Health Services Research

Cervical Cancer Rates and the Supply of Primary Care Physicians in Florida

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Background and Objectives: *This study's aim was to determine if an increased supply of primary care physicians is associated with lower incidence and mortality rates for cervical cancer.* Methods: *We determined cervical cancer incidence and mortality rates for each of Florida's 67 counties over the 3-year period of 1993–1995 using data from Florida's population-based tumor registry. Data on physician supply were obtained from the 1994 American Medical Association Physician Masterfile. We used multiple linear regression analysis to examine the relationship between physician supply and cervical cancer incidence and mortality rates, adjusting for other county-level characteristics.* Results: *In regression analysis that adjusted for other county-level characteristics, each increase in the supply of family physicians of one physician/10,000 persons was associated with a corresponding drop in the incidence rate of 1.5 cases/100,000 persons and a corresponding drop in mortality rate of .65 cases/100,000 persons.* Conclusions: *Our results indicate that a greater supply of primary care physicians is likely associated with a lower incidence of cervical cancer and a lower cervical cancer mortality rate. More studies are needed at the individual patient level to confirm this association.*

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Cervical cancer is an important public health problem in the United States. There were an estimated 12,800 cases of invasive cervical cancer in the year 2000, with 4,600 deaths.[1] Primary care physicians can significantly influence both cervical cancer incidence and mortality rates by screening for cervical cancer with Pap smears and by providing patient education on the risks of developing cervical cancer. Studies have consistently reported that access to health care and a physician's recommendation are important predictors of cancer screening.[2-7] As a result, one might expect that the incidence and mortality rates for cervical cancer would be dependent on the availability of physicians who provide cancer screening services.

The availability of physicians in the United States has been the source of considerable debate.[8-14] Most studies have concluded that there is an overabundance of specialists. Whether there are adequate numbers of primary care physicians, however, has not been agreed on, with some concluding that there is a deficit,[14-16] while others argue that the current supply is adequate.[17-19] Absent from this debate, however, have been studies demonstrating the effects of physician supply on health-related outcomes. As a result, it is not clear how the supply of primary care physicians affects health outcomes or to what extent the supply of different primary care specialties influences health outcomes. This study's aim was to determine if an increased supply of primary care physicians is associated with lower incidence and mortality rates for cervical cancer. We hypothesized that increasing primary care physician supply would be associated with lower rates.

Methods

We performed an ecologic study to determine if primary care physician supply was associated with cervical cancer incidence and mortality rates in Florida counties. Counties were the unit of analysis for this study.

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Data Sources

Cervical Cancer Rates. We obtained data on cervical cancer incidence and mortality rates from the Florida Cancer Data System (FCDS), Florida's population-based tumor registry. By state law, all cases of invasive cervical cancer are reportable to the FCDS. The FCDS has well-established methods to ensure complete case finding, including cooperative arrangements with other state tumor registries. The FCDS is a member of the North American Association of Central Cancer Registries (NAACCR). NAACCR audits have estimated the completeness of case ascertainment for the time period 1991–1995 to be 99.7%. For each county, we recorded cervical cancer incidence and mortality rates. We averaged incidence and mortality rates for each county over the 3-year period 1993–1995 to stabilize the estimated rate of a rare event. All incidence and mortality rates are age adjusted.

Physician Supply. Data on physician supply were obtained from the 1994 American Medical Association (AMA) Physician Masterfile. This data set contains information on all allopathic physicians (regardless of AMA membership) and includes 83% of osteopathic physicians.[20] The AMA Physician Masterfile specifies physicians' self-designated primary specialty and practice address. Population estimates were obtained from the 1990 US Census. Data contained in the AMA Physician Masterfile has been verified in previous studies.[21-23]

For each Florida County, we determined the supplies of individual primary care physician specialties (family practice, general practice, obstetrics-gynecology, and general internal medicine) and non-primary care physicians. Physicians who indicated that they were engaged in full-time direct patient care were counted as one full-time equivalent (FTE); those who were either semiretired, in residency training, or engaged in teaching or research were counted as .5 FTE.[24] Physicians who indicated that they were no longer involved in direct patient care were excluded. All physician supplies are expressed as the number of physicians/10,000 population.

Population Characteristics. We obtained data from the 1990 US Census to account for other characteristics of counties that might affect cervical cancer incidence and mortality. Previous studies have shown that cervical cancer incidence and mortality are higher in populations that are non-white, rural, unmarried, or of lower socioeconomic status.[25-31] Using census data, we determined for each Florida county the following characteristics: the percentage of the population that was white, the percentage of the population having less than a high school education, the median household income, the percentage of females who were married versus unmarried, and the percentage of persons living in an urban versus non-urban setting.

