Published in final edited form as:
World J Obstet Gynecol. 2014 May ; 3(2): 71–77. doi:10.5317/wjog.v3.i2.71.

The Effect of Gynecologic Oncologist Availability on Ovarian Cancer Mortality

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Abstract

AIM—To determine the association between the distribution of gynecologic oncologist (GO) and population-based ovarian cancer death rates.

MATERIALS AND METHODS—Data on ovarian cancer incidence and mortality in the United States (U.S.) was supplemented with U.S. census data, and analyzed in relation to practicing GOs. GO locations were geocoded to link association between county variables and GO availability. Logistic regression was used to measure areas of high and low ovarian cancer mortality, adjusting for contextual variables.

RESULTS—Practicing GOs were unevenly distributed in the United States, with the greatest numbers in metropolitan areas. Ovarian cancer incidence and death rates increased as distance to a practicing GO increased. A relatively small number (153) of counties within 24 miles of a GO had high ovarian cancer death rates compared to 577 counties located 50 or more miles away with high ovarian cancer death rates. Counties located 50 or more miles away from a GO practice had an almost 60% greater odds of high ovarian cancer mortality compared to those with closer practicing GOs (OR 1.59, 95% CI 1.18–2.15).

CONCLUSION—The distribution of GOs across the United States appears to be significantly associated with ovarian cancer mortality. Efforts that facilitate outreach of GOs to certain populations may increase geographic access. Future studies examining other factors associated with lack of GO access (e.g. insurance and other socioeconomic factors) at the individual level will assist with further defining barriers to quality ovarian cancer care in the United States.

Keywords

ovarian cancer; gynecologic oncologists; mortality; access to care

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Author Contributions: Stewart SL, Cooney D, Richards TB, and Rim SH designed the research; Thomas CC provided data access and technical assistance for cancer data; Cooney D, Hirsch S, Westervelt L analyzed the data; and Stewart SL, Cooney D, Hirsch S, Westervelt L wrote the paper. All authors provided critical comments and revisions on the paper.

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INTRODUCTION

Ovarian cancer (OC) is the deadliest gynecologic malignancy and the fifth leading cause of cancer death among women in the United States[1]. Each year, more than 22,000 women are diagnosed with and almost 16,000 women die from the disease[1]. The majority of diagnoses (61%) are at late stages, when the disease is present in both ovaries and has spread throughout the peritoneal cavity[2]. Treatment for late-stage OC requires both surgery and chemotherapy, the costs of which confer a substantial burden on the United States (U.S.) healthcare system. The annual cost of managing OC patients in the U.S. is estimated to be approximately $612 million[3].

While treatment protocols for epithelial OC (accounting for 90% of all malignant cases) have improved, five-year survival for late-stage OC is just 27%[2]. The poor survival rate associated with OC is often attributed to the absence of gynecologic-specific signs and symptoms, and the lack of an effective screening test that can detect the disease at early stages. Currently, optimal surgery and delivery of chemotherapy are the only methods available to reduce OC mortality [4]. Several studies have suggested that optimal treatment (from staging through receipt of chemotherapy) resulting in better outcomes is more often achieved through subspecialist gynecologic oncologist (GO) care [5–9], leading several organizations to recommend OC patients receive treatment from GOs [4].

Despite the evidence and recommendations, many OC patients (about 30–60%) are not treated by a GO [7, 8]. Several barriers exist to receipt of guidelines-based care, including socioeconomic factors such as insurance status. In this study, we examined a potential geographic barrier to receipt of GO care. Our objective was to examine the geographic relationship between GO providers and OC mortality, in order to determine the effect that geographic availability of specialized care has on mortality, and add further evidence to the association between receipt of GO care and OC outcomes.

