2023

SOCIODEMOGRAPHIC FACTORS RELATED TO LATE-STAGE LUNG CANCER DIAGNOSIS IN KENTUCKY

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CAPSTONE PROJECT PAPER

By

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Abstract.

Lung cancer is the leading cause of cancer mortality in the United States, and the state of Kentucky has a significant burden of lung cancer morbidity and mortality. The aim of this study is to examine the sociodemographic factors associated with late-stage lung cancer diagnosis in Kentucky. The present study is a retrospective, population-based cohort study that utilizes data from the Kentucky Cancer Registry to examine the associations between late-stage lung cancer diagnosis and sociodemographic factors. Descriptive, bivariate, and multivariable analyses were conducted to estimate the significance of these associations. Significant relationships between the variables of sex, age, Appalachian status, and primary insurance payer were found after conducting bivariate analyses. Higher odds of late-stage lung cancer diagnosis were found in several demographic groups included in the study. Higher odds of late-stage lung cancer diagnosis were found among males, Appalachian cases, cases among individuals living alone, cases who were <50 years of age, cases who were aged 50-69, cases who were uninsured, and cases who received Medicaid benefits. Year of diagnosis was found to be a protective factor, with the odds of late-stage lung cancer diagnosis decreasing as year of diagnosis increased. Although results from the present study were found to be significant, additional research on the topic of sociodemographic factors and association with late-stage lung cancer diagnosis should be done to solidify understanding of this relationship.

Background.

Lung cancer is and has historically been the most commonly occurring cause of cancer mortality in the United States. The state of Kentucky has historically had the highest burden of lung cancer incidence and mortality in the nation.[1] The age-adjusted lung cancer incidence rate in Kentucky for 2019 was 83.2 cases per 100,000 population, compared to the national age-

adjusted lung cancer incidence rate of 53 cases per 100,000 population.[2] Kentucky's unique socioeconomic, environmental, and behavioral conditions contribute substantially to this disparity in lung cancer incidence and mortality.[3] The distinct combination of these factors have led to the significant burden of lung cancer in Kentucky and have highlighted the need to better understand the subpopulations in the state at risk for being diagnosed with late stage lung cancer.

Early diagnosis of lung cancer is crucial to successful treatment and improved lung cancer survival.[4] In recent years, early diagnosis of lung cancer has been improved due to the development of low-dose computed tomography as a screening tool for cases at high risk of lung cancer.[5] Low-dose computed tomography (LDCT) for lung cancer screening has been recommended since 2013; with the United States Preventive Services Task Force (USPSTF) recommending annual screening for lung cancer with LDCT in adults aged 50-80 years who have a 20-pack-year smoking history and currently smoke or have quit smoking within the past 15 years.[6] Following the development of these guidelines and the implementation of LDCT screening, lung cancer is being diagnosed at an earlier stage and mortality has decreased.[4] It is vital that all at-risk populations be screened appropriately to improve lung cancer survival and decrease the burden of lung cancer in Kentucky and across the nation.

Following USPSTF recommendations for LDCT, lung cancer screening has increased.[4,5] However, the applications of these increased screening rates have not been uniform across the population.[4,5] Despite the extraordinarily high lung cancer burden in the state, in 2018, Kentucky had a screening rate of 13.7%, more than twice the national average of 5.0%. [4] This is, in part, due to a robust response from the University of Kentucky Markey Cancer Center, the Kentucky Cancer Consortium, the Kentucky Cancer Program, and some support from the state government to address the disproportionate burden of lung cancer in Kentucky and improve survival.[4]

Though lung cancer screening programs in Kentucky have been successful, access to healthcare and attitudes surrounding healthcare in Kentucky can still pose challenges for public health programs.[3,7,8] Kentucky, particularly Appalachian Kentucky, is mostly rural and access to healthcare in these rural areas is often lacking.[3,8] Not only is healthcare access a barrier, but also attitudes and beliefs surrounding receiving treatment and screening can prevent certain populations from successfully accessing screening and receiving treatment of lung cancer when it is in an early, more treatable stage.[8] When examining lung cancer screening in Kentucky, it is important to consider these cultural and physical barriers to care to better understand how to reach the at-risk populations.

