Electronic Delivery Cover Sheet

Cancer Mortality Trends in Medically Underserved Counties in Virginia

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Context: Cancer mortality rates in the United States have improved during the past 40 years. The improvement in mortality rates is not equal for all types of cancer or all geographic locations, however.

Objective: To compare trends in cancer mortality rates in Virginia counties from 2005 through 2009.

Methods: Publicly available data from the National Cancer Institute, the State Cancer Profile, and the Virginia Department of Health were accessed for this analysis. For all counties in Virginia with all-cancer and lung cancer mortality data available, the authors compared counties considered medically underserved areas (VMUAs) with non-VMUAs to examine trends in cancer mortality rates that increased, remained stable, or decreased from 2005 through 2009. The significance level for all data was set at $P \leq .05$.

Results: Of 136 counties in Virginia, 134 had all-cancer and 123 had lung cancer mortality data available. The VMUAs had a 48% lower decreasing all-cancer mortality rate than non-VMUAs (13 [26%] vs 37 [74%], respectively; $P=.004$). Non-VMUAs had a 33.3% higher stable all-cancer mortality rate than VMUAs (50 [66.6%] vs 25 [33.3%], respectively; $P=.004$) and a 55.2% higher lung cancer mortality rate (17 [22.4%] vs 59 [77.6%], respectively; $P<.001$).

Conclusion: The all-cancer and lung cancer mortality rates were found to either remain stable or, in the case of all-cancer mortality, to increase in VMUAs.

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Data published by the American Cancer Society in 2015 demonstrated overall improvements in cancer mortality rates in the United States.[1] The rates of improvement were not equal for all types of cancers or geographic areas, however. In some counties in Virginia considered to be medically underserved areas (VMUAs), the 5-year average age-adjusted mortality rate for all cancer was as high as 229 per 100,000, such as in Lee county, where all-cancer mortality rates increased.[2] Conversely, the trend in all-cancer mortality rate in Alexandria, Virginia, one of the wealthiest counties in the United States, decreased, at 131.3 per 100,000.[3]

Differences in cancer mortality rates can be attributed to certain risk factors such as cancer type, race/ethnicity, and geographic location.[2] For example, from 2006 to 2010, cancer mortality rates in Virginia were decreasing for lung cancers but increasing for liver cancers.[2] All-cancer mortality rates have been found to decrease in whites compared with nonwhites.[2] The differences are more dramatic in Virginia than in other states because

Virginia has some of the wealthiest and poorest counties in the nation.[3] Health indicators such as cancer mortality rates often parallel socioeconomic variables. This bimodal distribution in wealth and health in Virginia places a greater strain on statewide health care policies and programs than in other states.[2]

The purpose of the current study was to compare trends from 2005 through 2009 all-cancer and lung cancer mortality rates between VMUAs and non-VMUAs. We selected these categories because the data were more robust, and fewer counties had unreported cancer mortality rates for these 2 categories. Further, lung cancer is the leading cause of cancer mortality in both men and women in the United States.[4] Cancer mortality is a measure of our attempts at preventive medicine as well as a measure of the success of the health care profession in early detection and treatment, which are lacking in medically underserved areas (MUAs). We suspected that because Virginia has some of the wealthiest counties in the country as well as some of the poorest counties, and because such income disparaties can affect access to health care, vast differences would be found in cancer mortality outcomes between VMUAs and non-VMUAs.

Methods

Institutional review board approval was not needed for this study, as all data used were publically available. The inclusion criterion for this study was cancer deaths as reported to the National Cancer Institute (NCI). "All cancer" was defined as all invasive cancer sites, including bladder, breast, brain, cervix, childhood cancers (all sites combined), colon and rectum, esophagus, kidney, leukemia, liver and bile duct, lung and bronchus, skin melanomas, non-Hodgkin lymphoma, oral cavity and pharynx, ovary, pancreas, prostate, stomach, thyroid, and uterus. "Lung cancer" was defined as cancers of the lung and bronchus.

