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Research Article

Smoking and Stroke in Appalachian Kentucky

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ABSTRACT

This project used a retrospective case series design to investigate factors associated with stroke in a rural area in Appalachian Kentucky. The south-eastern region of the U.S. is often referred to as the 'stroke belt,' and includes the Appalachian region of the state of Kentucky. Data were collected from medical records of patients from a neurology practice and regional hospital with a diagnosis of stroke from March 2012 through November 2015. Data were collected without personal identifiers and included demographic characteristics, stroke type, treatments received, and referrals for additional care including rehabilitation. Data from a total of 84 stroke cases diagnosed between March 2012 and November 2015 were included. Of the 84 cases, 46 (54.8%) were female and all but one was Caucasian. The distribution by race is consistent with the population of the region. The stroke cases ranged in age from 41 to 92 (M=66.3) and the age at stroke diagnosis ranged from 40 to 90 (M=65.7). Fourteen (16.7%) had evidence of a previous stroke at diagnosis. For smokers, the mean age at diagnosis was 62.7 for smokers while for non-smokers it was 67.5. The study reported smoking rates that were nearly three-times the national average, and the smokers in this study were found to have stroke onset approximately five-years earlier than non-smokers. The results from this case series support the need for further investigation on stroke prevalence and factors contributing to continued risk for stroke in Appalachia.

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Introduction

Stroke is the fifth leading cause of death in the United States and a major cause of severe long-term disability [1, 2]. There are approximately 800,000 new strokes and 130,000 stroke deaths each year, or approximately one new stroke death every four minutes. While stroke occurs in all areas of the U.S., the south-eastern region has the highest incidence and mortality rates. This region of the country is often referred to as the "stroke belt," and includes the state of Kentucky.³ In Kentucky, heart disease and stroke are the leading causes of death and disability with rates higher than the national average. The rural Appalachian counties in the eastern part of the state have the highest rates. [4, 5].

The Appalachian Regional Commission (ARC) defines the Appalachian region as stretching across 13 states from southern New York to northern Mississippi and is home to an estimated 25 million people [6]. In Kentucky, 54 of the 120 counties are considered part of Appalachia. These counties are mostly rural with abundant natural resources and beauty, but with a population that, compared to the rest of the state, has higher rates of poverty, lower educational attainment, lower standards of living, reduced access to medical care, and significant health disparities [7-9]. The economic and social inequity in Appalachian communities leaves the individuals living in this region highly vulnerable to chronic diseases [10]. Health-related characteristics of the region include elevated rates of cancer incidence and mortality, stroke mortality, heart disease and cardiac mortality, obesity, and diabetes [11]. Individuals

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who are older in age, have a family history of stroke, male, and/or belonging to an ethnic minority are at a higher risk for stroke [12]. For the Appalachian Kentucky region specifically, common stroke risk factors include lack of physical exercise, tobacco use, and high-calorie and high-fat nutritional consumption [13]. Not only do these negative social and behavioral determinants of health contribute to the high incidents of stroke and other cardiac-related diseases, they also play a large role in hindering rehabilitation after a stroke [14]. Region-specific cultural values in Appalachia, such as fatalism and resiliency, are also suspected to influence stroke aftercare and quality of life.

Learning about health disparities and the differences based on geographic characteristics is important in several ways. For instance, examining the geographical patterns of health disparities can provide valuable information about the social conditions and structures that influence well-being [10]. Moreover, it gives insight into the mechanisms that impact physical health and disease outcomes [13]. There are relatively few reports on stroke in Appalachian Kentucky and no known case series reports describing stroke occurrence and its aftermath. This report describes a case series of strokes in Appalachian Kentucky and compares findings with broader state and national stroke data. The project was reviewed and approved by the University of Kentucky Office of Research Integrity.

Methods

This project used a retrospective case series design. Cases with a diagnosis of stroke from March 2012 through November 2015 were identified from a neurology practice and regional hospital that serve a large area of eastern Kentucky, all of which is classified as within Appalachia by the Appalachian Regional Commission. The catchment area for the practice and hospital include parts of Kentucky, Virginia, West Virginia and Tennessee. Data for the project were obtained from review of medical records of patients with a diagnosis of stroke seen as hospital patients and as outpatients. Data were collected without personal identifiers and included demographic characteristics, stroke type, treatments received, and referrals for additional care including rehabilitation. Medical record abstractors were trained prior to data collection and were encouraged to bring questions to the attention of the investigators during data collection. For quality control in abstracting the medical records, a 10% random sample was selected and re-reviewed.

Results

Data were collected from a total of 84 stroke cases diagnosed between March 2012 and November 2015. Of the 84 cases, 46 (54.8%) were female and all but one was Caucasian. The distribution by race is consistent with the population of the region. The stroke cases ranged in age from 41 to 92 ($M=66.3$) and the age at stroke diagnosis ranged from 40 to 90 ($M=65.7$). Fourteen cases (16.7%) had evidence of a previous stroke at diagnosis. Table 1 presents the study population characteristics. As Table 1 shows, the study population was relatively balanced by gender and the distribution of insurance coverage is consistent with the age distribution of the study population. However, the 41.5% smoking rate was substantially higher than the national and state rates. The CDC estimated the U.S. smoking rate to be 15.1% in 2015, a rate that is over

25 percentage points lower than the Kentucky rate [15]. For smokers, the mean age at diagnosis was 62.7 compared to 67.5 for the non-smokers.