Setting.

Kentuckians are uniquely prone to several different types of exposures that increase the risk of lung cancer. One obvious risk factor that is present in Kentucky is high rates of cigarette smoking.[9] Smoking has long been known as the number one risk factor for lung cancer diagnosis. Rates of smoking in Kentucky among both youths and adults are among the highest in the nation.[9] Kentucky has a low tax on cigarettes and also does not have a state-wide indoor smoking ban in place, likely contributing to high rates of smoking, and in turn, high rates of lung cancer.[9] While smoking obviously contributes to the high rates of lung cancer incidence and mortality in Kentucky, the disparity cannot exclusively be explained by smoking alone.[10,11]

Appalachian Kentucky has incredibly high rates of lung cancer incidence and mortality. Appalachian counties in Kentucky had an age-adjusted lung cancer incidence rate of 103.3 per 100,000 population for the years 2015-2019, higher than both Kentucky's rate and the national rate.[12] These high rates are believed to be caused by a combination of sociodemographic and behavioral factors.[3] Income and educational attainment tend to be lower in Appalachian

Kentucky compared to the rest of the state.[8,11] Rates of smoking are also higher in Appalachian counties in Kentucky than non-Appalachian counties.[8,11] However, these factors alone do not explain the difference in lung cancer mortality. The Eastern Kentucky Coal Field covers most of Appalachian Kentucky. The coal mined in this area has high concentrations of carcinogenic metals (arsenic, cadmium, chromium, and nickel).[10] However, these same high concentrations of carcinogenic elements are not found in the Western Kentucky Coal field. Environmental exposure to these known lung carcinogens is believed to contribute to the excessively high lung cancer incidence rates in the Appalachian region of the state.

Lung Cancer Staging and Survival.

Lung cancer is divided into two types based on the type of cancer cells found in the lungs; small-cell and non-small cell lung cancer.[13] Small cell lung cancer is the much more aggressive type, and is also less common, accounting for approximately 10-15% of all lung cancer cases.[13] Non-small cell lung cancer is the most commonly diagnosed type of lung cancer, accounting for about 80-85% of all lung cancer diagnoses.[13]

There are two methods for lung cancer staging: TNM staging and SEER summary staging. TNM stands for Tumor, Node, and Metastasis, and is typically used in clinical settings, while SEER summary stage is more often used in epidemiological research.[14] Both types of lung cancer staging are dependent on the location of the tumor within the lung, tumor size, and whether or not it has spread to distant organs.[13] Early stage lung cancer is typically defined as any stage *in situ* or local, meaning the cancer is confined to the organ of origin, and late-stage lung cancer is defined as any stage that is regional or distant, meaning the cancer has spread to organs outside of the primary organ.[13,14] The higher the lung cancer stage, the more advanced the disease is, and the worse the prognosis is.[13]

Prognosis of lung cancer cases is increasingly poor as the stage of diagnosis increases.[15] The 5-year survival rate for late-stage lung cancer is approximately 7.2%, while the 5-year survival rate for early stage lung cancer is 57%.[2] This is because early-stage diagnosis often allows for surgical intervention. Late stage disease is treated with chemotherapy and radiation therapy but these treatments are less effective with late stage disease.[16] Despite improved survival for lung cancer cases diagnosed with early-stage disease, cases are often not diagnosed until their disease has progressed, as symptoms of lung cancer can overlap with symptoms of other common chronic respiratory diseases and can also sometimes be ignored and attributed to physiological changes that occur with aging.[17] The lack of noticeable symptoms can contribute to a higher proportion of advanced stage lung cancer diagnoses, as cases without symptoms do not feel the need to seek treatment.[18] This further highlights why screening which identifies lung cancer at an early stage is incredibly important to improve lung cancer survival and mortality.

