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Positive and Negative Deviant Counties: Identification of Factors Associated with Health Outcomes

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Positive and Negative Deviant Counties:

Identification of Factors Associated with Health Outcomes

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ABSTRACT

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Rural counties in the United States vary drastically on metrics related to socioeconomic status and dominant economic industry as well as health behaviors and outcomes. This study sought to understand the underlying structural reasons why some rural counties have better or worse than expected health outcomes using a positive deviance (PD) approach. The study aimed to: 1) create an area deprivation index and divide counties into quartiles using the index; 2) identify positive, negative, and non-deviant counties using health outcome metrics; 3) analyze differences between deviance on a variety of local public health system metrics; and 4) analyze differences between deviance on a variety of health service system metrics. All data were secondary, with data on public health systems derived from NACCHO's 2016 National Profile of Local Health Departments (LHDs) and data on healthcare systems derived from HRSA's 2016-2017 Area Health Resource File. Multivariate analysis, nonparametric analysis, and multinomial logistic regression were conducted. Results indicated that public health systems in positive deviant counties were more likely to have their next year's budget exceed their current budget compared to negative and non-deviant counties. Public health systems in negative deviant counties had much lower rates of completed community health assessments, community health improvement plans, and strategic plans. LHDs overseen by their local government were 6.20 (p=.001) times more likely to be positive deviant, and negative deviant counties were much less likely (OR=0.12, p<.001) to have a local government structure compared to non-deviant counties.

Local healthcare system analysis found high rates of health professional shortage areas for mental health professionals in all deviance categories and quartiles. Positive deviant counties were 2.98 ($p<.001$) times more likely to have higher physician per capita rates (> 17.28 physicians per 10,000 population), while negative deviant counties were less likely (OR=.35, $p<.001$) compared to non-deviant counties. However, negative deviant counties exhibited higher nurse practitioner per capita rates (OR=1.47, $p=.38$) compared to non-deviant counties. Future research should continue using the PD approach for population-level studies and seek to understand which components of local public health and healthcare systems are associated with better population health.

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TABLE OF CONTENTS

LIST OF TABLES

Chapter 1. Introduction

Background

Within the United States (US), vast differences in health outcomes exist at local, state, and regional levels and between rural and urban populations. Many of these differences can be linked to health disparities attributable to historic economic and social inequities. Egen et al. (2017) explored this association in their study titled, "Health and Social Conditions of the Poorest Versus Wealthiest Counties in the United States". While many of the findings reinforced previously identified correlations between socioeconomic status and health outcomes, several unexpected and interesting results emerged. All counties in the US were ranked based on 5-year median household income and then divided into 50 subgroups (Egen et al., 2017). Within these subgroups, vast discrepancies in female and male life expectancy, years of potential life lost, prevalence of poor or fair health, and diabetes were discovered. It became clear that certain counties experienced health outcomes that were unexpectedly positive and others experienced health outcomes that were unexpectedly negative, based on subgroup level income of the county.

The focus of this dissertation research was on rural counties that perform better than or worse than expected on a myriad of health measures. Urban and rural counties perform quite differently in terms of health services and local public health systems, which makes identification of both rural and urban positive and negative deviant counties difficult (i.e., in subgroups, there would be relatively few rural, positive deviant counties in a selection of both rural and urban counties). Therefore, in order to compare 'like' counties to 'like' counties, we only examined rural counties in this study. Rural counties were of particular interest, because higher rates of lung cancer, diabetes, heart disease, and intentional injuries have resulted in lower life expectancies in many rural locations (Singh & Siahpush, 2014).

A positive deviance (PD) framework was utilized to identify counties performing better than or worse than expected. PD primarily focuses on identification of positive behaviors, attributes, or features that confer a benefit; however, the method can also be used to identify negative behaviors, attributes, or features that can be detrimental. PD is an innovative methodology that has recently been gaining popularity in public health research and practice. Several health metrics were used to identify those counties that were experiencing better than and worse than expected health outcomes including: male and female life expectancy; years of potential life lost; prevalence of fair or poor health; and number of poor physical health days.

Counties were compared to peer counties by dividing all US counties into four subgroups using an area deprivation index. Instead of determining subgroups based upon one metric, such as median household income or poverty level, an index was created using several material and social factors to assure similarity between peer counties. These measures helped ensure that deviant counties, those that perform better or worse than expected, are deviant not because of economic advantages of their constituents, but for some, heretofore unidentified reason. Positive and negative deviant counties were compared to each other and to non-deviant counties in each subgroup to identify differences in health services and local public health systems that may explain their differing health outcomes.

Statement of the Research

Why are some rural counties more or less healthy than others with similar levels of material and social deprivation?

Purpose of the Research

1) Create an area deprivation index and divide counties into quartiles accordingly.
2) Identify positive, negative, and non-deviant counties using health outcome metrics.

3) Analyze differences between positive deviant vs. non-deviant counties and negative deviant counties vs. non-deviant counties on a variety of local public health system metrics.
4) Analyze differences between positive deviant vs. non-deviant counties and negative deviant counties vs. non-deviant counties on a variety of health service system metrics.

Rural Disparities

Disparities in Rural Areas

As of July 2019, there were over 328.2 million people living in the US (United States Census Bureau, 2019) of which 46.1 million people, roughly 14%, lived in rural (non-metropolitan) counties (Cromartie et al., 2020). The number of people living in rural America has held relatively steady for the past decade (Cromartie et al., 2020) despite the emigration of many white residents, which is mostly attributable to historically under-represented population increases in rural areas (Lichter & Johnson, 2020). Lichter and Johnson (2020) found that Latino population growth in rural counties was often the deciding force of whether a rural counties' population grew or declined.

Rural counties have a poverty rate that is higher, 16.1%, than urban counties, 12.6% (Cromartie et al., 2020), and rural Americans are older (Choi, 2012; Cromartie et al., 2020; Goins et al., 2005; Harris & Leininger, 1993; Probst et al., 2002) than their urban counterparts. Rural Americans also have lower levels of education when compared to their urban counterparts, but over the past two decades, these differences have been declining (United States Department of Agriculture [USDA], 2021). From 2000 to 2019, the proportion of rural residents with a bachelor's degree or higher increased from 15% to 21%, while the proportion that had less than a high school diploma or equivalent decreased from 24% to 13% among adults aged 25 or older (USDA, 2021). However, when compared to urban residents, differences in educational attainment still exist; 21% of rural adults have a bachelor's degree or higher compared to 35% of urban adults (USDA, 2021). These factors (i.e., poverty, education, a growing number of residents from marginalized groups, and an aging population) contribute to the vulnerability of rural Americans.

In order to better understand rural health and to create goals to improve health in rural areas, the U.S. Department of Health and Human Services, Office of Disease Prevention and Health Promotion created Rural Healthy People. The first iteration was Rural Healthy People 2010, and the current iteration is Rural Healthy People 2020 (Rural Healthy People 2030 is under development currently). As part of Rural Healthy People 2020, the top ten rural health priority areas were identified. A nationally disseminated survey found that the top health issues were: 1) access to healthcare; 2) nutrition; 3) diabetes; 4) mental health issues; 5) substance abuse; 6) heart disease and stroke; 7) physical activity; 8) older adult issues; 9) maternal and child health; and 10) tobacco use (Bolin et al., 2015).

These top health issues are backed by a significant number of studies that show rural populations often experience higher rates of unintentional injuries, obesity, and cardiovascular disease (Deligiannidis, 2017; Probst et al., 2002) and worse health outcomes compared to urban residents (Deligiannidis, 2017; Douthit et al., 2015), culminating in shorter life expectancies which have not increased relative to urban areas over the past three decades (Singh & Siahpush, 2014). Additionally, significant differences in Years of Potential Life Lost (YPLL) exist between comparable rural and urban counties (Hale et al., 2018).

Some preventive services that are associated with numerous health behaviors and health outcomes, including cholesterol screenings, breast exams, mammograms, and pap tests, are less likely to be utilized in rural areas as compared to urban areas (Arcury et al., 2005; Arcury et al., 2004; Casey et al., 2001; Chan et al., 2007; Harris & Leininger, 1993; Probst et al., 2002). To compound this issue, residents of rural counties tend to be older, (Choi, 2012; Cromartie et al., 2020, Goins et al., 2005; Harris & Leininger, 1993; Probst et al., 2002) signifying that many of the preventive screenings, with age-specific recommendations, should happen more frequently in rural areas.

Probst et al. (2002) found that, in ambulatory care settings, urban practices had higher rates of diet, tobacco, exercise, and injury prevention counseling, while blood pressure measurements, cholesterol screenings, breast exams, and urinalysis were provided less frequently in rural practices. Casey et al. (2001) found similar differences in preventive care utilization rates between rural and urban areas. They found significantly lower utilization, in rural areas, of the following recommended services: fecal occult blood tests (screen for colon cancer), proctosigmoidoscopy, mammograms, and pap tests. The only preventative care that did not differ between rural and urban areas was the rate of influenza and pneumonia vaccinations for adults over 65 years of age (Casey et al., 2001). In addition to these worse economic and health outcomes, rural counties tend not to perform as well as urban counties on a number of local public health and heath care system factors.

Local Public Health Systems in Rural Areas

One of the main purposes of the current study was to compare potential differences in local public health system metrics between rural counties that were positive and negative deviants versus non-deviant. Local health departments (LHDs) are vital in protecting a community's health and date back to the 1798 public health office in Baltimore (Berkowitz, 2004). Today, public health in the US fulfills three core functions (assessment, policy development, and assurance) as outlined by the Institute of Medicine's report on The Future of

Public Health (Institute of Medicine [IOM], 1988) and ten essential services (Public Health Functions Steering Committee, 1994) originally created in 1994 and updated in 2020 (The Public Health National Center for Innovations, 2020). The updated ten essential public health services are similar to the original services with expansion in both language and scope of each service as well as the inclusion of equity at the center of all the public health services.

Key to the fulfillment of these functions is the infrastructure of local and state public health departments including workforce and organization capacity, workforce competence, and information systems (Berkowitz, 2004). Additionally, in many locales, especially rural areas, public health departments continue to provide direct care to meet the needs of the population (Berkowitz, 2004; Harris et al., 2016). Throughout the US, there is significant variation among local health departments in infrastructure, provision of services, workforce, budgets, and revenue sources, and it will be important to ascertain what differences in local public health systems exist between positive and negative deviant counties.

The US public health system is complex and includes state, regional, local, and tribal public health departments (governmental and non-governmental) with various structures of authority (Hyde & Shortell, 2012). Governmental public health in the US consists of 51 state, 2,794 local, and 565 tribal public health departments/agencies (Hyde & Shortell, 2012): 14% of states have a centralized authority structure, 61% have decentralized, and 24% have a mixed or shared authority for LHDs (National Association of County & City Health Officials [NACCHO], 2020). Many LHDs in states with decentralized authority, and some LHDs in states with centralized, have local boards of health that hold an advisory role, and it has been found that LHDs' ability to fulfill their responsibilities is positively associated with having a local board of health (Hyde & Shortell, 2012). Additionally, decentralized LHDs spend, on average, 25% more than their peer centralized LHDs (Hyde & Shortell, 2012).