Table 1: Study Population Characteristics (N=84)*

	n(%)
Age	M=66.3 (SD=12.1)
≤50	9 (10.7%)
51-60	20 (23.8%)
61-70	21 (25%)
71+	34 (40.5%)
Gender	
Female	46 (54.8%)
Male	38 (45.2%)
Insurance	
Medicaid	13 (15.5%)
Medicare	44 (52.4%)
Medicaid and Medicare	3 (3.6%)
Private	24 (28.6%)
Smoking Status	
Smoker	34 (41.5%)
Non-smoker	48 (58.5%)
Comorbidities	
2 or less	36 (42.9%)
3 or more	48 (57.1%)
Disability Status	
Not disabled	39 (46.4%)
Disabled due to stroke	35 (41.7%)
Disabled not due to stroke	4 (4.8%)

*Totals may vary from 84 due to missing data

Stroke characteristics are presented in Table 2 and show that majority of participants had no prior evidence of stroke (82%), and most of the strokes captured were characterized as “Minor” (44%) or “Moderate” (50%). Ischemic strokes (89%) were significantly more common than hemorrhagic strokes (1.2%); while the location of the strokes was dispersed relatively evenly between the right- and left-brain hemispheres.

Table 2: Stroke Characteristics

	n(%)*
Type	
Ischemic	76 (92.7%)
Hemorrhagic	6 (7.3%)
Location	
Left	38 (45.2%)
Right	36 (42.9%)
Other	10 (11.9%)
Previous Stroke Evidence (Yes)	14 (16.7%)
NIH Score	
1-4 (Minor)	37 (44%)
5-15 (Moderate)	42 (50%)
16-20 (Moderate/severe)	3 (3.6%)
21+ (Severe)	2 (2.4%)

*Totals may vary from 84 due to missing data

Stroke discharge destination by severity is shown in Table 3. Two patients expired prior to discharge. Of the remaining patients, over half (55.8%) were discharged home with smaller percentages, 22.6% and 13.1%, respectively, discharged to inpatient rehabilitation or another unspecified destination.

Table 3: Discharge Destination by Severity (NIH Score)

Stroke Severity	Home	Nursing Home	Inpatient Rehab	Other NOS	Total
Minor	26 (70.3%)	3 (8.1%)	2 (5.4%)	6 (16.2%)	37 (44.0%)
Moderate	21 (47.7%)	3 (6.8%)	16 (36.4%)	4 (9.1%)	44 (52.4%)
Moderate /Severe	1 (33.3%)	0	1 (33.3%)	1 (33.3%)	3 (3.6%)
Severe	0	1 (100%)	0	0	1 (1.2%)
Total	48 (55.8%)	7 (7.0%)	19 (22.6%)	11 (13.1%)	84

Discussion

The findings of this study provide several observations regarding patterns of stroke occurrence in eastern Kentucky. While the distribution by type of stroke is consistent with national data, the average age at diagnosis is somewhat lower with approximately 34% being diagnosed before age 61. In addition, it appears that there is an interaction between age at diagnosis and smoking. In our data, the mean age at diagnosis was 62.7 for smokers while for non-smokers it was 67.5. Cigarette smoking is a well-established risk factor for stroke, and that appears to be consistent with the findings in this study. The study sample reported smoking rates that were nearly three-times the national average, and self-identified smokers were found have stroke onset approximately five-years earlier than non-smokers. This finding provides further evidence that smoking is associated with an increased risk for stroke and perhaps well as earlier onset of stroke. More specifically, ischemic strokes have been found to be more likely to lead to stroke among smokers. Our study supports this finding; where, nearly three-fourths of the strokes reported were ischemic, which is compelling evidence when coupled with the high smoking prevalence in this sample. The smoking rate in Kentucky is among the highest in the U.S., and the rate of smoking in the Appalachian region is highest in the Commonwealth. The results from this case series support the need for further investigation on stroke prevalence and factors contributing to continued risk for stroke in Appalachia.

Socioeconomic status has also been identified as a moderating factor regarding smoking rates and stroke risk [16]. The Appalachian region has been identified as an economically distressed region, and adults with less than a bachelor's degree, who are poor, or near poor are more likely to be smokers [6, 17]. About twenty-percent of this sample reported being on Medicaid or a combination of Medicaid and Medicare, which may display a linkage between socioeconomic status, smoking, and stroke rates in this sample.

Characterized as being a part of the "stroke belt," Appalachia is a region in continued need of effective prevention and intervention programs. Referral to rehabilitation is particularly problematic for many individuals living in this region, as transportation and availability to local services in Appalachia pose a barrier to care [18]. Future research on factors associated with stroke occurrence and prevention, with specific attention to comorbid conditions such as diabetes, would benefit health care providers and community leaders working in the Appalachia region.

Overall, over 60% of the patients received rehabilitation services. By severity score, 48.6% with minor strokes, 21.4% with moderate, 66.7% with moderate/severe, and 50% of those with severe strokes received rehabilitation.

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