was higher and the rate of serous cystadenoma was lower among Asian/Pacific Islander women compared with other groups. This observation is compatible with the concept that, at least in some instances, borderline tumors represent a transitional form to higher grade malignancy as a result of clonal expansion.<sup>18</sup> Molecular analysis has revealed that borderline mucinous and serous tumors have genetic features, such as p53 and Ki-RAS mutations, that are associated with malignancy.<sup>19</sup>

Several methodologic issues must be considered in reviewing these incidence data.

Proper assignment of racial or ethnic classification in the cancer registry is dependent on the accuracy of the medical record or other vital records that are primary sources of information.<sup>20</sup> Computation of valid cancer rates is dependent on the accuracy of the census counts and the comparability of racial designations used in the numerator and the denominator. If case ascertainment for a racial group is less complete than the census counts, the resulting rates will be underestimated. Aside from problems with racial and ethnic misclassification, this analysis is limited by our inability to examine ovarian cancer incidence among specific subgroups of Hispanic, American Indian, or Asian/Pacific Islander women. For example, approximately 60% of Hispanics in the U.S. are of Mexican descent, and many of these women reside in California and Texas.<sup>21</sup> Hispanics are the fastest growing minority in the U.S. and it is believed they will soon become the largest minority group in the nation.<sup>22</sup> American Indian and Asian/Pacific Islanders are equally heterogeneous populations of women who may have distinct ovarian cancer incidence patterns within subgroups that were missed in this analysis.<sup>3</sup> In the next year, census data will be available to allow the calculation of more precise ethnic-specific rates.

Ovarian cancer incidence may be affected by trends in the performance of hysterectomy and oophorectomy. Between 1991–1994, the rate of total hysterectomy in the U.S. decreased from 25.7 to 20.5 per 10,000 females and the rate of supracervical hysterectomy increased from 0.16 to 0.41 per 10,000 females.<sup>23–25</sup> To our knowledge, complete and accurate population data regarding the proportion of women who have undergone oophorectomy by age, race, and ethnicity (which would be potentially useful for adjusting ovarian cancer incidence rates) currently are lacking. Hysterectomy and oophorectomy rates may vary by race, ethnicity, socioeconomic status, access to health care, geographic region of the U.S., and other factors that may influence ovarian cancer incidence rates among specific groups of women.

The current analysis included clinical information from a large number of women diagnosed with ovarian cancer in the U.S. during the past decade. Observed ethnic and racial variations in ovarian cancer incidence were found to be in agreement with other analyses in the U.S. demonstrating higher risk among white women and women who were not Hispanic than among black, American Indian, Asian/Pacific Islander, and Hispanic women. Future analyses of these data will include separate rates for Asian/Pacific Islander women because these groups have distinct reproductive histories, exogenous hormone use, genetic background, and other factors that may influence the incidence of ovarian cancer.

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