There are a multitude of factors that can contribute to lung cancer stage at diagnosis. Racial and ethnic disparities in stage at diagnosis for lung cancer exist, as Non-white cases are more likely to be diagnosed at a later stage.[5,19-22] White cases are more often diagnosed at an earlier stage of disease and have better overall survival than non-whites.[19,22] This is likely due to a myriad of socioeconomic and systemic issues that commonly impact Non-white cases, such as higher rates of poverty and more barriers to care.[17,19,20] Sex is also a sociodemographic factor that can be associated with stage at diagnosis, with men typically being diagnosed at a later stage than women.[17,20,22] Lower socioeconomic status and educational attainment are also associated with later-stage diagnosis and higher rates of lung cancer mortality.[23,24] Cases who live in areas that do not have adequate healthcare access, such as rural areas, also experience disparities in stage at diagnosis.[5,22] Rural populations have higher lung cancer incidence and mortality as well,

particularly in the state of Kentucky.[5] Insurance status may also influence stage at diagnosis; current literature suggests that those patients who are uninsured or receive Medicaid benefits tend to be diagnosed later and also have poorer outcomes in terms of cancer survival.[22,25] This can be due in part to the fact that those who are uninsured or receiving Medicaid benefits have higher rates of poverty, lower health literacy, and increased barriers to healthcare access as compared to those with private insurance.[25]

Study Objective.

The main objective of this study is to identify key demographic factors and characteristics associated with late-stage lung cancer diagnosis in Kentucky. By answering this research question, public health professionals will be able to better understand which portions of the population are being diagnosed in later stages, and to effectively direct their resources toward increasing screening in populations with the greatest need.

Materials and Methods.

This study aims to explore the relationship between various sociodemographic characteristics of Kentuckians and late-stage lung cancer diagnosis.

Data Source.

The Kentucky Cancer Registry (KCR) is the data source for this study. This study is a retrospective, cohort study that utilizes previously collected data from the KCR.[26] The Kentucky Cancer Registry is Kentucky's official cancer surveillance system designed for the collection, storage, and management of Kentucky's cancer data.[26] All Kentucky hospitals and their associated outpatient facilities must report each cancer case to the Kentucky Cancer Registry.[26] The KCR currently operates as part of the National Cancer Institute's Surveillance Epidemiology

and End Results (SEER) program, as well as the Center for Disease Control and Prevention's National Program of Cancer Registries (NPCR).[26]

Study Sample

The selected sample for this study includes all primary lung cancer cases aged 18 years or older diagnosed in the state of Kentucky between January 1st, 2013, and December 31st, 2019. The sample provided by the KCR included 32, 343 cases. It is important to note that this data contains only information related to primary cases of lung cancer, rather than individual patient level data, and thus, will be referred to as cases.

Variables

Sociodemographic variables included in this study were sex, race, age group, Appalachian status, primary payer, and marital status.

- **Sex** – The sex variable is a categorical variable that groups cases as male or female.
- **Race** – The race variable is a categorical variable that groups cases as White/Other or Black. White and other races were combined due to a small sample size of other races.
- **Age group** – The age group variable is a categorical variable. Cases were grouped as <50, 50-69, or 70< years of age at diagnosis. The categorization of this variable was based on previous literature and was created to easily distinguish whether younger, middle-aged, or older cases are diagnosed more frequently with late-stage lung cancer.[18,27]
- **Appalachian status** – The Appalachian Status variable is a categorical variable that groups cases based on location as a resident of Appalachia or a resident of the non-Appalachian area of the state at diagnosis. The Appalachian Regional Commission

designates which counties are Appalachian. In Kentucky, 54 counties in the eastern region of the state are defined as Appalachian.[28]

- **Primary payer –** The primary payer variable is a categorical variable that groups cases based on primary insurance payer, categories were private insurance, Medicaid, Medicare, uninsured or unknown. As the Kentucky Cancer Registry does not contain direct measures of poverty or educational attainment, primary insurance payer is used as a proxy for these measures.
- **Marital status** – The marital status variable is a categorical variable that groups cases as married/partnered, single/divorced/widowed, or unknown.