Utilizing the ten essential public health services as a framework to gauge health departments' performance has been common since their development (Corso et al., 2000). Hyde and Shortell's (2012) systematic review identified several infrastructure indicators that predict how well LHDs are at providing the ten essential public health services: size of jurisdiction (larger jurisdictions perform better than smaller ones), staffing patterns (LHDs with more staff, comparatively, perform better), local boards of health (jurisdictions with boards of health perform better), per capita spending (higher rates are associated with better performance) and partnerships with outside organizations (jurisdictions that collaborate perform better). They found that LHD authority structure provided inconclusive evidence as to what structure is associated with better performance (Hyde & Shortell, 2012). Erwin's (2008) literature review of characteristics associated with LHD performance found size of jurisdiction (larger jurisdictions perform better than smaller ones), staffing patterns (LHDs with more staff perform better), expenditures (LHDs perform better with higher total expenditures and per capita expenditures), partnerships with community (jurisdictions that collaborate perform better), and having executives with advanced academic degrees (jurisdictions performed better when leaders had higher degrees) to be important. Bhandari et al. (2010) found associations between several indicators and performance by LHDs: size of jurisdiction/population size (larger jurisdictions perform better than smaller ones), local boards of health (jurisdictions with no boards of health perform better), LHDs having an executive with a doctoral degree (medical and nonmedical) or a degree in nursing (jurisdictions with these degrees performed better), and jurisdiction type. It was found that 8 to 32% of the variance in performance of the individual essential public health services and overall performance was accounted for by the system and community characteristic variables included in the analysis (i.e., population size, jurisdiction type, existence of local board of health, and LHDs having an executive with a doctoral or nursing degree) (Bhandari et al., 2010).

Overall, findings have been mixed when it comes to provision of the ten essential public health services by rural LHDs; in the provision of some of these activities, rural LHDs perform as well as their urban counterparts, but for other activities, they perform worse (Harris et al., 2016). Therefore, it is imperative to understand how positive and negative deviant counties differ from non-deviant counties in regards to public health system indicators; it may be the case that positively and negatively deviant counties are drastically different. This is important in rural areas since local public health performance has been positively associated with county health status (Hyde & Shortell, 2012).

There are significant differences between rural and urban public health agencies that make the delivery of public health services more difficult in rural areas: lower funding levels (Beatty et al., 2010; Berkowitz, 2004; Hajat et al., 2003), difficultly in recruiting and retaining staff (Berkowitz, 2004; Hajat et al., 2003), fewer staff (Beatty et al., 2010; Rosenblatt et al., 2002), large geographic areas with limited transportation (Berkowitz, 2004), and limited access to technology (Harris et al., 2016). All LHDs offer a variety of services, but urban LHDs tend to offer more services than their rural counterparts (Beatty et al., 2010). However, direct patient services are often offered in rural areas because there are unmet needs driven by either an absence or lack of other providers in the community (Berkowitz, 2004; Harris et al., 2016). For instance, 81% of rural health departments provide adult and child immunizations, while only 65% and 64% of urban department provide these services, respectively (Berkowitz, 2004). The provision of these direct health care services is often a sizable portion of rural LHDs' revenue compared to urban LHDs (Hajat et al., 2003; Harris et al., 2016; Hyde & Shortell, 2012). Rural health departments also provide several other essential public health services at higher levels than urban health departments; for instance, 66% of rural and 54% of urban health departments perform community assessments, while 75% of rural and 62% of urban LHDs offer community education (Berkowitz, 2004).

Rural public health departments tend to lack variation in personnel that is seen in urban health departments (Beck & Boulton, 2015; Hajat et al., 2003; Harris et al., 2016; Rosenblatt et al., 2002); the majority of the rural workforce consists of public health nurses with few health educators, epidemiologists, nutritionists, or social workers. Additionally, Rosenblatt et al. (2002) found that rural public health workers are less likely to be formally trained in public health, instead learning on-the-go, and the rural workforce tends to rely on part-time employees. Hajat el al. (2003) found, in a nationwide survey, that public health nurses were the most needed health professional in both rural and urban LHDs and that rural LHDs spend more of their continuing education training on clinical staff (as opposed to non-clinical staff). In Beck and Boulton's (2015) study on public health workforce changes between 2010 and 2013, they found that rural LHDs had no changes in the number of full-time equivalent staff and no changes in any occupation category, even though many state and LHDs underwent budgetary changes between these times. Rural LHDs are also funded at lower levels compared to urban LHDs (Beatty et al., 2010; Berkowitz, 2004; Hajat et al., 2003), which is problematic since it has been found that LHDs that receive more federal and state funding actually increase their funding at the local level (Bernet, 2007).

There are several strategies that LHDs can undertake to ensure efficient and effective delivery of public health services. Collaboration is the primary model that can be used to ensure the delivery and planning of services even in constrained environments (Beatty et al., 2010; Berkowitz, 2004). Partnerships with public and private sector community organizations can extend the services LHDs can offer and ensure that duplication of services within communities is limited (Beatty et al., 2010). Usual partners include schools, faith communities, non-profit organizations, health insurers, health-related organizations, and businesses (Beatty et al., 2010). In addition to streamlining direct service provision in communities, collaboration allows for information sharing with partners and the broader community, identification of difficult to reach populations, coordination of health programs, and completion of community health assessments (CHAs) (Beatty et al., 2010). Carlton and Singh (2015) found that the size of population served (a correlate for rurality in the study) was associated with LHD collaboration with hospitals on CHAs; LHDs currently collaborating and discussing collaboration for CHAs had median populations double the size of LHDs not engaged in collaborations with hospitals. Beatty et al. (2010) found that rural LHDs tend to have fewer partners in each type of partnership they investigated (information sharing, working, and financial partnerships), and working partnerships mediate the relationship between provision of services and resources – meaning that partnerships are important to the provision of services, especially when LHDs lack resources.

Health Service Systems in Rural Areas

Another focus of the current study was to compare potential differences in health service system metrics between rural counties that were positive and negative deviants versus non-deviant. To compound the public health issues found in rural areas, highlighted in the above section, many rural areas are also medically underserved (Morelli, 2017) which limits the potential for individuals to access health services. There is evidence that preventive services, which are an integral part of health care in the US, are not utilized as frequently in rural areas as in urban areas (Arcury et al., 2005; Arcury et al., 2004; Casey et al., 2001; Chan et al., 2007; R. Harris & Leininger, 1993; Probst et al., 2002). Access and utilization of health care services are linked concepts, in that, the inability to access services results in lower levels of utilization; indeed, the inability to access services and the lack of preventive care utilization share many of the same risk factors.

One of the most important dimensions of health care systems is access to services. Some of the most prominent access issues in rural areas include shortages in the number of primary care physicians (Brundisini et al., 2013; Deligiannidis, 2017; Douthit et al., 2015; Goins et al., 2005; Harris & Leininger, 1993; Weinhold & Gurtner, 2014; Woods et al., 2003), scarcity of clinics and hospitals (Douthit et al., 2015), lower levels of insurance coverage (Douthit et al., 2015; Goins et al., 2005), and rural culture (Brundisini et al., 2013; Douthit et al., 2015; Goins et al., 2005; Weinhold & Gurtner, 2014). Additionally, perceptions of prejudice by health care providers (Douthit et al., 2015; Goins et al., 2005), financial burden due to cost (Douthit et al., 2015; Goins et al., 2005; Weinhold & Gurtner, 2014), and transportation difficulties (distance to facilities, lack of public transportation, and lack of driver's license) (Brundisini et al., 2013; Douthit et al., 2015; Goins et al., 2005; Weinhold & Gurtner, 2014) can also affect access to services.

While health care provider shortages are a familiar issue which directly affects individuals' ability to access services, secondary issues attributable to shortages also exist. Harris and Leininger (1993) found that while both rural and urban primary care physicians tend to work the same number of hours each week, primary care physicians in rural areas were conducting an average of 14.3 more office visits each week. Therefore, beyond just a shortage of primary care physicians, is the issue of providers spending less time with patients. A systematic review of rural access issues in developed countries by Weinhold and Gurtner (2014) also found the majority of studies identified provider shortages and subsequent higher caseloads of health care professionals to be the largest access issue. Larger patient caseloads can contribute to deficiencies in care often seen in rural areas including a lack of comprehensive, coordinated, and continuous care (Weinhold & Gurtner, 2014).

Elderly patients, which make up a larger percentage of rural populations than urban populations (Goins et al., 2005; Harris & Leininger, 1993; Probst et al., 2002), are especially vulnerable and have shared and unique access issues. In Goins et al.'s (2005) study on perceived barriers to health care access, patients identified a lack of quality health care (including long wait times, lack of trust in providers, and inaccurate diagnoses), limited long-term care options, and social isolation issues. The concept of cultural differences in rural and urban populations is something that several studies identified and Brundisini et al. (2013) discuss in-depth. Culture differences in rural areas, sometimes referred to as 'rural culture', include concepts of self-reliance and reluctance to seek care which means that home remedies are often used, help is not sought, and care is only sought after all other options have been exhausted (Brundisini et al., 2013; Goins et al., 2005).

Woods et al. (2003) found that one of the main determinants of health care utilization by rural children is health insurance status. In fact, children under the age of five with Medicaid had 3.8-fold and children with private insurance had 1.6-fold more health visits per year compared to children without health insurance. Children, over the age of five, with Medicaid had 6.08-fold and with private insurance had 1.37-fold more health visits than those without health insurance

(Woods et al., 2003). It is also interesting to note that in a study by DeVoe et al. (2003) it was found that having insurance as well as a usual source of care greatly increased the odds of having a physical examination, pap test, breast examination, and mammogram due to independent, but additive effects. Transportation-related difficulties are also central to understanding reduced utilization of preventive services in rural areas because of access issues. Chan et al. (2007) found that patients in isolated rural areas had 9.9% fewer yearly visits to health care providers and a median travel time of 30 minutes to health care facilities (one-way). However, for certain procedures – radiation, cardiac procedures, spinal surgeries, and intubation – patients had to travel significantly farther, greater than 50 minutes (one-way), to receive services (Chan et al., 2007).

Analytic Frameworks Literature

Handler, Issel, and Turnock Conceptual Framework

The Handler, Issel, and Turnock conceptual framework for measuring public health system performance (Handler et al., 2001) was used to examine the relationship between public health practice and population health outcomes. The framework was based on previous work of several of the authors (Turnock & Handler, 1997), an expert panel, and input from the Centers for Disease Control and Prevention (CDC) (Handler et al., 2001). It is important to note that this framework has an open system structure with interactions and feedback loops between the different system components (Handler et al., 2001); however, measurement of the interactions and feedback loops is beyond the scope of this research project. Therefore, the focus of this exploration was on the system components themselves. The framework can be used to examine public health systems at multiple levels including national, state, county, and community, which fits the focus of this research on county-level public health systems.