Data Analysis

We examined whether county-level cervical cancer incidence and mortality rates were associated with measures of physician supply using the Pearson correlation coefficient. We also used multiple linear regression analysis to determine relationships between physician supply and cervical cancer incidence and mortality rates, controlling for other county-level characteristics. The following variables were assessed in all models: the percentage of persons who were white versus non-white, the percentage living in urban versus non-urban settings, the percentage of women who were married, the percentage of persons having less than a high school education, and the median household income for the county.

We also added measures of physician supply to all models, including family physicians, general practitioners, general internists, obstetrician-gynecologists, and all other non-primary care specialists. Variables remained in final regression models if they maintained statistical significance at the .05 level using a stepwise variable selection algorithm. Separate regression models were performed for age-adjusted incidence rates and mortality rates. Graphical methods showed that the normal distribution assumption was consistent with the data. We also used the SAS Collin option to perform collinearity diagnostics (SAS/STAT user's guide, version 8, Cary, NC, SAS Institute Inc, 1999). We used approaches described by Belsey et al[32] and Affifi[33] to assess collinearities among the variables.

The standard errors for estimates of incidence and mortality varied by county and were generally larger for counties having small populations. To determine if this influenced our findings, we repeated regression analyses using the technique of weighted least squares. We used two different methods for calculating weights. First, we determined the variance for each county estimate of incidence and mortality and used the inverse of the variance as the weight. Counties having less variation in incidence and morality rates were thus given greater weight in regression models than counties showing greater variability. We also repeated regression models using county populations as the weights.

Results

Population Demographics

Census-derived characteristics of Florida counties include: percentage of the county population that is white (average=84%, standard deviation [SD]=10%, range=41%–95%), percentage of the county population living in an urban area (average=34%, SD=40%, range 0%–93%), percentage of women in the county who are married (average=56%, SD=6%, range=38%–

63%), percentage of the population without a high school education (average=20%, SD=6%, range=9%–28%), and median household income (average=$24,500, SD=$4,700, range=$15,400–$31,800).

Cervical Cancer Rates

Table 1 reports the cervical cancer incidence and mortality rates among Florida's 67 counties. Incidence rates for cervical cancer varied widely by county; some counties reported no cases of cervical cancer in the 3-year period, and others had rates as high as 35 cases/100,000 population. Cervical cancer mortality rates similarly varied widely among counties; some counties had no deaths from cervical cancer during the study period, and others had cervical cancer death rates as high as 14.7 deaths/100,000. Table 2 presents the average supplies of physicians for Florida's 67 counties. There was again substantial variation among counties in the supplies of physicians.

Table 1

Average Cervical Cancer Incidence and Mortality Rates for Florida Counties, 1993–1995

	Average Rate	*Range*	*SD*
Incidence	10.8	0–35	5.47
Mortality	3.64	0–14.7	2.76

Rates are expressed as the number of cases or deaths/100,000 population.

SD—standard deviation

Table 2

Average Physician Supply for Florida Counties, 1994

	Physicians Per 100,000 Population	*Range*	*SD*
Primary care			
Family physicians	17.5	0–101.8	13.4
General practitioners	10.7	0–33.5	6.5
General internists	13.9	0–47.4	10.7
Obstetrician-gynecologists	7.2	0–25.1	5.8
Other specialists	85.2	0–436.4	71.2
Total	134.9	15.5–561.4	90.7

SD—standard deviation

Relationship With Physician Supply

Correlations between county-level cervical cancer incidence and mortality rates with measures of physician supply are reported in Table 3. Only the supply of family physicians was statistically significant and inversely correlated with cervical cancer incidence rates. Although not reaching statistical significance, there were trends for cervical cancer incidence rates to be inversely correlated with most measures of physician supply.

Cervical cancer mortality rates were inversely correlated with overall measures of physician supply, including both primary care and non-primary care specialties. Among primary care physician supplies, cervical cancer mortality rates were inversely associated with the supplies of general internists, with a statistically nonsignificant trend for inverse correlation with the supply of family physicians.

Linear regressions were performed to determine whether county-level characteristics were associated with cervical cancer incidence and mortality rates. Only two variables were statistically significant predictors of cervical cancer incidence rates: the percentage of the population that was white and the county's supply of family physicians. For each 1% increase in the proportion of the county population that was white, there was a corresponding decrease in the incidence rate of .15 cases per 100,000 persons (95% confidence interval [CI]=.02–.27). Similarly, for each increase in the supply of family physicians of one doctor/10,000 persons, there was a corresponding drop in the incidence rate of 1.5 cases/100,000 persons (95% CI=.5–2.4). These two variables explained 15% of the variation observed in cervical cancer incidence rates among the 67 counties.