MATERIALS AND METHODS

Data Sources and Inclusion Criteria

County level OC mortality data (2002–2006) were obtained from CDC's National Vital Statistics System (NVSS) through a public-use data file http://www.cdc.gov/nchs/ accessed on 2/17/2011. County-level contextual data were from several additional sources including: 1) Area Resource File (ARF 2008); 2) 2000 U.S. Census Summary File; and 3) U.S. Census Bureau's 2005 Small Area Health Insurance Estimates (SAHIE). OC incidence data (2002–2006) were obtained from CDC's National Program of Cancer Registries (NPCR) and the National Cancer Institute's (NCI) Surveillance Epidemiology and End Results (SEER) for registries that met data high-quality criteria for publication[1]. Mortality data and incidence data covered 100% and 97% of the U.S. population, respectively. A list of practicing GOs in 2009, along with their practice address was obtained from the Foundation for Women's Cancer website (http://www.foundationforwomenscancer.org/find-a-gynecologic-oncologist. This list is populated by the Society of Gynecologic Oncologists and is estimated to cover 95% of practicing GOs (personal communication—SGO).

This study only includes data from the 48 contiguous U.S. states and the District of Columbia as the geography of Hawaii and Alaska results in transportation networks that are substantially different from other parts of the country. Of the 3,141 counties that compose the United States, 32 counties and boroughs in Hawaii (5) and Alaska (27) were excluded from all analyses. Data from the remaining 3,109 counties were used to examine the distribution of GOs (Figure 1). Data from 731 counties were suppressed due to less than four OC incident or death cases and patient confidentiality concerns; data from 198 counties were suppressed due to a death rate of zero and female population of 10,000 or less; data from 112 counties in Kansas (45) and Minnesota (65) were excluded due to county-level data release restrictions for these states. Data from the remaining 2,068 counties were used to analyze the association between GO availability and county-level death rates (Tables 1–3; Figure 2).

Coding and Variable Definitions

County of residence (the geographic unit of analysis for this study) for each OC death was determined by using county Federal Information Processing Standards (FIPS) codes. FIPS codes were used to aggregate data at the county level, and to calculate five-year average OC incidence and death rates. FIPS codes were also used to categorize counties as metropolitan, non-metropolitan or rural based on 2003 USDA rural urban continuum (RUCA) codes. The following variables were included as measures of county socioeconomic status: 1) county household income inequality ratio; 2) the percent of county population living below the federal poverty line; and 3) the percent of county population without health insurance. The county household income inequality ratio is defined as the ratio of the number of households with incomes above the population's top 22% household income to the number of houses with incomes below the population's bottom 22% household income. To assess availability of physicians other than GOs for OC treatment, the average number of general surgeons, primary care physicians (PCPs) and obstetrician/gynecologists (OB/GYNs) per 100,000 women in the county were derived using female population estimates from 2002–2006. Primary care physicians were defined as general practitioners, family medicine and internal medicine practitioners. Socioeconomic status and physician variables were categorized into equal tertiles (high, moderate and low) based on all counties included in the analysis. The 2002–2006 female population estimates were also used to calculate the county composition percentages for age, race, and ethnicity. Age was modeled as the percent of county population in the following age categories: 0 to 44 years, 45 to 54 years, 55 to 64 years, 65 to 74 years, and 75 years or older. Race/ethnicity was defined as the percent of county population in the following groups: non-Hispanic white, non-Hispanic black, non-Hispanic Asian-Pacific Islander, non-Hispanic other (including non-Hispanic American Indian/Alaska Native), and Hispanic.