The framework includes five main components, three of which are within public health systems. The first component of this framework is the macro context which includes outside forces that could affect the functioning and purpose of public health systems, including political, economic, and social forces (Handler et al., 2001). The three components of this framework that measure public health system characteristics are the public health system mission and purpose, structural capacity, and processes. The mission of public health systems refers to the focus and goals of that system and how these may be operationalized through their performance of the core functions of public health (Handler et al., 2001). Handler et al. (2001) state that is may be possible to determine if a particular public health system is focused on population-based or personal health-based services.

The structural capacity of public health systems is a more reliably measured and easily conceptualized component of this framework. They are the resources public health systems need to carry out their work including information, organization, human, physical, and fiscal resources (Handler et al., 2001). The processes of public health systems are often considered the essential public health services (Handler et al., 2001). They may also include those activities public health systems complete to improve the health of their constituents.

The final component of the Handler et al. (2001) framework are the outcomes. “The ultimate results of public health practice are system outcomes, typically measured as improvements in population health status” (Handler et al., 2001, p. 1236). However, it can be difficult to link public health system structural capacity and processes to specific health outcomes, especially if the focus is on an entire public health system rather than a specific program or intervention that system may provide.

This framework provides a clear conceptual basis to examine relationships between system components, which encourages a more consistent focus in the measurement of public health system performance.

Andersen Behavioral Model of Health Services Use

The framework used to examine the relationship between healthcare capacity and deviance was the Andersen Behavioral Model of Health Services Use. The original model was created in the 1960s, and it has gone through five phases of re-development to become the model that is currently utilized (Andersen, 2008). The current model includes contextual and individual characteristics that drive health behaviors that then lead to health outcomes. Contextual characteristics include predisposing factors (i.e., broad social, cultural, and demographic characteristics of an area), enabling factors (i.e., available resources and organizations), and need factors (i.e., societal need for healthcare services) (Andersen, 2008). The individual characteristics focus on an individual’s predisposing, enabling, and need factors (Andersen, 2008). Earlier versions of the model, and many of the studies that have utilized the model, have primarily focused on individual factors rather than contextual factors; however, the latest phase of the model has highlighted the importance of focusing on the larger context in which healthcare systems exist.

While the Andersen Behavioral Model of Health Services Use is primarily used to explain health service utilization by individuals, it illuminates the importance of contextual characteristics including enabling factors. As Andersen and Newman (1973) outline, healthcare systems consist of two primary dimensions – resources and organization. Resources (or capacity) include capital and labor associated with healthcare delivery, which includes personnel, facilities, and equipment, while organization refers to how those resources are used (i.e., how personnel, facilities, and equipment are coordinated) (Andersen & Newman, 1973). This study focused on these enabling factors, specifically resources (capacity), to examine if differing rates of capacity factors between counties with better and worse than expected health may point to structural features that could potentially be driving differences.

Review of Area Deprivation Indices

To identify counties that were truly 'deviant', in that they differ in uncommon ways, it was essential to ensure that counties were only compared to those that were similar. For example, evidence consistently shows that socioeconomic status (the combination of income, education, and job status) is associated with health outcomes (Biggs et al., 2010; Frank et al., 2003; Geronimus et al., 1999; Geronimus et al., 1996; Hahn et al., 1996; Isaacs & Schroeder, 2004; John D and Catherine T MacArthur Foundation, 2007; Marmot, 2002, 2004, 2005; Marmot & Smith, 1991; Singh, 2003); essentially, higher income, education, or job status equates to better health outcomes. This is true on a gradient scale as well which means that incremental increases in income, education, or job status are associated with incremental increases in positive health outcomes (Egen et al., 2017; John D and Catherine T MacArthur Foundation, 2007; Marmot, 2004, 2005; Marmot & Smith, 1991). Therefore, it was vitally important to ensure that identified positive and negative deviant counties were not deviant due to advantages in material and social conditions, but rather, another, yet unidentified, reason.

While it was possible to categorize counties based on one or two socioeconomic related metrics, a more comprehensive approach is to create an area-deprivation index to categorize like counties. Utilizing an index was a more valid and robust way of identifying counties which are deprived since a single indicator, such as poverty or income, does not fully capture the different components of material and social deprivation (Singh, 2003). Furthermore, while poverty indicators only measure the lack of resources or income in an area, deprivation measures include indicators on the lived experience of individuals who are poor (Gordon, 1995); both of these components were vital in identifying positive and negative deviant counties. Finally, many socioeconomic and social indicators cluster at the neighborhood level which makes utilization of an index ideal (Messer et al., 2006).

Area deprivation indices have been used in Europe (Šlachtová et al., 2009), Canada (Pampalon et al., 2012), and the US (Hale et al., 2015; Messer et al., 2006; Singh, 2003). They contain a number of indicators chosen primarily through a literature review of the health outcome under investigation and they are often computed one of three ways: 1) through summation of z-scores (Šlachtová et al., 2009); 2) through primary components analysis (Messer et al., 2006; Pampalon et al., 2012) or factor analysis (Singh, 2003); or 3) by some combination of these statistical procedures (Hale et al., 2015).

English Indices of Deprivation. The most recognized use of an index is in England where the English Indices of Deprivation are released every 5 years by the Department of Communities and Local Government (Smith et al., 2015). The English Indices of Deprivation include an exhaustive list of indicators: 37 indicators spread across seven domains of deprivation as outlined by the Smith et al. (2015). The seven domains include: “income deprivation, employment deprivation, education, skills, and training deprivation, health deprivation and disability, crime, barriers to housing and services, and living environment deprivation” (Smith et al., 2015, p. 7). While these domains can be used separately, they are commonly combined and known as the Index of Multiple Deprivation (IMD). Contrary to most other area deprivation indices, the IMD combines separate indicators into domains and are then weighted to create the final index. The weight for domains were not found using principal components analysis or factor analysis (the usual methods). Rather, they are based on existing literature and robustness of the separate domains (Smith et al., 2015). While this Index is utilized across England, its general methodology was not chosen for the current study due to its vast number of indicators and its use of weighting based on literature instead of statistical procedures.

Czech Republic Index. Šlachtová et al. (2009) use the methodology of summation of indicator z-scores to create their index for the Czech Republic. Eighteen material and social indicators were identified through a literature review and were then analyzed for correlations and data availability before they were included in the final index (Šlachtová et al., 2009). The original 18 indicators and the nine included in the index are available in Table 1.1. They used Pearson correlation coefficients to identify correlations between the index and several mortality and disease indicators for both men and women (Šlachtová et al., 2009). It was found that the index was significantly associated with all causes of death examined except breast cancer mortality for both men and women and lung cancer and respiratory diseases in women (Šlachtová et al., 2009). Associations were stronger in men than women and all associations were moderate except for respiratory and cardiovascular diseases (Šlachtová et al., 2009). While this index was able to show correlations between area deprivation and mortality the lack of weighting the index indicators is a potential issue (Gordon, 1995), although the relativity of the index, due to use of z-scores, is a benefit. Therefore, it was determined that the Czech Republic Index would not be utilized for this study although it has benefits.

Table 1.1.

Five Area Deprivation Indices and Their Indicators

Czech Republic Index (Šlachtová et al., 2009)	**Québec & Canada Index** (Pampalon et al., 2012)	**19-City, 5-County Index** (Messer et al., 2006)	**US County Index** (Singh, 2003)	**Rural Area County Index** (Hale et al., 2015)
Detached houses	Average personal income	Less than high school diploma**	Population with < 9th grade education	Median income
Ownership of housing*	Persons without high school diploma	Males and females unemployed	Population with high school diploma	Population below poverty line
Ownership of cottage houses	Ratio employment/ population	Males no longer in work force**	Median family income	Population with < high school diploma
Housing water supply*	Persons living alone	Rented housing**	Income disparity	Unemployment
Flats without amenities*	Persons separated, divorced or widowed	Renter or owner costs > 50% of income**	Occupational composition	Population without a vehicle*
Density of housing	Single-parent families	Crowded housing	Unemployment rate	Household crowding*
Housing with phone		Vacant housing**	Family poverty rate	Population renting**
Housing with PC*		Median household value**	Population > 150% of the poverty rate	Population with limited English**
Housing with internet*		Males in management	Single-parent household rate	Single-parent household rate
Car ownership		Males in professional occupations	Home ownership rate	Non-white*
Basic/university education		Females in management**	Median home value	Physicians per 1000 people**
Unemployment		Females in professional occupations**	Median gross rent	Mental health inpatient units per 1000 people**
Single men		Households in poverty	Median monthly mortgage	Mental health outpatient units per 1000 people**
Single women		Female-headed households w/ children	Households without access to motor vehicles	Health-related businesses per 1000 people**
Complete families with children*		Households earning < $30,000/ year	Households without access to telephone	Parks per 1000 people**
Incomplete families with children*		Households on public assistance	Households without access to plumbing	Grocers per 1000 people**
Complete families without children*		Households with no cars**	Household crowding	
Incomplete families without children *		Residents who are non-Hispanic blacks**	English language proficiency**	
		Same residence since 1995**	Urban population**	
		Residents 65 years and above**	Divorce rate**	
			Immigrant population**	
*Excluded from final Index due to data availability or correlation analysis **Excluded from final Index due to factor analysis or principal components analysis				

Quebec and Canada Index. The Canadian Index included six indicators (Table 1.1) shown to be correlated with health and used the sum of the principal factor analysis factor scores (which identify the level of deprivation) for each indicator to rank Canada's small area units into quintiles (Pampalon et al., 2012). Associations between the index and life expectancy, all-cause mortality, YPLL, and cancer and circulatory system mortality were found (Pampalon et al., 2012). Additionally, associations were found between the index and health services which show that with increasing area deprivation there is also an increase in health services utilization (Pampalon et al., 2012). The Canadian Index is different from other indices in that it looks at material and social deprivation bi-dimensionally instead of in combination (Pampalon et al., 2012) which allows it to identify areas that may be materially, but not socially deprived or vise-versa. While this index is more specific, the number of counties in the US made such an undertaking impractical for the current study.