These two variables were also the only significant predictors of cervical cancer mortality rates in regression models. For each 1% increase in the proportion of county population that was white, there was a corresponding drop in the mortality rate of .1 cases per 100,000 persons (95% CI=.04–.16). Similarly, for each increase in the supply of family physicians of one doctor/10,000 persons, there was a corresponding drop in mortality rate of .65 cases/100,000 persons (95% CI=.17–1.13). These two variables explained 17% of the variation observed in cervical cancer mortality rates among the 67 counties. Results were similar when regression models were repeated using the method of weighted least squares and inverse variance as the weights. Results were also similar when county population was used as the weights.

Discussion

We found that increasing supplies of family physicians and general internists tended to be associated with lower incidence and mortality rates of cervical cancer in Florida counties. Associations were especially strong for the supply of family physicians. Each increase in the supply of family physicians of one doctor/10,000 persons was associated with a reduction in the cervical cancer incidence rate of 1.5 cases/100,000 persons and

Table 3

Correlation of Physician Supply and Other County Characteristics With Cervical Cancer Incidence and Mortality*

	INCIDENCE RATES		MORTALITY RATES	
Physician Supply	*Correlation Coefficient*	P *Value*	*Correlation Coefficient*	P *Value*
Total physician supply	-.21	.085	-.31	.012
Primary care supply	-.22	.070	-.30	.013
Non-primary care supply	-.19	.129	-.29	.019
Primary care specialties				
Family physicians	-.29	.015	-.23	.064
General practitioners	.24	.051	.06	.611
General internists	-.22	.068	-.34	.004
Obstetrician-gynecologists	-.13	.282	-.18	.146
County characteristics				
Percent of population white	-.18	.141	-.28	.021
Percent of population urban	-.23	.063	-.32	.009
Percent of women married	-.03	.800	-.09	.493
Percent without HS education	.28	.023	.35	.004
Median household income	-.23	.062	-.38	.002

HS—high school

a drop in the mortality rate of .65 cases/100,000 persons. Our findings are similar to other studies that have linked increased family physician supply with improved health outcomes.[34-36] There is reason to believe that primary care physician supply may be an important determinant of patients' access to health services. Having a regular physician, for example, has been found to be an important determinant of access to care.[37] Primary care physician supply has been linked to patients' use of ambulatory care,[38] and increases in physician supply have been linked with increased access and use of ambulatory services.[39,40]

Access to primary care physicians may be an especially important determinant of patients receiving cancer screening. Primary care physicians tend to recommend preventive health care services during visits for chronic illnesses much more so than do specialists.[22,41,42] The National Ambulatory Medical Care Survey, for instance, showed that in 1991, 87% of all mammograms were recommended by primary care physicians (family physician, internists, obstetrician-gynecologists), rather than by specialists.[43]

Increasing the supply of primary care physicians may not necessarily ensure that they are located in areas of most need. Some programs have been successful, however, in targeting primary care residency graduates to areas of greatest need.[44] In addition, increasing the supply of physicians alone may not adequately address problems of inadequate access to care if other issues, such as a lack of health insurance, are not also addressed.[45] Finally, non-physician providers may potentially meet primary care needs, and their supply is also amenable to public policy.[46]

In bivariate analyses, we found that higher cervical cancer mortality was correlated with several other county characteristics. Increasing percentages of the county population that were rural or non-white and lower levels of education and income were all correlated with higher cervical cancer mortality. Previous studies have shown that cervical cancer mortality is higher in populations that are non-white, rural, unmarried, or of lower socioeconomic status.[25-31]

This study has a number of limitations that should be considered. First, this was an ecologic study, which has limited ability to establish causality. Such studies are subject to the "ecologic fallacy," in which associations at the county level are not reflective of associations at the individual patient level. We did not have information on each patient's actual use of physician services. We also did not have detailed information on other health characteristics of counties that might influence incidence and mortality rates, such as supplies of other health care providers (ie, nurse practitioners) or the reproductive/sexual/smoking histories of county residents. Our small sample size, and the restricted number of control variables, limited our ability to control for confounding and to separate the effects of variables that are highly correlated. It is possible, therefore, that associations that we have attributed to physician supply resulted to some extent from correlations with other characteristics of counties that influence cervical cancer outcomes.

Conclusions

A greater supply of primary care physicians was associated with a lower incidence of cervical cancer and a lower cervical cancer mortality rate among Florida counties. More studies are needed at the individual patient level to confirm this association.

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