Mapping and Statistical Analyses

Mapping and statistical analyses were used to assess the relationship between the county-level death rate and distance to the nearest GO. County centroids were defined as the geographic center for a county and GOs were geocoded to latitude-longitude coordinate locations within the continental United States using ArcGIS (version 9, ESRI). Geographic access to specialized care was measured as the linear distance, ignoring roads, from county geographic centroid to nearest GO. This distance was then split into tertiles of 0–24 miles, 25–49 miles, and greater than 50 miles. Geographic availability to other less specialized care (PCPs, general surgeons and OB/GYN) was defined as the average number of each of these physicians per average female population (per 100,000) for a county from 2002–2006. Death rates were dichotomized as low or high (less than or greater than the median death rate [11.6 per 100,100]). A logistic regression model was fit to the data to determine the association between distance to a GO and high county death rate, after adjusting for other county-level variables. Both forward and backward selection were examined, built with the criteria of a $P < 0.05$ value for model entry or inclusion, and both methods led to the same conclusions. The inclusion of OB/GYNs in the model caused a lack of stability due to collinearity with other variables; therefore even though it was found initially to be significant, this covariate was removed to improve the model fit. All statistical analyses were performed using SAS (version 9.2; Cary, North Carolina).

RESULTS

Gynecologic Oncologist Practice Characteristics in the United States

The location and number of practicing GOs in the U.S. are shown in Figure 1. Of the 3,109 U.S. counties, 2,906 do not have a practicing GO and only 143 counties have more than one practicing GO. GO density is highest in the Northeast region of the United States. Within individual states, practicing GO locations are unevenly distributed, and practices tend to cluster in particular counties or regions. Florida appears to have a relatively even distribution of GOs across the state, while North Dakota and Wyoming have no practicing GOs within the state.

Table 1 shows GO practice location in relation to U.S. county characteristics. A total of 536 U.S. counties were within 24 miles of a practicing GO, 890 counties were located between 25 and 49 miles of a GO, and 1,683 counties were located over 50 miles from a GO. The vast majority of counties within 24 miles of a GO practice (90.7%) were classified as metropolitan, whereas only 38.8% and 15.2% of counties within 25 to 49 miles and over 50 miles from a GO were classified as metropolitan, respectively. Most counties within 24 miles of a GO (81.9%) had a large difference in income among the highest and lowest earning households, while relatively few counties over 50 miles from a GO (14.6%) had a large difference in income among high and low earning households. Poverty levels were relatively low in counties within 24 miles of a GO (55.0% of counties had less than 11% of the population in poverty), and were higher in counties greater than 50 miles from a GO (38.9% of counties had 15.2% or more of population in poverty). Counties within 24 miles of a GO also had high densities of PCPs (43.5% had greater than 169 per 100,000 women), general surgeons (39.6% had greater than 20 per 100,000 women), and OB/GYNs (44.4% had greater than 20 per 100,000 women). These physicians were less prevalent in counties 50 miles or greater from a GO practice compared to those within 24 miles of a GO practice. A substantial proportion of counties 50 miles or greater from a GO practice did not have any general surgeons (39.6%), and most did not have any OB/GYNs (55.6%). The majority of women in each distance category were non-Hispanic white, although the percentage was slightly lower in counties within 24 miles of a GO (range 77.6%–82.5%). Overall, higher percentages of women aged 65 and older were found in counties farther away from GO practice locations compared to those within 24 miles of a GO practice location.

Ovarian Cancer Burden in Relation to Gynecologic Oncologist Practice

Table 2 displays OC incidence and mortality in relation to GO practice locations. Both OC incidence and death rates increase as distance to GO practice increases. Counties within 24 miles of a GO practice location had the lowest incidence (14.21) and death (10.09) rates. Counties located 50 miles or greater from a GO practice had the highest OC incidence (16.31) and death (13.57) rates.

Figure 2 shows dichotomized county-level OC death rates in relation to GO practice location. The number of counties with a high death rate increased as distance from practicing GOs increased. A total of 153 counties within 24 miles of a GO had high death rates compared to 577 counties 50 miles or greater from a GO.