This study's outcome variable was stage at diagnosis.

- **Stage at diagnosis** – The stage at diagnosis variable is a categorical variable that groups cases as early-stage or late-stage diagnosis. This variable was created by combining two variables of SEER stage at diagnosis: SEER Summary Stage 2000 and SEER Summary Stage 2018, as the SEER guidelines for staging were changed in 2018. For cases diagnosed in 2013-2017, the SEER Summary Stage 2000 was used. For cases diagnosed in 2018 and 2019, SEER Summary Stage 2018 was used. This did not change the stages determined as early or late stage for purposes of this study. Early-stage diagnosis was defined as *in situ* or local, and late-stage diagnosis was defined as any regional or distant stage.

Statistical Analysis

Descriptive analyses were calculated for the total sample, then stratified by early or late-stage diagnosis. The sociodemographic characteristics of lung cancer cases were examined to determine their associations with lung cancer stage at diagnosis. These bivariate analyses were

performed to determine the significance of the relationship of each independent variable with late-stage lung cancer diagnosis. Chi-squared tests of independence were used to determine the significance of the relationship between late-stage lung cancer diagnosis and the categorical variables included in this study. The T-test statistic was used to determine the significance of the relationship between late-stage lung cancer diagnosis and the continuous variable included in this study. Statistical significance was determined using two-sided p-values of alpha=0.05.

Multivariable logistic regression models were used to examine the association of late-stage lung cancer diagnosis across various exposure groups, using odds ratios and 95% confidence intervals. The final logistic regression model estimated the association between late-stage cancer diagnosis while controlling for sex, age group, Appalachian status, primary payer, year of diagnosis and marital status.

All analyses were carried out with SAS 9.4 statistical software.

Results.

Table 1 displays the descriptive statistics of 32,343 primary lung cancer cases diagnosed in Kentucky between 2013-2019. Among those cases, 76.9% were considered late-stage at the time of their diagnosis. The sample was primarily comprised of non-black (94.43%), non-Appalachian (67.17%) cases and cases between the ages of 50-69 (50.37%). The average age among the sample was 68.07 years old. There was a slightly higher percentage of males than females (52.20% and 47.80% respectively). Married or partnered cases also made up a larger proportion of the sample than those who were single, widowed, or divorced (50.16% and 47.32%, respectively). The majority of the sample was insured through Medicare (67.07%), followed by private insurance (20.07%), then Medicaid (11.00%). The remainder of the sample

was uninsured (1.25%) or had an unknown insurance status (0.62%). The number of lung cancer diagnoses were consistent over the 6-year study time frame.

The total sample was stratified by early (n=7,472) or late (n=24,871) stage diagnosis in Table 2, illustrating significant differences among certain sociodemographic characteristics of the sample. A larger percentage of males were found to be diagnosed at a late stage than females (p-value =<.0001), with 78.64% of males and 75.00% of females being diagnosed at a late stage. A higher percentage of Blacks (78.61%) in the sample were diagnosed at a late stage than Whites or other races (76.80%), however, this relationship was not statistically significant (p-value=0.0759). There was a significant difference between average age at early and late stage diagnosis (p-value=<.0001), with the average age for late-stage diagnosis being 67.63 years old, and early being 69.51 years old. Age group was also a statistically significant variable (p-value=<.0001), with the largest percentage of late-stage diagnoses occurring in the <50 age group (84.52%). A significant relationship between Appalachian status and stage at diagnosis was demonstrated (p-value=0.0001), with a larger percentage of Appalachian cases in the sample being diagnosed at a late stage than non-Appalachian cases (78.18% and 76.27%, respectively). There was also a significant relationship between primary payer and stage at diagnosis (p-value=<.0001), with the highest percentage of late-stage diagnosis occurring in cases who were uninsured (88.12%). Marital status was not significantly related to stage at diagnosis in this sample. Year of diagnosis displayed a significant relationship with stage at diagnosis (p-value=<.0001), and the number of early diagnoses was shown to increase as year of diagnosis increased.