19-City, 5-County Index. Messer et al. (2006) created their index to identify if area deprivation is associated with birth outcomes for infants (low birthweight and pre-term birth) in cities and counties in the US. They identified 20 variables from a literature review pertaining to indicators included in deprivation indices for perinatal outcomes (Messer et al., 2006). They retained only the first principal components identified through principal components analysis and indicators with high loadings at any one site to identify which indicators had both shared and unique associations with deprivation (Messer et al., 2006). This resulted in the identification of eight indicators (Table 1.1) that were included in the index – only these indicators were included in another principal components analysis to obtain final loadings which were used in the weighting of each variable for the final index (Messer et al., 2006). The index was standardized by dividing it by the square of the eigenvalue (obtained from the principal component analysis procedure) (Messer et al., 2006). They found that, for white women, more low birthweight and pre-term births occurred in areas with higher deprivation, however this same pattern was not observed for Black women; instead it was found that adverse outcomes (low birthweight and pre-term births) were seen in all quartiles of deprivation among Black women (Messer et al., 2006). This index uses principal components analysis, which allows for weighting of index indicators, however, the index is not relative because it does not use z-scores. Therefore, this index was not appropriate for the current study although it has benefits.

US County Index. Factor analysis, which is the methodology utilized by Singh (2003), differs slightly from principal component analysis in that factor analysis identifies the shared variance of indicators (variables) whereas principal component analysis identifies total variance of indicators (Messer et al., 2006). Most researchers utilize principal components analysis instead of factor analysis. However, Singh (2003) utilized factor analysis in identifying county-level deprivation and associated US mortality. Indicators were identified through a literature review and those with theoretical relevance – 21 indicators – were selected to be included in the factor analysis. Through factor analysis, it was determined that 17 indicators would be retained for the final index (Table 1.1), and the factor scores were used to weigh the indicators and create the county index scores (Singh, 2003). Utilizing the index, it was found that while mortality rates declined for all groups from 1969-1998, the decline was slowest for populations in areas that were most deprived. For white men and women, this decline followed a gradient pattern. However, this was not seen when analyzing the data for Black men and women; those in the 3rd, 4th, and 5th quintiles had overlapping declines in mortality rates (Singh, 2003). While the factor components method is unique, it was not appropriate for this study; rather, evidence suggests the use of principal components analysis is a more appropriate method.

Rural Area County Index. Hale et al. (2015) used a rural area deprivation index to identify potential associations to hospitalization rates (for ambulatory care sensitive conditions – conditions which could have been prevented) for children in the US. They identified 16 indicators utilized in the creation of another index (Eibner & Sturm, 2006) as the starting point; however, several variables were dropped due to data availability and inappropriateness (Hale et al., 2015). Principal components analysis was then used to identify those indicators which load onto the first component: five variables were retained in the final index (Table 1.1). The index was standardized by calculating the z-scores of variables, the z-scores were summed to create county index rates, and deprivation quartiles were found (Hale et al., 2015). They found that in rural counties, discharges were disproportionately seen in the counties with the highest deprivation rates. Although rurality alone was not associated with increased hospitalizations, the pattern that was observed suggests that the intersection of rurality and deprivation is important (Hale et al., 2015).

Evidence suggests the use of area deprivation indices is a more robust method of categorizing counties based on deprivation because of their association with many health outcomes and behaviors of concern and their inclusion of several measures of material and social deprivation, which would better ensure that positive and negative deviant counties were truly deviant. That is, their deviance was due to infrequent practices or environments rather than better material or social conditions. Careful consideration of the literature suggests the use of an index that employs principal components analysis to identify indicators and z-score summation to create final county scores; this is why the index utilized by Hale et al. (2015) was used. It was the most appropriate index because of the focus on rural counties, health services research, and the use of principal components analysis and summation of z-scores.

Review of Positive Deviance Framework

The PD framework was first utilized as a method to eliminate malnutrition in children in Central America during the 1970's (Wishik & Vynckt, 1976). Wishik and Vynckt (1976) outlined a five phase methodology for the implementation of the PD framework. The first phase includes an analysis of the 'situation' – essentially, identifying those individuals within a community who are performing better than expected for the health outcome in question (in their case, children who were not malnourished) (Wishik & Vynckt, 1976). It is of extreme importance in this step to ensure that those positive deviants are not performing better due to an advantage (e.g., they have some socioeconomic or other benefit that could explain their better outcome). During the second phase, behaviors are identified that are both 'normative' (the behaviors which the majority of the population are undertaking) and 'deviant' (the behaviors that individuals with better outcomes are undertaking) (Wishik & Vynckt, 1976). Once behaviors that may be conferring advantage are identified, a method for adapting them for broader use by community members is undertaken in the third phase. These adaptations, which are essentially an intervention, are introduced during the fourth phase and evaluation of the intervention concludes the fifth phase (Wishik & Vynckt, 1976).

However, popularity of the PD framework was the result of its utilization in Vietnam during the 1990's to reduce malnutrition in children (Pascale et al., 2010). While the underlying PD philosophy and methodology follows that outlined by Wishik and Vynckt (1976), significant changes were made. In Vietnam, it was realized that extensive inclusion of community members was essential for uptake of 'new' behaviors. This was, in part, due to the historical focus by international NGOs on the childhood malnutrition problem in Vietnam; NGO employees would come into the communities, determine what was 'wrong', and create a quick fix – which oftentimes meant bringing food into these communities (Pascale et al., 2010). Once funding was exhausted, the NGO would leave and communities would return to previous behaviors and levels of malnutrition. Therefore, it was determined that the community needed to own any changes so that they would become common practice and continue beyond the PD process (Pascale et al., 2010).

For this reason, community involvement was a vital part of the PD process in Vietnam. Community members identified positive deviants (those families with children that were not malnourished), conducted interviews and observed feeding practices, identified the uncommon behaviors of positive deviant families, and created ways to implement community-wide change (Marsh et al., 2004; Pascale et al., 2010). Community members were accepting of this approach because of its nature; it focused on assets within the community and spread behavior change that was discovered from inside the community itself, not brought by outside ‘experts’. Through the PD process it was discovered that families who consistently washed their own and their children’s hands during feeding and who included crabs and shrimp in children’s daily diet did not have malnourished children (Mackintosh et al., 2002; Pascale et al., 2010). Although these were uncommon behaviors, with some stigmatization, they were implemented by many families because the behaviors came from community members (Pascale et al., 2010).

Much of the popularity the PD framework received from its implementation by Save the Children in Vietnam was due to the results this approach garnered. It was found that severe childhood malnutrition fell by 74% among children under three (Mackintosh et al., 2002; Marsh et al., 2004). Decreased malnutrition was sustained in communities for as many as four years after PD initiation staff left (Mackintosh et al., 2002) and younger children (who were not the primary targets of the original PD intervention) experienced the largest nutritional benefits

(Mackintosh et al., 2002; Marsh et al., 2004). However, a later randomized controlled trial (Marsh et al., 2002) of the effects of the PD framework on child malnutrition in other Vietnam villages found that, overall, children exposed to the PD intervention did not attain better growth than comparison children (Schroeder et al., 2002). The only significant difference in growth was seen for younger children and more malnourished children (Schroeder et al., 2002). Since then, the PD framework has been used to investigate potential solutions for many public health issues including obesity (Foster et al., 2015; Sharifi et al., 2015), nutrition (Marty et al., 2015), and malaria (Shafique et al., 2016). It has also been broadly used within health care organizations to improve quality of care (Baxter et al., 2016) and reduce infection rates (Baxter et al., 2016; Pascale et al., 2010). Additionally, the PD framework has been used by businesses to identify uncommon practices utilized by some employees which result in better outcomes (Pascale et al., 2010).

Several guides to the PD framework have been created which help to direct its utilization (Marsh et al., 2004; Positive Deviance Initiative, 2010). Key messages within these guides include:

- A focus on individual members within communities with uncommon practices that confer benefits – the ‘positive deviants’ (Marsh et al., 2004; Positive Deviance Initiative, 2010)
- Strong partnership with and social mobilization of community members for the entirety of the PD process – their involvement and leadership in *all* steps of the PD process (Marsh et al., 2004; Positive Deviance Initiative, 2010)
- A focus on assets existing within communities; solutions are already being implemented by some community members and are the basis of the interventions (Marsh et al., 2004; Positive Deviance Initiative, 2010)

Additionally, the *Basic Field Guide to the Positive Deviance Approach* (Positive Deviance Initiative, 2010) outlines the five steps of the PD methodology, which mirror those originally outlined by Wishik and Vynckt (1976), although the Field Guide provides more detailed instructions to those wishing to implement the methodology.

Adaptation of the PD methodology, outlined above, is necessary for the proposed research project since the focus in not on individuals exemplifying uncommon behaviors or practices, but counties with uncommon health outcomes in comparison to peer counties (counties with similar material and social constraints). To this end, there have been numerous adaptations to the PD methods including its application to public health data (Walker et al., 2007), health services research (Rose & McCullough, 2017), health care-related quality improvement (Bradley et al., 2009), and improvement of business organizations (Spreitzer & Sonenshein, 2004).

Walker et al.'s (2007) work on the application of the PD framework with existing public health data suggests that the core PD concept – identifying uncommon practices – could, and should, be used even if the original methodology associated with the framework is not utilized. Information garnered from a modified PD framework can identify uncommon, positive behaviors or metrics and can assist in the creation of a culturally acceptable intervention. Three steps are outlined in their approach to using PD with existing data sets: 1) "determine whether positive deviance fits the situation" (Walker et al., 2007, p. 572); 2) "assess the health problem, situation, and risk in the group of interest" (Walker et al., 2007, p. 573); and 3) "identify positive deviants' characteristics and interpret findings" (Walker et al., 2007, p. 575). They suggest engaging community participation to interpret findings to understand underlying mechanisms which may be at work (Walker et al., 2007). While their modified approach suggests identification of individuals with the outcome of interest (Walker et al., 2007) it could also be used to identify larger subgroups, beyond the individual level, which exemplify the outcome of interest. Therefore, the three-step modified PD framework outlined by Walker et al. (2007) will be utilized to guide this research.

Rose and McCullough (2017) suggest that in health services research a PD framework can be used to identify variations in quality of care, cost of care, utilization of care, and rate of appropriate-to-inappropriate care. While they focus on a qualitative approach (Rose & McCullough, 2017) to provide insight into positive variations in these health care areas, Bradley et al. (2009) had a mixed methods approach (qualitative and quantitative data).

Several studies have also utilized adapted methodologies with a focus on subgroups. Canavan et al. (2016) focused on county-level variations in adult obesity rates and used a qualitative approach to identify why some counties were positive deviants. They determined positive deviant counties to be those that had obesity rates in the lowest national quartile, but were located in states with higher than average obesity rates. Additionally, to ensure that obesity rates were not skewed towards those states with variables known to be correlated with obesity, they controlled for education, income, and race (Canavan et al., 2016). They interviewed 80 key participants in six counties to identify community- and county-level factors that may provide insight into their better-than-expected obesity rates. It was found that key participants, including government officials, had a nuanced understanding of their community, realized that obesity was a complex issue that could not be solved by individual behavior change, and recognized that county-wide strategies to promote healthy living would need to be created (Canavan et al., 2016).