The adjusted results of the association between high OC mortality and GO practice location are shown in Table 3. High OC mortality was significantly associated with increased distance from GOs. Counties with GO practices 25–49 miles from the county centroid had a 40% greater odds of high OC mortality compared to those counties with practices within 24 miles (OR 1.40, 95% CI, 1.04–1.89). Counties with practices greater than 50 miles to a GO had an almost 60% greater odds of high OC mortality (OR 1.59, 95% CI 1.18–2.15). The presence of a general surgeon was associated with a decreased chance of high OC mortality compared to counties without a general surgeon; however, this effect was relatively constant and the odds ratios did not vary substantially in relation to increasing density of general surgeons per average population of women (ORs 0.32–0.35). Other factors associated with an increased odds of high OC mortality include counties with high OC incidence rates (OR 1.15, CI 1.12–1.18), counties with higher proportions of women aged 45–54 years (OR 1.25, 95% CI 1.15–1.37), and higher proportions of women 75 years or older (OR 1.39, 95% CI 1.31–1.48). Conversely, counties with higher proportions of non-Hispanic Asian/Pacific Islander and Hispanic women had a reduced odds of high OC mortality (OR = 0.88, 95% CI 0.80–0.96, OR=0.99, 95% CI 0.97–1.00, respectively).

DISCUSSION

Our findings indicate that there is an uneven distribution of GOs in the United States, with higher concentrations of GOs in metropolitan counties. While there are lower numbers of GOs overall compared to other potential OC practitioners, GO availability tends to be geographically similar to the availability of these other practitioners. Importantly, we have established that increasing distance from a GO has a significant association with increased likelihood of higher OC death rates.

Previous studies with other cancers have demonstrated similar results. In addition to uneven distribution of specialists, Odisho et al. noted significant prostate, bladder and kidney cancer mortality reductions in counties with urologists compared to those without [10]. Similar results have been reported with regard to dermatologists and melanoma [11]. A lung cancer study also reported uneven distribution of specialist providers, but found no difference in mortality based on the density of thoracic surgeons or oncology services [12]. Further, this study reported that a higher proportion of PCPs (as opposed to specialists) was associated with a lung cancer mortality reduction in some populations [12]. This PCP finding is somewhat consistent with our study in that we also observed decreased OC mortality in relation to the density of general surgeons; however, the mortality reduction in our study was similar regardless of increasing density of PCPs.

Current and projected shortages in the availability of cancer care providers have been well-documented. In a recent workshop sponsored by the U.S. Institute of Medicine, it was noted that almost all oncology professions are experiencing workforce shortages, including physicians, nurses, allied health care professionals, public health workers, social workers, and pharmacists [13]. A 2007 study commissioned by the American Society of Clinical Oncology found that the demand for oncologists is likely to increase dramatically by the year 2020, driven by the aging and growth of the population as well as improvements in cancer survival rates [14]. The supply of oncologists is only projected to increase 14% during the same timeframe, creating a shortage of 2,500 to 4,080 oncologists[14]. A similar situation exists for gynecologic oncologists. A 2010 study projected that at constant training rates, the annual number of new cancer cases per practicing GOs will rise 19%, with an expected increased caseload of almost 20% over the next 40 years [15]. In New Zealand, which also has an uneven distribution of GOs, a reorganization of gynecologic cancer care has been suggested in order to ensure that all patients have access to subspecialists in the face of GO shortages[16]. This model is based on one adopted in the United Kingdom, and establishes a connection between major comprehensive cancer centers that have GOs and smaller satellite hospitals without GOs. This connection may help to facilitate multidisciplinary care for patients in the smaller centers. Additionally, a national gynecologic cancer steering group with representation from the comprehensive cancer centers, and key medical and nursing disciplines would oversee care coordination, including development of a standardized protocol for treatment and referral guidelines [16]. A similar coordinated approach may assist with alleviating the negative outcomes (higher OC mortality) that geographic barriers to GO care has in the United States. However, it should be noted that several other factors in addition to geographic availability may impact receipt of quality care for OC in the United States. These factors are numerous and include lack of insurance or other socioeconomic limitations, language and cultural differences, psychosocial, lifestyle and behavioral factors[17–19].