Multivariable logistic regression analyses for sociodemographic characteristics of the sample are summarized in Table 3. This saturated model included all variables of interest to

determine significant associations with late-stage lung cancer diagnosis. Significant associations between late-stage lung cancer diagnosis and many of the variables of interest were found.

Sex was found to be significantly associated with late-stage lung cancer diagnosis. Males (OR: 1.25, 95% CI: 1.17-1.34) had a higher odds of late-stage lung cancer diagnosis than that of females. Appalachian status was also significantly associated with late-stage lung cancer diagnosis. Appalachian cases in the sample (OR: 1.08, 95% CI: 1.02-1.16) had a higher odds of late-stage lung cancer diagnosis than non-Appalachian cases. Age group was also significantly associated with late-stage lung cancer diagnosis. Cases younger than 50 (OR: 1.68, 95% CI: 1.38-2.05) and cases aged 50-69 (OR: 1.24, 95% CI: 1.17-1.34) both had higher odds of late-stage lung cancer diagnosis than cases over 70 years of age.

Cases with Medicaid (OR: 1.33, 95% CI: 1.18-1.51) and uninsured cases (OR: 2.01, 95% CI: 1.41-2.89) were found to have higher odds of late-stage lung cancer diagnosis than those who were privately insured. Cases with Medicare were not significantly associated with late-stage lung cancer diagnosis. Cases who were single/living alone (OR: 1.08, 95% CI: 1.01-1.15) had higher odds of late-stage lung cancer diagnosis than those who were married/partnered. Cases with an unknown marital status were not significantly associated with late-stage lung cancer diagnosis.

Cases who were diagnosed from 2016 to 2019 demonstrated a significant decrease in odds of late-stage lung cancer diagnosis when compared to odds of late-stage diagnosis in 2013. The lowest odds of late-stage lung cancer were found in those diagnosed in 2019. Cases diagnosed in 2019 had a 40% decrease in odds of being diagnosed with late-stage lung cancer as compared to cases diagnosed in 2013 (OR: 0.60, 95% CI: 0.54-0.66).

Race was the only variable included in the model that did not have a significant association with late-stage lung cancer diagnosis. A second model was run without including the race variable (not shown), however, no significant differences in odds of late-stage lung cancer were found among the included independent variables.

Discussion.

When diagnosed at a later stage, lung cancer has low survival rates and high mortality rates.[13] A better understanding of the relationship between sociodemographic factors and stage at diagnosis needs to be developed to improve lung cancer morbidity and mortality. Thus, the objective of this study was to identify key demographic factors associated with late-stage lung cancer diagnosis in the state of Kentucky using data from the Kentucky Cancer Registry. Descriptive, bivariate, and multivariable analyses performed in this study demonstrated significant relationships between several key sociodemographic characteristics and late-stage lung cancer diagnosis.

Sex was found to be significantly associated with late-stage lung cancer diagnosis in the descriptive analysis performed, and males were found to have a higher odds of late-stage lung cancer diagnosis than females in the logistic regression model. Males have consistently been associated with poorer lung cancer outcomes than females in previous literature.[17,20,22,29] Males are typically diagnosed with lung cancer at a higher rate and at a later stage than females, findings that were supported by the present study as well.[17,20,22,29]

Appalachian status was also found to have a significant relationship with late-stage lung cancer diagnosis. Appalachian cases in this study were found to have higher odds of late-stage lung cancer diagnosis. Previous literature has noted higher incidence and mortality from lung cancer in Appalachian Kentucky and the region has been long known for poor health outcomes

and health disparities.[3,7,11,30] The findings of the present study indicate that Appalachian status is a contributing factor to stage at diagnosis. This could be due in part to barriers to accessing adequate healthcare and lower rates of screening among residents of Appalachia.[8,31] Future studies that examine the relationship between specific demographic factors in Appalachia and poor lung cancer outcomes could be performed to better understand why the disparities in this region exist, and which populations are most affected. Similarly, additional research that examines screening rates in Appalachian Kentucky could be done to better understand how to improve their rate of lung cancer screening and increase the rate of early diagnosis.