Another study by Klaiman et al. (2016) identified county public health agencies in Florida, New York, and Washington with positively deviant maternal and child health outcomes (compared to non-deviant counties). Indicators used to determine if county public health agencies were positive deviants included infant-specific indicators: low birth weight rates and infant mortality rates; and maternal-specific indicators: teen pregnancy rates and late or no prenatal care rates (Klaiman et al., 2016). These data were compiled for all counties and studentized residuals for each of these indicators were found (Klaiman et al., 2016); studentized residuals are the residuals, found at each point, divided by an estimate of that location's specific standard deviation (Field, 2009). Indicators were only found to be deviant if the studentized residual was less than -1, (lower rates indicate better health outcomes for all four indicators). However, to be identified as a positive deviant in this study a county had to have multiple indicators below the threshold or have an indicator below the threshold over multiple years. This method resulted in the identification of 50 LHDs as positive deviants (Klaiman et al., 2016). The researchers investigated what factors and practices differed between those county public health agencies that were positive deviants and non-deviants. They found that most positively deviant LHDs were in metropolitan areas, had no clear funding patterns (some positive deviant LHDs had higher per capita expenditures for programs while other positive deviant LHDs lower per capita expenditures for programs), and funding patterns varied greatly state-to-state (Klaiman et al., 2016).

It was determined that the PD framework would be utilized in this study because of its focus on the positive, health promoting activities that happen within all communities. Oftentimes public health system and healthcare system research focus on the problems rural communities experience without enough attention to the problem-solving and innovative services and activities that happen in rural communities (Bourke et al., 2010). By looking across counties that have a similar economic makeup (using a social and material deprivation index) one can identify counties that are performing better than expected. This research is focused on those strengths that already exist in rural counties and seeks to identify what activities or structures are in place in these rural areas that allow them to experience better health outcomes.

Methods

Index

Creation of an area deprivation index allows counties to be compared to those that are most similar, both materially and socially. This was a more valid and robust way of identifying sub-groups of counties since sub-group identification based on only one indicator does not fully capture the true condition of a county. While counties may be similar for poverty or income metrics, differences that exist between counties may be explained by county wealth or education levels, which would mean that positive and negative deviant counties are not truly being identified (Singh, 2003).

Since it was beyond the scope of the current study to create a new index it was determined that the Rural Area County Index utilized by Hale et al. (2015) would be used. This index was chosen because of the similarities between their study and the current study (i.e., a focus on rural health care services). Therefore, the five variables identified through principal components analysis by Hale et al. (2015) were used to create the index: 1) median household income, 2) percent of population with less than high school diploma, 3) percent of population unemployed, 4) percent of population in poverty, and 5) percent of population that are single parents. Z-scores for each variable were calculated and summed to create the final county index scores.

The following equation was used to calculate z-scores:

$$z = \frac{(county\ value) - (mean\ of\ all\ counties)}{(standard\ deviation\ of\ all\ counties)}$$

One variable, median household income, needed to be reverse coded because a higher score indicated a more desirable outcome, but for the other variables a higher score was less desirable.

Positive and Negative Deviant Counties

Walker et al.'s (2007) three-step approach to using PD with existing data will be used. The first step includes determining whether the PD framework fits the situation. As stated previously, the current study, focused on why some rural counties perform better or worse than expected when compared to similar counties, fits the PD framework because it seeks to understand which activities or structures in rural counties lead to better health outcomes. Essentially, this study is focused on a strengths-based rather than a deficit-based approach – some rural counties are experiencing better than expected health outcomes and this study seeks to understand what underlying structures exist that predispose counties to better outcomes. Steps two and three include "assess the health problem, situation, and risk in the group of interest" (Walker et al., 2007, pp. 573) and "identify positive deviants' characteristics and interpret findings" (Walker et al., 2007, pp. 575). These steps align with the purpose of the current study.

Several strategies to identify deviant counties were tested. All strategies utilized z-scores to standardize the health metrics; however, cut-points and inclusion of specific health metrics differed. Z-scores were calculated using the equation above. The following county-level health metrics were utilized to identify deviant counties: 1) male life expectancy, 2) female life expectancy, 3) YPLL, 4) fair or poor health, 5) physically unhealthy days, and 6) mentally unhealthy days. For all of these health metrics a higher z-score designates poorer health, except for female and male life expectancy where a higher score indicates a more desirable health outcome. Therefore, male and female life expectancy z-scores were reverse coded for all counties to ensure metric consistency. A full review of all strategies tested to identify deviant counties follows.

One deviance identification strategy identifies deviant counties as those that have z-scores above or below the threshold of ±1.25 for two or more health metrics (out of the six metrics). This strategy will subsequently be referred to as ‘Threshold of 2 or More Metrics’. The counties that had at least two health metrics with z-scores below -1.25 were considered positive deviants, those that had at least two health metrics with z-scores above 1.25 were negative deviants, and those with z-scores between -1.25 and 1.25 were non-deviant. Counties were identified as deviant if their performance was above or below ±1.25 for at least two health metrics to ensure robustness of deviance identification.

The second deviance identification strategy focused only on male and female life expectancy and used an average z-score of these two metrics. This strategy will subsequently be referred to as ‘Life Expectancy’. This strategy differs significantly from the Threshold of 2 or More Metrics in that the z-score average of male and female life expectancy was assessed to determine deviants (those exceeding the threshold) rather than independently assessing whether each health metric exceeded the threshold. In the Life Expectancy strategy, those counties that had an average z-score above or below ±1.0 were considered deviants. This strategy is more objective because male and female life expectancy rates are calculated for each county based on mortality data and, therefore, do not rely on self-reported observations which are the basis for other metrics (fair or poor health, physically unhealthy days, and mentally unhealthy days).

The third and fourth deviance identification strategies were similar to the Life Expectancy strategy. However, the third method used z-scores averages of all six health metrics and had a threshold of ±0.8 to identify deviance. Those counties with an average z-score below -

0.8 were considered positive deviants, those that had an average z-score above 0.8 were negative deviants, and those with average z-scores between -0.8 and 0.8 were non-deviant counties. This strategy will subsequently be referred to as 'All Health Metrics'. Initially, a z-score threshold of ±1.0 was used to identify deviants, but this threshold was too restrictive, resulting in too few counties identified as deviant.

The fourth deviance identification strategy was nearly identical to All Health Metrics with one exception: mentally unhealthy days z-scores were not included in the z-score averages for each county. This strategy will subsequently be referred to as 'All Health Metrics except Mentally Unhealthy Days'. This exclusion was based on correlation analysis, which showed mentally unhealthy days had the weakest correlation to male and female life expectancy and YPLL (which are objective health metrics). Z-score averages included male life expectancy, female male life expectancy, YPLL, fair or poor health, and physically unhealthy days with a threshold to determine deviance set at ±0.8. Those counties with an average z-score below -0.8 were considered positive deviants, those that had an average z-score above 0.8 were negative deviants, and those with average z-scores between -0.8 and 0.8 were non-deviant counties.

Each of these strategies was used to identify positive, negative, and non-deviant counties within each deprivation quartile. Deviant county classification by each identification strategy was then compared. Appendix A includes these comparisons in detail. However, several strategies could be used and it was essential to test each of them to determine which strategy would ultimately best identify a sufficient number of deviant counties. The tables in Appendix A highlight the differences between these strategies. While it is, of course, expected that some positive or negative deviant counties identified through one strategy would be non-deviant counties in a different strategy it was not expected that some would switch from positive deviant to negative deviant between strategies. As can be seen in Tables A1, A4, and A6, the Life Expectancy strategy was not valid, as it was the only strategy resulting in a “switch” from positive to negative deviance when compared to each of the other strategies. This analysis also shows that two counties switched from positive to negative deviance when the Life Expectancy and Threshold of 2 or More Metrics strategies were compared. Only one county switched from positive to negative deviance when the Life Expectancy strategy was compared to All Health Metrics and All Health Metrics except Mentally Unhealthy Days.

Ultimately, the All Health Metrics except Mentally Unhealthy Days strategy was chosen to identify positive, negative, and non-deviant counties within each county quartile. This method was chosen, because it included all pertinent health measures in its calculation since correlation analysis showed that mentally unhealthy days had the weakest correlation to the other health measures. In fact, when comparing the exclusion versus inclusion of mentally unhealthy days, it can be seen that excluding mentally unhealthy days yielded more positive and negative deviant counties overall (Table A.6) which was needed to provide more power for later analyses.

Both rural and urban counties were included in the initial identification of positive deviant, negative deviant, and non-deviant counties within each quartile. However, only rural counties were included in the analysis of differences in local public health system and local health care system metrics. The 2013 Rural-Urban Continuum Codes (USDA, n.d.) from the US Department of Agriculture, Economic Research Service identifies all counties in the US as Metro or Non-Metro and includes 9 subcategorizations. For this research only those counties that were Non-Metro were considered.

Data Sources

The metrics used to create the area deprivation index (median household income, percent of population with less than high school diploma, percent of population unemployed, percent of population in poverty, and percent of population that are single parents) were pulled from the United States Census Bureau, 2015, American Community Survey 5-year estimates (US Census Bureau, n.d.).

Metrics used to classify counties as positive, negative, and non-deviant counties came from two sources. Male and female life expectancy came from the 2014 Institute of Health Metrics and Evaluation US County Profiles (Institute for Health Metrics and Evaluation [IHME], 2016). YPLL, fair or poor health, physically unhealthy days, and mentally unhealthy days came from the 2017 County Health Rankings data (University of Wisconsin Population Health Institute, 2017).

To determine county rurality the 2013 Rural-Urban Continuum Codes (USDA, n.d.) from the US Department of Agriculture, Economic Research Service were used. This continuum identifies all counties in the US as Metro or Non-Metro and includes 9 subcategorizations. This study utilized rural-urban continuum codes 1, 2, and 3 for metropolitan counties (urban) while codes 4-9 were used to for nonmetropolitan counties (rural). In this study only those counties that were Non-Metro were considered.

Metrics for data analyses included in Chapter 2 came from the 2017 County Health Rankings data (University of Wisconsin Population Health Institute, 2017) and included population, percent of population that is non-Hispanic African American, percent of population with some college, percent of children in poverty, income ratio, percent of uninsured adults, and percent of uninsured children. Identification of rural counties came from the US Department of Agriculture, Economic Research Service 2013 Rural-Urban Continuum Codes (USDA, n.d.).

Metrics for data analysis included in Chapter 3 came from the 2016 National Profile of Local Health Departments collected by the National Association of County and City Health Officials (NACCHO) (NACCHO, 2017a, 2017b). NACCHO began collecting data on Local Public Health Departments in 1989-1990 and again in 1992-1993, 1996-1997, 2005, 2008, 2010, 2013, and 2016. All health departments received a core questionnaire while a random sample of health departments received one of two additional question modules in 2016 (NACCHO, 2017a). However, only questions from the core questionnaire were utilized since these questions were sent to all health departments and will therefore provide information on local public health systems in most counties. Only questions with a response rate of at least 75% were included in the analysis.