Given the lack of geographic availability of GOs in many areas in the United States, an emphasis on OC prevention may be warranted. However, OC is difficult to prevent and no evidence-based prevention or early detection methods are currently available [4]. A large U.S. study investigating serum CA-125 levels in combination with transvaginal ultrasound as a potential early detection method resulted in more harms than benefits to patients [20, 21], and did not reduce overall OC mortality [20]. A comprehensive evidence review assessing oral contraceptive use for OC prevention also found the potential for more harms than benefits, particularly with regard to effects on quality of life from increases in breast cancer and vascular events caused by oral contraceptive use[22]. The identification of patients who are at an increased risk for OC due to genetic mutations in the BRCA gene currently offers the greatest potential for prevention of OC[23]. Stressing the importance of family history knowledge, and appropriate genetic counseling and testing to determine BRCA status among women may ultimately reduce ovarian cancer risk and mortality in some women [24].

This study has several strengths. To our knowledge, it is the first to relate geographic proximity to GOs with lower OC mortality in the United States. Additionally, the use of population-based OC data from a large portion of the United States likely improved the accuracy of the results. Limitations to this study include the ecologic study design which impedes the ability to apply the results at the individual level. Also while our data sources were current at the beginning of the study, they are now slightly dated and the years of OC incidence and mortality vary from that of the practicing GOs. However, since OC incidence and death rates changed little over the last decade, and any changes in GO numbers and distribution by state are relatively minor, this likely has little impact on the results. Finally, although our data sources are comprehensive in coverage, a small percentage of GO providers and OC incident cases remain missing from our analysis. It is unlikely that the results would be different based on these small percentages; however, we are unable to make any conclusions with regard to the areas where data are missing.

The uneven distribution of GOs across the United States appears to be significantly associated with OC mortality, with death rates increasing as distance to GO increases. These findings may have important implications for the oncology workforce and cancer control planning. Appropriate genetic counseling and testing for the prevention of OC, as well as facilitated outreach to GOs in order to provide a coordinated approach to quality OC care, may be promoted through the efforts of cancer control planners in the U.S. National Comprehensive Cancer Control Program. Future studies examining the effects of GO distribution on OC mortality at the individual level may assist with further defining barriers to quality OC care in the United States.

Acknowledgments

Funding Source: This project was funded by the Centers of Disease Control and Prevention, Atlanta, GA, USA, contracted to SciMetrika, LLC, contract number 200-2008-27889 TO 5.

The authors would like to acknowledge Dr. Wendy Brewster for assistance with obtaining gynecologic oncologist information.

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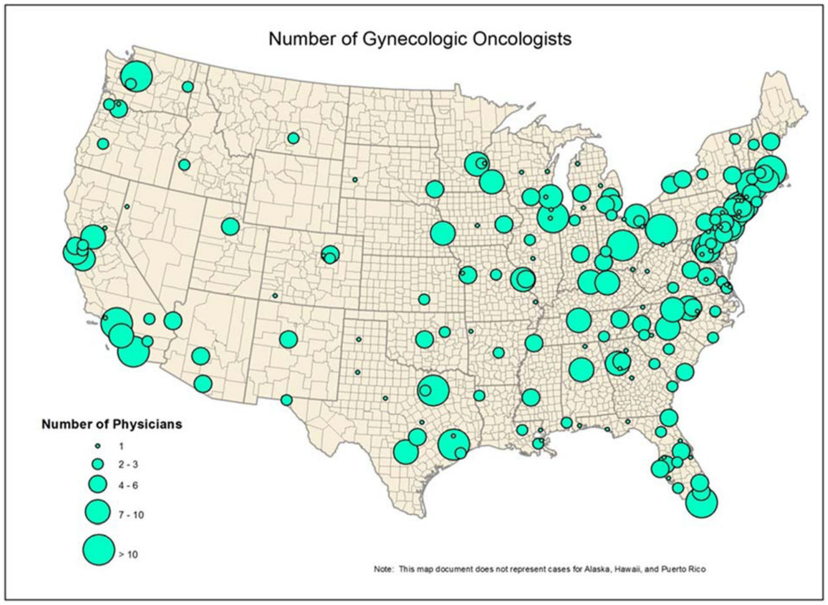