Primary insurance payer was found to be significantly associated with late-stage lung cancer diagnosis in the analyses. Cases in the sample who received Medicaid benefits had higher odds of late-stage lung cancer diagnosis than those who had private insurance. The relationship between cases who receive Medicaid and poor health outcomes is supported by many other studies.[22,25] Those receiving Medicaid benefits are likely to have lower socio-economic status and educational attainment, also associated with poorer cancer outcomes.[22,25] Uninsured cases in this sample were also found to have higher odds of late-stage diagnosis. Without insurance, it can be difficult and expensive to obtain necessary screening and can in turn lead to later stage diagnoses and higher rates of mortality.[25]

The data indicated that the rate of early-stage lung cancer diagnosis in Kentucky has increased during the study period. This is reflective of the recent change in the United States Preventive Services Task Force (USPSTF) lung cancer screening guidelines, and the advent of low-dose computed tomography (LDCT) for lung cancer screening. Screening for lung cancer using LDCT was first recommended by the USPSTF in 2013, and since then Kentucky has had one of the highest rates of lung cancer screening in the nation.[5,32] However, as this study

illustrates, there are still populations that can be specifically targeted for screening to improve their outcomes through earlier diagnosis. Additional research that examines the relationship between sociodemographic factors and screening rates in Kentucky can be done to better understand which populations may be underserved.

Public Health Impact.

The American Cancer Society estimates that approximately 238,000 new cases of lung cancer will be diagnosed in 2023.[13] The burden of lung cancer both in Kentucky and the United States is still significant, despite recent improvements in morbidity and mortality.[4] Through changes in guidelines for lung cancer screening and targeted interventions, the rate of early diagnosis has increased.[4] However, there are still populations that are in need of additional attention and resources to improve lung cancer outcomes, as is made evident from this study as well as previous literature. The findings of this study are in line with similar research and can be utilized to generate hypotheses for further research into the relationship of sociodemographic factors and lung cancer stage at diagnosis. Public health professionals can utilize findings from studies like this one to target these populations to improve lung cancer screening, which in turn will improve lung cancer mortality.

Strengths and limitations.

The greatest strength of this study was its data source and sample size. The Kentucky Cancer Registry (KCR) provided population-based individual case data for analysis; 32,343 cases were provided and subsequently analyzed. These data ensure that all primary lung cancer cases in the state of Kentucky with stage at diagnosis information could be included in the study sample. Thus, the findings from this study are generalizable to the population of Kentucky,

however, due to the state's unique sociodemographic makeup, it may not be generalizable to other states. A possible limitation of this study was the grouping of certain categorical variables, such as the race variable being grouped as White/Other and Black. This could possibly mask certain findings within the study, but this rationale is supported by other literature and is also necessary to ensure appropriate analysis of the data, as the number of minority cases included in the sample was very low. There were also no direct individual measures of poverty or educational attainment in the KCR dataset, and insurance status was used as a proxy measure for poverty. Another possible limitation of this study is that both small-cell and non-small cell lung cancer cases were included in analysis. These lung cancers are different biologically and behave differently. Including both together in the analysis has the potential to influence findings and should likely be analyzed separately in future studies.

Conclusion.

This study demonstrated a significant relationship between several demographic factors and late-stage lung cancer diagnosis in the state of Kentucky. The variables of sex, age, Appalachian status, marital status, and year of diagnosis were found to be significantly associated with late-stage lung cancer diagnosis in this study. Additional exploration of the relationship of sociodemographic characteristics and lung cancer screening, stage at diagnosis, incidence, and mortality can be done to best understand how to improve lung cancer outcomes in the state of Kentucky.