Metrics for data analysis included in Chapter 4 came from the U.S. Department of Health and Human Services, Health Resources and Services Administration (HRSA) 2016-2017 Area Health Resource File (AHRF) (Health Resources and Services Administration [HRSA], n.d.).

Indicators and data sources for analyses of differences between positive deviant, negative deviant, and non-deviant counties for health services systems and local public health systems comparison are identified in Table 1.2.

Table 1.2.

Local Public Health System and Health Service Systems Data Elements and Sources

Local Public Health System Indicator	**Health Care Service System Indicator**
Population Size Served[1]	JCAHO certified hospital[2]
Governance Type[1]	Federally qualified health centers[2]
Jurisdiction Type[1]	Community health centers[2]
LHD Part of Combined Health and Human Services Agency[1]	Rural health clinics[2]
Local Board of Health[1]	Health professional shortage areas –Mental Health Professionals[2]
Current Budget Compared to Previous Year's[1]	Health professional shortage areas – Dental Practitioners[2]
Current Budget Compared to Next Year's[1]	Health professional shortage areas – Primary Care Practitioners[2]
Top Executive Has a Doctoral Degree[1]	Physicians per capita (10,000)[2]
Top Executive Has a Nursing Degree[1]	Nurse Practitioners per capita (10,000)[2]
Total Number of FTE Employees[1]	Hospital Beds per capita (10,000)[2]
New Public Health Ordinance[1]	Hospitals per capita (10,000)[2]
Revised Public Health Ordinance[1]	
Completion of a Community Health Needs Assessment (CHNA) [1]	
Presence of non-profit hospital serving residents[1]	
Development of health improvement plan[1]	
Development of an agency-wide strategic plan[1]	
Participation in PHAB's national accreditation program[1]	
[1] (NACCHO, 2017b) [2] (HRSA, n.d.)	

Chapter 2. Identifying Deviance in Rural Counties Using an Area Deprivation Index and Positive Deviance Framework

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Abstract

Purpose: The purpose of this study is to understand how rural counties with better than and worse than expected health outcomes (outlier counties) compare to non-outlier rural counties. This is an essential starting point in considering why differences in health outcomes exist between counties and how the conditions may drive better, or worse, health outcomes. The creation of a material and social deprivation index is detailed in this study as is the selection of positive, negative, and non-deviant counties. Demographic, social, and economic differences between deviant and non-deviant counties are investigated.

Results: Statistically significant differences exist between positive and negative deviant and non-deviant counties within each Quartile. Additionally, an expected hierarchical pattern is also seen – as Quartiles become more deprived, worse health, economic, and social outcomes within deviance categories emerge. Female life expectancy within positive deviant counties was 84.19 years in Quartile 1 while negative deviant counties had a life expectancy of 80.11. By Quartile 4 female life expectancy within positive deviant counties was 80.89 years and 76.08 years for negative deviant counties.

Conclusion: Generally, positive deviant counties experience better outcomes than non-deviant counties and have better outcomes than negative deviant counties. The area deprivation index was moderately successful in ensuring that differences in health outcomes were not merely based on the indicators within the index. This highlights the need to identify what other underlying factors could account for differences in health outcomes given that these differences are not only driven by the social and material conditions of counties.

Keywords: positive deviance, deviance, area deprivation index, rural

Introduction

Americans living in rural areas, roughly, 46.1 million people (Cromartie et al., 2020), are more likely to be poor (16.1% poverty rate versus 12.6%) (Cromartie et al., 2020) and older (Choi, 2012) than their urban counterparts. Rural Americans also have higher rates of several health conditions (Deligiannidis, 2017; Probst et al., 2002) and lower life expectancies (Singh & Siahpush, 2014). However, not all rural counties are the same and vast differences exist. When comparing rural counties by census region (Midwest, Northeast, South, and West) differences in poverty, education, and economic orientation are obvious (O'Dell, 2021). Rates of poverty range from as low as 13.0% in Northeastern rural counties to as high as 19.8% in Southern rural counties, while education rates, those over 25 years of age with a bachelor's degree or higher, range from 16.0% in Southern rural counties to 23.6% in Northeastern rural counties (O'Dell, 2021). When investigating differences in rural economies, counties in the Midwest are heavily farming-dependent, counites in the Northeast are heavily recreation-dependent, counties in the South are heavily mining and manufacturing-dependent, and counties in the West are a mix of mining, recreation, and Federal-State government-dependent (USDA, 2018). While differences exist between regions, differences also exist within regions, highlighting that differences are not a result of location alone. To better understand what sets outlier counties apart, counties were compared using a myriad of demographic, social, and economic variables.

A material and social deprivation index was used to group similar counties and then the innovative positive deviance (PD) approach was utilized to identify outlier counties. Counties with better than expected health outcomes were labeled positive deviants and counites with worse than expected health outcomes were labeled negative deviants. The traditional PD approach involves the identification of behaviors, beliefs, or policies individuals utilize within a community that allow them to experience better health outcomes. This approach has been used since the 1970's in several countries for a variety of health concerns including obesity (Foster et al., 2015; Sharifi et al., 2015), nutrition (Marty et al., 2015), and malaria (Shafique et al., 2016) and in health care to improve quality (Baxter et al., 2016) and reduce infection rates (Baxter et al., 2016; Pascale et al., 2010). Wishik and Vynckt (1976) first utilized this approach in Central America in the 1970's and outlined a five step process for implementing the PD approach.

This study focused on steps #1 and #2 of Wishik and Vynckt's (1976) PD approach – that is, identification of positive and negative deviant counties and the comparison of these deviant counties to non-deviant counties. While investigating deviance at the county-level differs greatly from the traditional PD approach, several other studies have utilized this strategy to identify correlations at the population-level (Canavan et al., 2016; Klaiman et al., 2016). However, there is no universally accepted approach to identifying deviance at the county-level. Indeed, the methods utilized by the few studies that implemented the PD framework to identify deviant counties vary drastically. Canavan et al. (2016) investigated differences in county-level adult obesity rates and sought to explain why these differences existed. They identified positive deviant counties as those counties that had obesity rates in the lowest national quartile while simultaneously being in states with above average obesity rates. Klaiman et al. (2016) investigated maternal and child health outcomes and utilized metrics tied to these outcomes. They found deviance by using studentized residuals of each of their metrics. They then determined that metrics were deviant if the residual was less than -1 for several of the indicators or a metric was below the threshold for multiple years.

An understanding of how rural counties with better and worse than expected health outcomes compare to non-deviant counties is an essential starting point in considering differences that exist between counties and what these differences mean for the health of communities. The aim of this study was to discuss selection of positive, negative, and non-deviant counties and investigate demographic, social, and economic differences between deviant and non-deviant counties.

Methods

Creation of an Area Deprivation Index

An area deprivation index was created to compare subsets of counties within the United States (US). An index is both a valid and robust way to identify subsets of counties which should be compared since it includes multiple material and social indicators rather than one indicator that would not fully capture the true conditions of a county (Messer et al., 2006; Singh, 2003).

Similar to the present study, Hale et al.'s (2015) study focused on rural health care services research. They used principal components analysis to identify those indicators that loaded onto the first component and these variables, five in total, were retained in their final index. The variables included in the final area deprivation index were: 1) median household income, 2) percent of population with less than high school diploma, 3) percent of population unemployed, 4) percent of population in poverty, and 5) percent of population that are single parents. They calculated the z-scores for each variable in order to standardize the metrics and summed them to create county index scores.

The z-score for each indicator was calculated using the following equation:

$$z = \frac{(county\ value) - (mean\ of\ all\ counties)}{(standard\ deviation\ of\ all\ counties)}$$

For most indicators a higher z-score designates more deprivation. However, for median household income a higher score indicates a more desirable outcome (less material deprivation); therefore, median household income was reverse coded for all counties.

Since the focus of this study is not to create a new area deprivation index, it was determined that the methods used in a previous study would be replicated. Due to the similarity between Hale et al. (2015) and the study proposed here, their methods are most appropriate. Therefore, an index was created by summing the z-scores of the five variables identified by Hale et al. (2015). Based upon the area deprivation index scores, counties were divided into quartiles. Quartiles are often used as a cut point and were utilized in this study to ensure enough positive and negative deviant counties would be included in each subset for analytical purposes.

Positive and Negative Deviant Counties

The metrics used to identify deviance were: 1) male life expectancy, 2) female life expectancy, 3) years of potential life lost (YPLL), 4) fair or poor health, and 5) physically unhealthy days and were chosen because they are general indicators of health. This research is not focused on a specific topic such as obesity or maternal and child health, therefore, it was important to use general measures so as not to potentially skew the selection of counties. Additionally, as the primary objective of this study is to explore whether differences exist between positive and negative deviant counties and non-deviant counties for a variety of demographic, social, and economic variables, the utilization of general health metrics was most appropriate.

A threshold was used to identify positive and negative deviant counties similar to Klaiman et al. (2016), except this study utilized z-scores of the five health metrics. Male and female life expectancy z-scores were reverse coded to ensure they were consistent with the other variables. For most health metrics a higher z-score designates a less desirable health outcome. However, higher life expectancy scores are more desirable; therefore, they were reverse coded for all counties. To determine positive and negative deviance z-scores, each of the indicated metrics were averaged and ±0.8 was used as the threshold to determine deviance. Those counties with an average z-score below -0.8 were considered positive deviants, those that had an average z-score above 0.8 were negative deviants, and those with average z-scores between -0.8 and 0.8 were considered non-deviant counties. Initially, z-scores of ±1.0 (one standard deviation) were used, however, this threshold was found to be too restrictive (too few counties were identified as positive or negative deviant).

Data Sources

The data used to create the area deprivation index (median household income, percent of population with less than high school diploma, percent of population unemployed, percent of population in poverty, and percent of population that are single parents) came from the US Census Bureau, 2015, American Community Survey 5-year estimates (US Census Bureau, n.d.). Health metric data for the identification of positive, negative, and non-deviant counties came from two sources – the 2014 Institute of Health Metrics and Evaluation US County Profiles (IHME, 2016) which provided male and female life expectancies and the 2017 County Health Rankings data (University of Wisconsin Population Health Institute, 2017) which provided YPLL, fair or poor health, physically unhealthy days, and mentally unhealthy days.

The following demographic, social, and economic data came from the 2017 County Health Rankings data (University of Wisconsin Population Health Institute, 2017): population, percent of population that is non-Hispanic African American, percent of population with some college, percent of children in poverty, income ratio, percent of uninsured adults, and percent of uninsured children. Rural county identification used the US Department of Agriculture, Economic Research Service 2013 Rural-Urban Continuum Codes (USDA, n.d.).