Five criteria were used in determining whether an area qualifies for the designation of VMUA: (1) percentage of population whose income is at or below 100% of the federal poverty level, (2) percentage of population aged 65 years or older, (3) primary care physician-to-patient ratio, (4) infant mortality rates, and (5) unemployment rate.[11] The practice of designating health care professional shortage areas in VMUAs has been a national strategy to identify areas with the greatest health disparities. Areas were selected according to specific geographic, population, and facility criteria. The use of designations such as VMUA has not only been useful for decisions on allocation of efforts and funds, but it also assists osteopathic physicians, who are educated on and attentive to the philosophies of care specific to rural areas and MUAs.

Publically available data from the NCI state cancer profile and the Virginia Department of Health for the years 2005 to 2009 were obtained and evaluated.[5] These dates were selected because they had the latest available data at the time of the analysis. Mortality data were obtained from the National Vital Statistics System public use data file, and mortality rates were calculated by the NCI's SEER*Stat. The NCI data were derived from the state cancer registries, which collect data on cancer-related deaths. For all NCI data, the average annual percent change (AAPC) was based on the percent change calculated by the Joinpoint Regression Program. The data for VMUA and non-VMUA were obtained from the Virginia Department of Health.[5] Mortality rates were age-adjusted to the 2000 US standard population. All-cancer and lung cancer mortality rates were obtained from VMUA and non-VMUA counties and cities in Virginia[2] and reported by trends of increasing, decreasing, and stable rates. Increasing mortality rate was defined by the NCI as a 95% CI of AAPC above 0; decreasing mortality rate was defined as a 95% CI of AAPC below 0; and stable mortality rate was defined as 95% CI of AAPC of 0.

A χ^2 statistical analysis was used for the categorical data, with 1 dichotomous variable and 3 levels of nominal outcomes. The significance level for all data was set at $P \leq .05$.

Results

At the time of the current study, there were 136 counties and county-equivalent cities in Virginia. For all-cancer mortality rate comparisons, data were reported for 42 VMUAs and 92 non-VMUAs; data were not reported for 2 counties. Lung cancer mortality rates (n=123) were reported for 40 VMUA counties and 83 non-VMUA counties. No data on lung cancer mortality were available for 13 counties. The total number of deaths from all cancer in Virginia from 2005 through 2009 was 13,964, with a mortality rate of 183.2 (95% CI, 181.8-184.5 per 100,000). The total number of deaths in the United States from all cancer from 2005 through 2009 was 563,025, with a mortality rate of 178.7 (95% CI, 178.4-178.9 per 100,000). Overall, trends for Virginia demonstrated a decreasing rate of cancer mortality at −1.4 (95% CI, −1.6 to −1.3), and for the United States, the annual average was also decreasing, at −1.6 (95% CI, −1.7 to −1.5)

All-Cancer Mortality Rates

For all-cancer mortality, Lee county averaged 229 (95% CI, 205-255); Russel County, 209.6 (95% CI, 188.7-232.2); Buchanan County, 209.5 (95% CI, 187.7-236.7); and Smyth County, 208.4 (95% CI, 189.4-229.0). Each of these mortality rates was higher than the state average of 183.2 (95% CI, 181.8-184.5) and made up nearly 10% of the MUAs.[3] The remaining counties with increasing mortality rates made up approximately 5% of the non-VMUAs.

No statistically significant difference was found in increasing all-cancer mortality rates between VMUAs and non-VMUAs. Furthermore, VMUAs did not have a statistically significantly higher all-cancer mortality rate than non-VMUAs (44.4% vs 55.6%, respectively). Increasing all-cancer mortality rates were observed in 4 of 42 VMUAs (9.5%) and 5 of 92 non-VMUAs (5.4%; P=.74).

A statistically significant difference was found in stable all-cancer mortality rates between VMUAs and non-VMUAs. Non-VMUA counties had a 33.3% higher stable all-cancer mortality rate than VMUAs (50 [66.6%] vs 25 [33.3%], respectively; P=.004). Stable all-cancer mortality rates were found in 25 of 42 VMUAs (59.5%) and 50 of 92 non-VMUAs (54.3%; P=.004).