Table 1. Descriptive Characteristics of Sample (n = 32,343)

Variable	**n**	**%**
Stage at Diagnosis		
Early	7,472	23.10
Late	24,871	76.90
Year of Diagnosis		
2013	4,534	14.02
2014	4,568	14.12
2015	4,461	14.35
2016	4,484	13.86
2017	4,722	14.60
2018	4,632	14.32
2019	4,761	14.72
Sex		
Male	16,883	52.20
Female	15,460	47.80
Race		
White/Other	30,543	94.43
Black	1,800	5.57
Age in years		
(mean, SD)	68.07 (10.29)	
Age Group		
<50	1,124	3.48
50-69	16,290	50.37
>70	14,929	46.16
Appalachian Status		
Appalachian	10,617	32.83
Non-Appalachian	21,726	67.17
Primary Payer		
Insured	6,490	20.07
Medicaid	3,559	11.00
Medicare	21,691	67.07
Uninsured	404	1.25
Unknown	199	0.62
Marital Status		
Married/Partnered	16,224	50.16
Single	15,304	47.32
Unknown	815	2.52

Table 2. Descriptive Characteristics of Sample Stratified by Early or Late Diagnosis (n = 32,343)

	Late Diagnosis		Early Diagnosis		p-value
	n	%	n	%	
Variable					
Sex					
Male	13,276	78.64	3,607	21.36	<.0001
Female	11,595	75.00	3,865	25.00	
Year of Diagnosis					
2013	3,679	81.14	855	18.86	<.0001
2014	3,686	80.69	882	19.31	
2015	3,686	79.42	955	20.58	
2016	3,504	78.14	980	21.86	
2017	3,558	75.35	1,164	24.65	
2018	3,346	72.24	1,286	27.76	
2019	3,412	71.65	1,350	28.35	
Race					
White/Other	23,456	76.80	7,087	21.91	0.0759
Black	1415	78.61	385	21.39	
Age in years					
(mean, SD)	67.63 (10.42)		69.51 (9.69)		<.0001
Age Group					
<50	950	84.52	174	15.48	<.0001
50-69	12,880	79.07	3,410	20.93	
>70	11,041	73.96	3,888	26.04	
Appalachian Status					
Appalachian	8,300	78.18	2,317	21.82	0.0001
Non-Appalachian	16,571	76.27	5,155	23.73	
Primary Payer					
Insured	5,045	77.73	1,445	22.27	<.0001
Medicaid	2,961	83.20	598	16.80	
Medicare	16,345	75.35	5,346	24.65	
Uninsured	356	88.12	48	11.88	
Unknown	164	82.41	35	17.59	
Marital Status					
Married/Partnered	12,414	76.52	3,810	23.48	0.1584
Single	11,839	77.36	3,465	22.64	
Unknown	618	75.83	197	24.17	

Table 3. Factors Associated with Late-Stage Diagnosis (Multivariable Logistic Regression Model)

	Late-Stage Diagnosis	
Variable	**OR (95% CI)**	**p-value**
Sex		
Male	1.25 (1.17-1.34)	<.0001
Female	1 (ref)	
Year of Diagnosis		
2013	1 (ref)	
2014	0.97 (0.87-1.00)	0.6389
2015	0.90 (0.81-1.00)	0.0577
2016	0.84 (0.75-0.93)	0.0012
2017	0.72 (0.64-0.80)	<.0001
2018	0.61 (0.55-0.68)	<.0001
2019	0.60 (0.54-0.66)	<.0001
Race		
White/Other/Unknown	1 (ref)	
Black	0.91 (0.80-1.03)	0.1299
Age Group		
<50	1.64 (1.36-1.96)	<.0001
50-69	1.25 (1.17-1.33)	<.0001
>70	1 (ref)	
Appalachian Status		
Appalachian	1.08 (1.02-1.15)	0.0083
Non-Appalachian	1 (ref)	
Primary Payer		
Insured	1 (ref)	
Medicaid	1.36 (1.21-1.53)	<.0001
Medicare	0.99 (0.91-1.06)	0.6128
Uninsured	1.86 (1.34-2.57)	0.0002
Unknown	1.40 (0.94-2.07)	0.2182.
Marital Status		
Married/Partnered	1 (ref)	
Single	1.08 (1.02-1.15)	0.0048
Unknown	0.90 (0.75-1.07)	0.3623

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