Geographical Disparities of Lung Cancer Mortality Centered on Central Appalachia

Timothy S. Hare, School of Public Affairs, Morehead State University, Morehead, KY, USA
Chad Wells, Morehead State University, Morehead, KY, USA
Nicole Johnson, Morehead State University, Morehead, KY, USA

ABSTRACT

This article explores regional disparities in lung cancer mortality for females and males and associated factors across central Appalachia and surrounding regions. It asks, how are lung cancer mortality rates distributed geographically, what are the relative contributions of specific factors to lung cancer disparities by sex, and how do the effects of these factors vary across the study area? This study is based on county-level data of potential determinants of disease to explore local effects on lung cancer mortality. It analyzes these data using a combination of spatial statistical analyses. The analysis shows that the spatial clustering of high lung cancer mortality rates differs for females and males. Additionally, the factors associated with lung cancer for females and males differ greatly. For instance, tobacco use is associated with male lung cancer mortality, but not with female lung cancer mortality. These factors also vary in their geographical relationships with female and male lung cancer mortality.

Keywords: Appalachia, Geographical Disparities, Health Disparities, Spatial Statistics

INTRODUCTION

We explore factors influencing geographical disparities in lung cancer mortality for females and males across central Appalachia and the surrounding area. Previous research reveals elevated mortality rates for a variety of causes clustered in Appalachian Kentucky and adjacent portions of West Virginia, Virginia, and Tennessee. In addition, high rates of lung cancer and related respiratory diseases in central Appalachia have been generally assumed to result from tobacco use and coal mining. These factors, however, are interconnected with restricted access to health care providers and measures of socioeconomic deprivation, such as high levels of poverty and unemployment, and low levels of educational attainment. While some of these factors have been investigated previously, their geographical distributions have received less

DOI: 10.4018/ijagr.2014100103
attention. Hence, our primary research ques-
tions are, how are lung cancer mortality rates
distributed across central Appalachia, what are
the relative contributions of specific factors that
influence lung cancer disparities by sex, and
how do the effects of these factors vary across
the study area?

Our analysis reveals a complex pattern of
clustered high rates of lung cancer mortality
across the study area with the largest cluster
centered in eastern Appalachian Kentucky.
Surprisingly, the rate of tobacco use and em-
ployment in mining activities are not significant
factors influencing the clusters of elevated lung
cancer mortality rates in these areas. The size of
the effects of particular factors also varies across
the study area. For instance, physical inactiv-
ity is a primary factor in central Kentucky, but
less so in rural western and eastern Kentucky.
Similarly, the geographical clustering of high
lung cancer mortality rates and the associated
factors differ for females and males across
the study area. Specifically, tobacco use is a
significant factor for male, but not for female
lung cancer mortality.

To facilitate geographical analysis, this
study is based on county-level data of lung
cancer mortality rates and a wide variety of
measures of potential determinants of lung
cancer mortality. We analyze these data using a
combination of traditional and spatial statistical
techniques. Descriptive statistics and spatial
descriptive statistics provide the initial evalua-
tion of variables and a way to assess the degree
of spatial autocorrelation of specific factors.
OLS regression and spatial regression provide
the means to test the global model linking lung
cancer mortality and potential determinants.
Geographically weighted regression calculates
regression coefficients for all locations in the
study area and reveals geographical variation
in the relationships connecting the independent
variables with lung cancer mortality.

The geographical disparities evident in
health outcomes in Appalachia and in the other
variables used in the study necessitate the use
of spatial analytical techniques. Conclusions
drawn from standard statistical analysis of
spatial data are often flawed, because the inde-
pendence of observations and the homogeneity
of variance cannot be reliably assumed. Until
recently, however, few techniques existed to
simultaneously assess complex spatial patterns.
These analytical techniques have revolution-
ized the way researchers explore numerous
subjects (Hochberg, Earle, & Miller 2000),
including poverty (Hall, Malcom, & Piwowar,
2001), education (Clarke and Langley, 1996),
economics (Gamper-Rabindran, 1996), health
(Gatrell, 2002; Gatrell & Senior, 1999; Meade
& Earickson, 2000; Ricketts, 2003), the envi-
ronment (de Savigny & Wijeyartne, 1995;
Lyon & McCarthy, 1995), and policy (Birkin,
Clarke, & Clarke, 1999; Rushton, 2001). GIS
allows analysts to explore relationships that are
difficult to study using traditional techniques.
In public health, spatial analytical techniques
encourage research on the “quantitative analysis
of health-related phenomena in a spatial set-
ting” (Gatrell & Senior, 1999, pg. 925) through
disease mapping, risk assessment, and disease
clustering (Cromley, 2003; Elliot et al., 2000).
These techniques enhance health geography
research through spatial regression (Fother-
ingham et al., 2002), boundary analysis, and
space-time analysis (Jacquez et al., 2000). These
techniques hold promise for better understand-
ing the factors influencing disease disparities
and geographical variation.

Epidemiological studies identify a complex
set of interacting factors that influence health
status generally and lung cancer incidence
and mortality specifically. Smoking is the leading
contributor to lung cancer morbidity rates,
causing incidence rates to increase nine times in
smokers over nonsmokers (Raaschou-Nielsen,
Ole et al., 2011). Smoking also has lasting
effects with studies showing that even former
smokers have over twice the risk of lung can-
cer as lifelong nonsmokers (Alavanja, et al.,
2011). Similarly, asbestos exposure has odds
ratios ranging from 1.88 to 2.0 (Alavanja, et al.,
2011; Cassidy, et al., 2008).

Less directly, an individual’s socioeco-
nomic status can affect health outcomes through
many pathways, such as limited access to af-
Related Content

An Examination of Job Titles Used for GIScience Professionals
[www.igi-global.com/chapter/examination-job-titles-used-giscience/63596?camid=4v1a](www.igi-global.com/chapter/examination-job-titles-used-giscience/63596?camid=4v1a)

Application of a GIS-Based Statistical Method to Access Spatio-Temporal Changes in Breast Cancer Clustering in the Northeastern United States
Daikwon Han and Peter A. Rogerson (2003). *Geographic Information Systems and Health Applications* (pp. 114-138).
[www.igi-global.com/chapter/application-gis-based-statistical-method/18838?camid=4v1a](www.igi-global.com/chapter/application-gis-based-statistical-method/18838?camid=4v1a)

Requirements for Model Server Enabled Collaborating on Building Information Models
[www.igi-global.com/article/requirements-model-server-enabled-collaborating/75132?camid=4v1a](www.igi-global.com/article/requirements-model-server-enabled-collaborating/75132?camid=4v1a)