SPSS Statistics 25 was used to conduct descriptive statistical analyses (IBM Corp, 2017). The Mann-Whitney U test was used to assess whether positive and negative deviant counties differed significantly from non-deviant counties in each income quartile. This nonparametric test is comparable to the independent samples t-test, however, it can be used when the assumption of normally distributed data is not met (Kim, 2014).

Results

As can be seen in Table 2.1, Quartile 1 (i.e., the least materially and socially deprived counties) had the fewest counties that were identified as either positive or negative deviant followed by Quartile 4 (i.e., the most materially and socially deprived counties). Quartile 2 had slightly more counties that were identified as positive deviant versus negative deviant (20.6% and 17.5%, respectively) while Quartile 3 had slightly more counties that were identified as negative deviant versus positive deviant (23.0% and 21.8%, respectively).

Table 2.1.

Rural Positive, Negative, and Non-Deviant Counties by Quartile Designation (N=1,970)

		Rural Counties
Quartile 1: Least Deprived (n=380)	Non-Deviant	283 (74.5%)
	Positive Deviants	44 (11.6%)
	Negative Deviants	53 (13.9%)
Quartile 2: Slightly Deprived (n=481)	Non-Deviant	298 (61.9%)
	Positive Deviants	99 (20.6%)
	Negative Deviants	84 (17.5%)
Quartile 3: Moderately Deprived (n=495)	Non-Deviant	273 (55.2%)
	Positive Deviants	108 (21.8%)
	Negative Deviants	114 (23.0%)
Quartile 4: Most Deprived (n=614)	Non-Deviant	410 (66.8%)
	Positive Deviants	95 (15.5%)
	Negative Deviants	109 (17.7%)

Most of demographic, health outcome, social, and economic indicators followed the expected hierarchal pattern of Quartile 1 (Least Deprived) indicators performing better than

Quartile 2 (Slightly Deprived) indicators, Quartile 2 (Slightly Deprived) indicators performing better than Quartile 3 (Moderately Deprived) and so on to Quartile 4 (Table 2.2) within positive, negative, and non-deviant counties. However, there were notable exceptions including percent of uninsured adults and percent of uninsured children. For negative deviant counties the percent of uninsured adults was very similar from Quartile 1 to Quartile 4 with slight fluctuations (Table 2.2). The percent of uninsured children pattern was different for positive, negative, and non-deviant counties. Most interestingly, the percent of uninsured children decreased in the negative deviant counties from 11.92% in Quartile 1, least deprived counties, to 6.03% in Quartile 4, most deprived counties (Table 2.2) (likely due to publicly funded insurance programs that cover children). Additionally, the percent of the population that was African American differed drastically between positive, negative, and non-deviant counties; in negative deviant counties, up to 29% of the population was black compared to up 3% in positive deviant counties (Table 2.2).

Table 2.2.

Positive, Negative, and Non-Deviant Counties Descriptive Statistics

	Non-Deviant Counties Mean or %				Positive Deviant Counties Mean or %				Negative Deviant Counties Mean or %			
	Q1 (283)	Q2 (298)	Q3 (273)	Q4 (410)	Q1 (44)	Q2 (99)	Q3 (108)	Q4 (95)	Q1 (53)	Q2 (84)	Q3 (114)	Q4 (109)
Demographics												
Median Household Income, $	54216.34	47851.42	42381.29	35765.54	60015.93	49842.79	44798.85	40191.19	57457.09	45335.49	38627.47	29551.26
Population	18718	25907	28253	24235	16011	20030	28416	19912	11608	24044	26762	19659
Populations that is African American	1.02	2.83	4.84	19.36	0.64	0.97	1.78	3.27	2.03	3.19	6.66	29.20
Health Outcomes												
YPLL	6247	7468	8445	10184	4266	5837	6686	7738	8224	9598	10376	13705
Female Life Expectancy, y	82.26	80.85	79.76	78.34	84.19	82.83	81.63	80.89	80.11	78.74	77.82	76.08
Male Life Expectancy, y	77.74	76.16	74.84	72.73	80.15	78.30	77.18	76.20	75.51	73.91	72.31	69.50
Fair or Poor Health	12.27	14.99	17.96	22.12	10.68	12.38	14.21	16.75	15.75	19.26	21.71	27.99
Physically Unhealthy, d	3.07	3.63	4.13	4.64	2.81	3.17	3.61	4.00	3.64	4.27	4.81	5.46
Mentally Unhealthy, d	3.07	3.57	3.91	4.28	2.87	3.16	3.55	3.83	3.52	3.94	4.42	4.78
Social and Economic Environment												
Less than High School	14.15	16.89	18.82	23.69	13.05	18.91	22.54	28.65	15.05	15.32	15.99	23.38
Some College	65.96	57.13	51.47	46.12	70.66	62.90	57.74	53.60	56.07	51.85	46.95	43.13
Below Poverty	10.04	13.76	17.68	23.78	9.10	12.45	15.93	19.12	10.95	16.20	19.63	32.00
Children in Poverty	14.55	19.70	25.67	34.37	12.28	17.26	21.75	28.76	16.33	23.14	28.97	43.48
Income Ratio	4.03	4.22	4.45	5.10	4.01	4.18	4.40	4.44	4.21	4.47	4.68	5.58
Unemployment	3.41	5.57	7.15	10.09	2.98	4.60	6.58	9.15	4.39	5.19	7.68	13.42
Single Parent Households	24.05	30.07	33.65	40.57	20.32	29.63	33.02	35.83	23.69	29.46	32.51	48.02
Uninsured Adults	13.22	15.94	19.60	22.24	12.09	13.57	14.82	19.20	19.49	20.32	19.54	20.86
Uninsured Children	7.79	8.20	8.96	8.16	7.79	7.77	7.16	9.13	11.92	10.03	7.19	6.03

Within Quartile 1 (least deprived counties), many variables were significantly different between positive deviant and non-deviant counties (Table 2.3) and between negative deviant and non-deviant counties (Table 2.4) with several exceptions. Unexpectedly, median household income was higher in negative deviant ($57,457.09) than the non-deviant counties ($54,216.34) in Quartile 1 even though this finding was not statistically significant (p=.143) (Table 2.4). Differences in health outcomes by deviance category (i.e., positive vs non-deviant and negative vs non-deviant) were all statistically significant. YPLL had a low of 4,266 for positive deviant counties while negative deviant counties had almost double that rate with 8,224 years and non-deviant counties had a rate of 6,247 years (Tables 2.3 and 2.4). However, many of the social and economic metrics were not statistically significant between positive and non-deviant counties for Quartile 1. Statistically significant differences included higher rates in positive deviant counties for percent with some college, percent below poverty, percent children in poverty, and percent single parent households (Table 2.3). The percent of uninsured children was the same for children in positive and non-deviant counties (7.79%). More statistically significant differences existed between negative and non-deviant counties within Quartile 1 including significant differences in percent of uninsured adults and children (Table 2.4). The percent of uninsured adults was much higher in negative deviant counties (19.49%) compared to non-deviant counties (13.22%). Likewise, 11.92% of children in negative deviant counties were uninsured compared to 7.79% of children in non-deviant counties.

Table 2.3.

Positive Deviant Counties Compared to Non-Deviant Counties – Quartiles 1 – 4

	Quartile 1 Mean ± SD or %		Quartile 2		Quartile 3		Quartile 4	
	Positive (44)	Non-Deviant (283)	Positive (99)	Non-Deviant (298)	Positive (108)	Non-Deviant (273)	Positive (95)	Non-Deviant (410)
Demographics								
Median Household Income, $	**60015.93 ± 11088.5**	**54216.34 ± 8154.0**	**49842.79 ± 5270.6**	**47851.42 ± 5523.6**	**44798.85 ± 4760.8**	**42381.29 ± 4530.1**	**40191.19 ± 4700.5**	**35765.54 ± 4635.5**
Population	16011 ± 18818	18718 ± 24537	**20030 ± 25164**	**25907 ± 23719**	28416 ± 25842	28253 ± 22862	**19912 ± 20432**	**24235 ± 18782**
Population that is African American	.64	1.02	**0.97**	**2.83**	**1.78**	**4.84**	**3.27**	**19.36**
Health Outcomes								
YPLL	**4266 ± 716**	**6247 ± 1199**	**5837 ± 980**	**7468 ± 1290**	**6686 ± 1020**	**8445 ± 1248**	**7738 ± 1597**	**10184 ± 1703**
Female Life Expectancy, y	**84.19 ± 1.2**	**82.26 ± 0.9**	**82.83 ± 1.0**	**80.85 ± 1.0**	**81.63 ± 0.8**	**79.76 ± 1.0**	**80.89 ± 1.3**	**78.34 ± 1.3**
Male Life Expectancy, y	**80.15 ± 1.7**	**77.74 ± 1.1**	**78.30 ± 1.4**	**76.16 ± 1.1**	**77.18 ± 1.1**	**74.84 ± 1.2**	**76.20 ± 1.4**	**72.73 ± 1.6**
Fair or Poor Health	**10.68**	**12.27**	**12.38**	**14.99**	**14.21**	**17.96**	**16.75**	**22.12**
Physically Unhealthy, d	**2.81 ± 0.2**	**3.07 ± 0.3**	**3.17 ± 0.2**	**3.63 ± 0.3**	**3.61 ± 0.3**	**4.13 ± 0.4**	**4.00 ± 0.3**	**4.64 ± 0.4**
Mentally Unhealthy, d	**2.87 ± 0.3**	**3.07 ± 0.3**	**3.16 ± 0.3**	**3.57 ± 0.3**	**3.55 ± 0.4**	**3.91 ± 0.4**	**3.83 ± 0.3**	**4.28 ± 0.3**
Social and Economic Environment								
Less than High School	13.05	14.15	**18.91**	**16.89**	**22.54**	**18.82**	**28.65**	**23.69**
Some College	**70.66**	**65.96**	**62.90**	**57.13**	**57.74**	**51.47**	**53.60**	**46.12**
Below Poverty	**9.10**	**10.04**	**12.45**	**13.76**	**15.93**	**17.68**	**19.12**	**23.78**
Children Poverty	**12.28**	**14.55**	**17.26**	**19.70**	**21.75**	**25.67**	**28.76**	**34.37**
Income Ratio	4.01 ± 0.5	4.03 ± 0.5	4.18 ± 0.5	4.22 ± 0.5	4.40 ± 0.7	4.45 ± 0.6	**4.44 ± 0.6**	**5.10 ± 0.7**
Unemployment	2.98	3.41	**4.60**	**5.57**	6.58	7.15	**9.15**	**10.09**
Single Parent Households	**20.32**	**24.05**	29.63	30.07	33.02	33.65	**35.83**	**40.57**
Uninsured Adults	12.09	13.22	**13.57**	**15.94**	**14.82**	**19.60**	**19.20**	**22.24**
Uninsured Children	7.79	7.79	7.77	8.20	**7.16**	**8.96**	9.13	8.16
p<0.05 by Mann-Whitney U test								

Table 2.4.