A statistically significant difference was also observed in decreasing all-cancer mortality rates between VMUAs and non-VMUAs. The VMUAs had a 48% lower decreasing all-cancer mortality rate than non-VMUAs (13 [26%] vs 37 [74%], respectively; P=.004). Decreasing all-cancer mortality rates were observed in 13 of 42 VMUAs (30.9%) and 37 of 92 non-VMUAs (40.2%; $P<.001$) (*Table*).

Lung Cancer Mortality Rates

No statistically significant difference in increasing lung cancer mortality rates was found in VMUAs compared with non-VMUAs (36.3% vs 63.6%, respectively; P=.2). Of the VMUAs, increasing lung cancer mortality rates were found in 8 VMUAs (20%) and 14 non-VMUAs (17%).

A statistically significant difference was found in stable lung cancer mortality rates between VMUAs and non-VMUAs. Stable lung cancer mortality rates were 55.2% higher in VMUAs than non-VMUAs (17 [22.4%] vs 59 [77.6%], respectively; $P<.001$). Of the VMUAs, stable lung cancer mortality rates were observed in 17 of 38 VMUAs (44.7%) and 14 of 87 non-VMUAs (67.8%).

No statistically significant difference was found in decreasing lung cancer mortality rates between VMUAs and non-VMUAs (48.1% vs 51.8%; P=.8). Of the VMUAs, decreasing lung cancer mortality rates were observed in 13 (34.2%) and of non-VMUAs, 14 (16.1%) (*Table*).

Discussion

Improving access to health care and medical services will continue to be a priority as the Patient Protection and Affordable Care Act provides medical insurance coverage to more people in the United States. Likewise, for the aging population, a focus on preventing cancer, treating patients with cancer, and sustaining cancer survivors' health will continue to be important, as malignant neoplasms remain the second most common cause of death in the United States in persons aged 65 years or older.[6]

Understanding associations between low socioeconomic status and poor health is a pillar of public health research and critical to clinical applications. In 1991, the director of the NCI, Samuel Broder, MD, declared poverty a carcinogen.[7] A study[8] on cancer screening and risk factors using data from the National Health Interview Survey examined access to health care by socioeconomic status and race. Poor cancer survival seemed to be influenced more by disparities in access to care, such as screening procedures and aggressiveness of early interventions, than by biological differences in the tumor itself. Low rates of cancer screenings among low-income residents may result from prohibitive costs, lack of insurance coverage, and lack of transportation to screening locations.[9] It was also determined that screening tests are not being used consistently because of lack of follow-up and lack of continuity in care. Four socioeconomic factors have been consistently shown to contribute to differences in cancer mortality rates: education, rural vs urban residence, race, and income.[10] Low-income areas are commonly known to lack health care resources and information that can help facilitate a healthy lifestyle.

In the current study, 4 of the 9 counties in which the mortality rates for all cancer were increasing were VMUAs. These 4 counties are all in southwestern Virginia, including the Appalachian region of Virginia, which is known to have several factors identified as risk factors for cancer mortality: lower high school graduation rates, rurality with lower access of health care, and lower household income. Lee county had a 50% graduation rate (one of the lowest in Virginia); Russel, 65%; Buchanan, 65%; and Smyth, 75%, within 4 years of ninth grade. The state average is 76%.[11] Four counties with increasing mortality rates for all cancer were within the 11 counties with the lowest household income, with Smyth at $33,451 and Buchanan at $26,571. The state average is $61,210.[11]

It is important to note that the lack of statistical significance is related more to the lack of power due to low sample size (few number of counties).