Figure 1.
Location and Number of Gynecologic Oncologist Practices in the United States

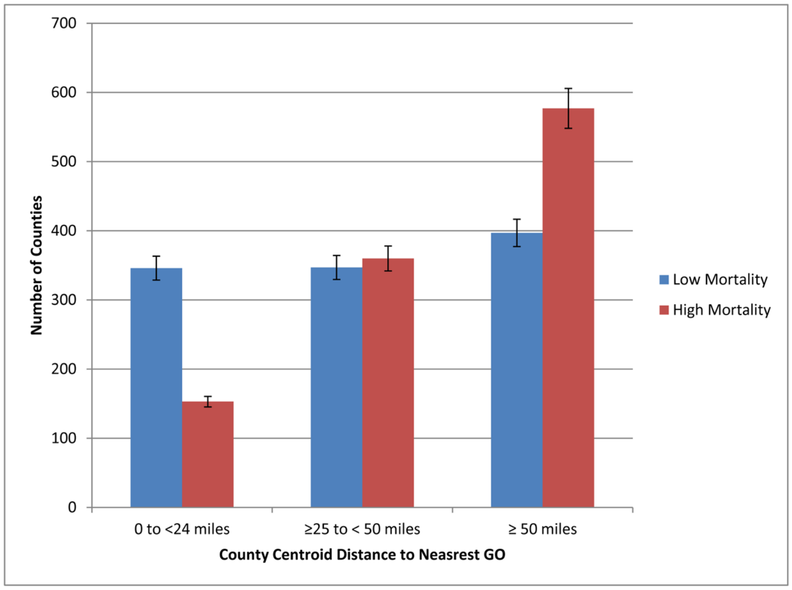

Figure 2.

Dichotomized Ovarian Cancer Mortality (High/Low) by Distance to Gynecologic Oncologist Practice Location

GO=gynecologic oncologist

Table 1

United States County Characteristics by Distance to Gynecologic Oncologist Practice Location

	Distance to Closest Gynecologic Oncologist		
	0 to <25 miles	**≥25 to < 50 miles**	**≥ 50 miles**
Number of U.S. Counties	536	890	1683
County Designation	n (%)	n (%)	n (%)
Metropolitan	486 (90.7)	345 (38.8)	255 (15.2)
Non-Metropolitan	42 (7.8)	424 (47.6)	901 (53.5)
Rural	8 (1.5)	121 (13.6)	527 (31.3)
Socioeconomic Characteristics	**n (%)**	**n (%)**	**n (%)**
Income Inequality Ratio[a]			
Low (<3.84)	26 (4.9)	226 (25.4)	773 (45.9)
Moderate (≥3.84 to <6.71)	71 (13.3)	323 (36.3)	664 (39.4)
High (≥6.71)	438 (81.9)	341 (38.3)	246 (14.6)
Percent of County Below Poverty Level			
Low (<11%)	295 (55.0)	292 (32.8)	452 (26.9)
Moderate (≥11 to <15.2%)	163 (30.4)	307 (34.5)	577 (34.4)
High (≥15.2%)	78 (14.6)	291 (32.7)	654 (38.9)
Percent of County Uninsured			
Low (<13.3%)	257 (47.9)	333 (37.4)	437 (26.0)
Moderate (≥13.3 to <18.5%)	181 (33.8)	321 (36.1)	563 (33.4)
High (≥18.5%)	98 (18.3)	236 (25.5)	683 (40.6)
Physician Characteristics (per 100,000 women)	**n (%)**	**n (%)**	**n (%)**
Primary Care Physicians			
0	1 (0.2)	15 (1.7)	115 (6.8)
Low (<105.79)	120 (22.4)	347 (39.0)	515 (30.6)
Moderate (≥105.79 to 169.97)	182 (34.0)	327 (36.7)	505 (30.0)
High (≥169.97)	233 (43.5)	201 (22.6)	548 (32.6)
General Surgeons			
0	51 (9.5)	223 (25.1)	666 (39.6)
Low (<11.72)	135 (25.2)	273 (30.7)	307 (18.2)
Moderate (≥11.72 to <20.47)	138 (25.7)	249 (28.0)	352 (20.9)
High (≥20.47)	212 (39.6)	145 (16.3)	358 (21.3)
OB/GYNs			
0	65 (12.1)	327 (37.7)	936 (55.6)
Low (<11.27)	94 (17.5)	235 (26.4)	259 (15.4)
Moderate (≥11.27 to <20.53)	139 (25.9)	199 (22.4)	268 (15.9)

	Distance to Closest Gynecologic Oncologist		
	0 to <25 miles	**≥25 to < 50 miles**	**≥ 50 miles**
High (≥20.53)	238 (44.4)	129 (14.5)	220 (13.1)
Population Characteristics	**% (SE)**	**% (SE)**	**% (SE)**
Non-Hispanic white	77.6 (17.7)	82.5 (16.9)	81.4 (20.1)
Non-Hispanic black	12.1 (14.1)	10.0 (14.8)	7.0 (14.6)
Non-Hispanic Asian/Pacific	2.4 (3.5)	0.8 (1.3)	0.6 (0.8)
Islander			
Non-Hispanic Other[b]	1.6 (1.2)	2.0 (4.8)	3.2 (8.1)
Hispanic	6.3 (8.8)	4.7 (8.7)	7.7 (14.6)
Ages 0 to 44	60.8 (5.2)	58.0 (5.3)	55.7 (6.6)
Ages 45 to 54	14.7 (1.3)	14.4 (1.5)	14.4 (1.6)
Ages 55 to 64	10.5 (1.6)	11.3 (1.8)	11.5 (2.0)
Ages 65 to 74	6.8 (1.7)	7.9 (1.6)	8.7 (1.9)
Ages 75+	7.3 (2.2)	8.4 (2.3)	9.8 (3.1)

[a]Defined as the ratio of the number of households with incomes above the population's top 22% household income to the number of houses with incomes below the population's bottom 22% household income

[b]Includes Non-Hispanic American Indian/Alaska Native.

Table 2

Ovarian Cancer Incidence and Mortality by Distance to Gynecologic Oncologist Practice Location

	Distance to Closest Gynecologic Oncologist		
	0 to <25 miles	**≥25 to < 50 miles**	**≥50 miles**
Mortality			
N	499	707	974
Rate (std error)	10.09 (3.14)	12.02 (4.73)	13.57 (6.43)
Incidence			
N	519	855	1,418
Rate (std error)	14.21 (4.23)	15.11 (6.54)	16.31 (8.51)

Table 3

Adjusted Odds of High Ovarian Cancer Mortality by Gynecologic Oncologist Practice Location

County Level Variable	Odds Ratio	Odds Ratio 95% CI	P-Value
Distance to GO			
≥25 to < 50 miles vs. < 25 miles	1.40	(1.04, 1.89)	0.029
≥50 miles vs. <25 miles	1.59	(1.18, 2.15)	0.003
General Surgeon per Avg. Pop.			
1st Tertile: (<11.72) vs. 0	0.35	(0.24, 0.50)	<0.001
2nd Tertile: (≥11.72 to <20.47) vs. 0	0.35	(0.24, 0.51)	<0.001
3rd Tertile: (≥20.47) vs. 0	0.32	(0.22, 0.48)	<0.001
Incidence Rate	1.15	(1.12, 1.18)	<0.001
% Population Age 45 to 54	1.25	(1.15, 1.37)	<.001
% Population Age 75+	1.39	(1.31, 1.48)	<.001
% Population non-Hispanic Asian Pacific Islander	0.88	(0.80, 0.96)	0.004
% Population Hispanic	0.99	(0.97, 1.00)	0.027

The model is adjusted for all the covariates shown in the county level variable column.