The VMUA population's health outcomes specifically related to cancer mortality are adversely affected by lack of access to health care services.[12] They are also adversely affected by the time it takes to travel to distant health care facilities and thus many may not have access to care and diagnosis. A study[13] examining patients' distance from health care with regard to melanoma diagnosis and treatment measured patients' distance from health care service and compared it with the stage of diagnosis using Breslow thickness, a prognostic tool

Table.
All-Cancer Mortality and Lung Cancer Mortality Rate Trends in Virginia's Medically Underserved and Non–Medically Underserved Counties, 2005-2009[a] (N=163)

Mortality Rate Trend	VMUA[b]	Non-VMUA[c]	Difference	*P* Value
All Cancer				
Increasing	4 (10)	5 (5)	1 (5)	.74
Stable	25 (60)	50 (54)	25 (6)	.004
Decreasing	13 (31)	37 (40)	24 (−9)	<.001
Lung Cancer				
Increasing	8 (20)	14 (17)	6 (3)	.2
Stable	17 (45)	59 (68)	42 (–23)	<.001
Decreasing	13 (34)	14 (16)	1 (18)	.8

[a] Data are given as No. (%) unless otherwise indicated.
[b] n=42 for all cancer and n=40 for lung cancer.
[c] n=92 for all cancer and n=83 for lung cancer.

Abbreviation: VMUA, Virginia medically underserved area.

used to stage melanoma. The authors found that distance from health care services was a barrier to screening and, therefore, a barrier to early diagnosis and outcome. Access to health care services may also be affected by other factors, including education, physician supply, and rurality.[14]

The current study aimed to provide additional analysis and interpretation of the publicly available information on VMUAs. Rather than broadly focusing on overall cancer mortality rates, we sought to determine whether there were differences in increasing, decreasing, and stable trends in cancer mortality rates between VMUAs and non-VMUAs. Data reported by the National Program of Cancer Registries, a program with the Surveillance, Epidemiology and End Results program of the NCI, is considered to be the highest-quality data available. Although the current study cannot be generalized to locations outside the counties studied, it does serve as a model for future research on MUAs throughout the United States.

This study had several limitations. Using counties within the state of Virginia provided geographic specificity along with a smaller population size; to have the power needed for statistically significant results, a larger sample size is needed. The small sample size did not allow us to analyze specific cancer types, particularly those with incidence rates much lower than that of lung cancer. Another limitation was that we did not study lifestyle factors that may affect cancer mortality rates, such as obesity and physical fitness. Studies are underway at our institution in which we focus on the MUAs identified in the current study and determine other factors that contribute to cancer mortality, such as obesity and physical fitness. On preliminary review of the data in these upcoming studies, it is unlikely that being medically underserved is the only factor involved in cancer mortality rates.

An important outcome of the current study is that identifying a disparity will prompt researchers and health care professionals to continue to seek a better understanding of the problems in MUAs and will help inform future policy makers and health care professionals in demonstrating an ongoing need to allocate resources for future research. By better understanding the problems of an area, interventions can be designed to best serve that area. The current study also demonstrated that we must continue to provide incentives and resources to grow primary care practice in MUAs. The importance of cancer screenings in MUAs is to detect cancers early enough to provide a cure. This is one of the many reasons why primary care physicians remain the cornerstone of health care and preventive medicine.

Research on health disparities related to geographic area, socioeconomic status, race, or other social factors is important to the ongoing practice of osteopathic medicine. Treating the patient as a whole being rather than a body of systems means incorporating the social, economic, and lifestyle factors when considering the best course of action and treatment. A better understanding of cancer epidemiology and how it relates to sociodemographic factors is important progress in cancer care. This study further demonstrates a key foundation of osteopathic medicine, which is that of preventive medicine.

Conclusion

The all-cancer and lung cancer mortality rates were found to either remain stable or, in the case of all-cancer mortality, to increase in VMUAs in comparison with non-VMUAs. This study adds to the growing body of research on cancer mortality rates in MUAs. More importantly, the current study shows that a disparity in mortality rate was found between VMUAs and non-VMUAs. It is important that further research be conducted on the prevalence of factors known to increase cancer mortality rates in MUAs, such as obesity and physical inactivity. Through the analysis of available data, researchers and health care professionals can design interventions that will better serve MUA populations.

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