Negative Deviant Counties Compared to Non-Deviant Counties – Quartiles 1 – 4

	Quartile 1 Mean ± SD or %		Quartile 2		Quartile 3		Quartile 4	
	Negative (53)	Non-Deviant (283)	Negative (84)	Non-Deviant (298)	Negative (114)	Non-Deviant (273)	Negative (109)	Non-Deviant (410)
Demographics								
Median Household Income, $	57457.09 ± 11213.4	54216.34 ± 8154.0	**45335.49 ± 6553.2**	**47851.42 ± 5523.6**	**38627.47 ± 4367.5**	**42381.29 ± 4530.1**	**29551.26 ± 5316.0**	**35765.54 ± 4635.5**
Population	11608 ± 11672	18718 ± 24537	24044 ± 20086	25907 ± 23719	26762 ± 19292	28253 ± 22862	**19659 ± 17559**	**24235 ± 18782**
Population that is African American	**2.03**	**1.02**	**3.19**	**2.83**	**6.66**	**4.84**	29.20	19.36
Health Outcomes								
YPLL	**8224 ± 1747**	**6247 ± 1199**	**9598 ± 1617**	**7468 ± 1290**	**10376 ± 1307**	**8445 ± 1248**	**13705 ± 2926**	**10184 ± 1703**
Female Life Expectancy, y	**80.11 ± 0.8**	**82.26 ± 0.9**	**78.74 ± 1.0**	**80.85 ± 1.0**	**77.82 ± 1.0**	**79.76 ± 1.0**	**76.08 ± 1.4**	**78.34 ± 1.3**
Male Life Expectancy, y	**75.51 ± 1.2**	**77.74 ± 1.1**	**73.91 ± 1.3**	**76.16 ± 1.1**	**72.31 ± 1.1**	**74.84 ± 1.2**	**69.50 ± 1.7**	**72.73 ± 1.6**
Fair or Poor Health	**15.75**	**12.27**	**19.26**	**14.99**	**21.71**	**17.96**	**27.99**	**22.12**
Physically Unhealthy, d	**3.64 ±0.3**	**3.07 ± 0.3**	**4.27 ± 0.4**	**3.63 ± 0.3**	**4.81 ± 0.4**	**4.13 ± 0.4**	**5.46 ± 0.4**	**4.64 ± 0.4**
Mentally Unhealthy, d	**3.52 ± 0.4**	**3.07 ± 0.3**	**3.94± 0.4**	**3.57 ± 0.3**	**4.42 ± 0.3**	**3.91 ± 0.4**	**4.78 ± 0.3**	**4.28 ± 0.3**
Social and Economic Environment								
Less than High School	15.05	14.15	15.32	16.89	**15.99**	**18.82**	23.38	23.69
Some College	**56.07**	**65.96**	**51.85**	**57.13**	**46.95**	**51.47**	**43.13**	**46.12**
Below Poverty	**10.95**	**10.04**	**16.20**	**13.76**	**19.63**	**17.68**	**32.00**	**23.78**
Children Poverty	**16.33**	**14.55**	**23.14**	**19.70**	**28.97**	**25.67**	**43.48**	**34.37**
Income Ratio	4.21 ± 0.7	4.03 ± 0.5	**4.47 ± 0.5**	**4.22 ± 0.5**	**4.68 ± 0.4**	**4.45 ± 0.6**	**5.58 ± 0.7**	**5.10 ± 0.7**
Unemployment	**4.39**	**3.41**	5.69	5.57	**7.68**	**7.15**	**13.42**	**10.09**
Single Parent Households	23.69	24.05	**28.00**	**30.07**	**32.51**	**33.65**	**48.02**	**40.57**
Uninsured Adults	**19.49**	**13.22**	**20.32**	**15.94**	19.54	19.60	**20.86**	**22.24**
Uninsured Children	**11.92**	**7.79**	**10.03**	**8.20**	**7.19**	**8.96**	**6.03**	**8.16**
p<0.05 by Mann-Whitney U test								

Within Quartile 2 (slightly deprived counties), most variables were significantly different between positive deviant and non-deviant counties (Table 2.3) and between negative deviant and non-deviant counties (Table 2.4). Differences in health outcomes by deviance category (positive vs non-deviant and negative vs non-deviant) were all statistically significant (Tables 2.3 and 2.4). Differences between each deviance category for female and male life expectancy were about 2 years. For female life expectancy, results ranged from 82.83 years in positive deviant counties to 78.74 years in negative deviant counties. Likewise, male life expectancy was 78.30 years in positive deviant counties and 73.91 years in negative deviant counties (Tables 2.3 and 2.4). Most of the social and economic metrics were statistically significant between positive and negative deviant and non-deviant counties for Quartile 2. Between positive deviant and non-deviant counties, percent with some college education, percent below poverty, percent children in poverty, percent unemployed, and percent uninsured adults were slightly better in positive deviant counties (Table 2.3). Between negative and non-deviant counties, negative deviant counties performed worse for all metrics, except percent less than high school diploma and percent single parent households, with only percent with less than high school diploma and percent unemployed not statistically significant (Table 2.4). Unexpectedly, positive deviant counties had the highest percent with less than a high school diploma, 18.91% followed by non-deviant, 16.89%, and negative deviant counties, 15.32% (Table 2.3 and 2.4).

Within Quartile 3 (moderately deprived counties), most variables were significantly different between positive deviant and non-deviant counties (Table 2.3) and between negative deviant and non-deviant counties (Table 2.4). Differences in health outcomes by deviance category were all statistically significant. Differences between each deviance category for female and male life expectancy was about 2 years. For female life expectancy, results ranged from

81.63 years in positive deviant counties to 77.82 years in negative deviant counties. Likewise, male life expectancy was 77.18 years in positive deviant counties and 72.31 years in negative deviant counties (Tables 2.3 and 2.4).

Most of the social and economic metrics were statistically significant between positive and non-deviant counties for Quartile 3 (Table 2.3). Positive deviant counties performed better than non-deviant counties for percent with some college, percent below poverty, percent children in poverty, percent uninsured adults, and percent uninsured children. In positive deviant counties 14.82% of adults were uninsured compared to 19.60% of adults in non-deviant counties which was essentially the same percent of uninsured adults in negative deviant counties (19.54%). Incidentally, only percent of uninsured adults was not statistically significant between negative and non-deviant counties within Quartile 3 with negative deviant counties performing worse for all metrics except percent less than high school diploma, percent single parent households, and percent uninsured children (Table 2.4). In Quartile 3 the highest percent, 22.54%, with less than a high school diploma was, once again, positive deviant counties, followed by non-deviant counties with 18.82%, and negative deviant counties where only 15.99% had less than a high school diploma (barely above the negative deviant rate in Quartile 2) (Tables 2.3 and 2.4).

Within Quartile 4 (most deprived counties), most variables were significantly different between positive deviant and non-deviant counties (Table 2.3) and between negative deviant and non-deviant counties (Table 2.4). Differences in health outcomes by deviance category (positive vs non-deviant and negative vs non-deviant) were all statistically significant. YPLL had a low of 7,738 for positive deviant counties while negative deviant counties were significantly higher with 13,705 years and non-deviant counties had a rate of 10,184 years. Most of the social and economic metrics were statistically significant between positive and non-deviant counties for

Quartile 4 (Table 2.3) with positive deviant counties performing better than non-deviant counties for all metrics except percent less than a high school diploma and percent uninsured (although this difference was not statistically significant). The only social and economic metric that was not statistically significant between negative and non-deviant counties was percent with less than high school diploma. Negative deviant counties performed worse for all metrics except percent uninsured adults and percent uninsured children (Table 2.4). Negative deviant counties had the lowest percent of uninsured children for all deviance categories with only 6.03% of children uninsured in Quartile 4 and percent uninsured adults was lower (20.86%) in negative deviant counties compared to non-deviant counties (22.24%). For percent with less than a high school diploma, positive deviant counties had the highest percent, 28.65%, followed by non-deviant counties at 23.69%. Negative deviant counties barely differed from non-deviant with 23.38% having less than a high school diploma – although this difference was not statistically significant (Table 2.4).

Discussion

Within each quartile, statistically significant differences existed between positive and negative deviant and non-deviant counties. As expected, the five health metrics used to initially determine deviance were significantly different between positive and negative deviant and non-deviant counties within each quartile and were some of the only variables that were consistently, significantly different. This underscores that those counties deemed positive and negative deviant counties vary significantly from those considered non-deviant. Health metric differences were quite large between positive, negative, and non-deviant counites as well as between Quartiles.

Positive deviant counties within Quartile 1, those counties that are least deprived, had a female life expectancy of 84.19 years while negative deviant counties had a life expectancy of

80.11, and non-deviant counties had a life expectancy of 82.26 years. As deprivation increased in subsequent Quartiles, female life expectancy declined for positive, negative, and non-deviant counties. In Quartile 4, the most deprived counties, female life expectancy for positive deviant counties was 80.89 years, for negative deviant counties 76.08 years, and 78.34 years for non-deviant counties. This was a reduction of about four years from Quartile 1 to Quartile 4. Similarly, male life expectancy for positive deviant counties within Quartile 1 was 80.15 years while negative deviant counties had a life expectancy of 75.51, and non-deviant counties had a life expectancy of 77.74 years. By Quartile 4 male life expectancy for positive deviant counties was 76.20 years, for negative deviant counties 69.50 years, and 72.73 years for non-deviant counties. This was also a reduction of about four years from Quartile 1 to Quartile 4. This finding aligns with Singh's (2003) finding of higher mortality rates in areas with more deprivation. Singh (2003) found that mortality inequalities (between deprived and non-deprived areas) have grown worse in the US because mortality rates in the deprived areas of the US have shown improvement at slower rates compared to non-deprived areas.

Comparable patterns were seen for fair or poor health, physically unhealthy days, mentally unhealthy days, and YPLL. The YPLL finding is similar to that seen by Hale et al. (2018) that found increasing rates of YPLL as deprivation level increased. This study also found that in rural counties YPLL increases were higher than in urban counties, highlighting the disparities present in rural areas. Indeed, most of the demographic, health outcome, social, and economic indicators for positive, negative, and non-deviant counties follow the expected hierarchal pattern of Quartile 1 indicators, least deprived counties, performing better than Quartile 2 indicators, slightly deprived counties, Quartile 2 indicators performing better than Quartile 3, moderately deprived counties, and so on to Quartile 4, most deprived counties. One notable exception of the expected pattern of positive deviant counties faring better than non-deviant counties which, in turn, were expected to fare better than negative deviant counties was that the median household income was actually higher in the negative deviant than the non-deviant counties in Quartile 1 (though this difference was not statistically significant).

The double disparity for Black populations in rural areas other studies have noted (James & Cossman, 2016) was seen here. The percent of the population that was African American increased as deprivation increased (e.g., for negative deviant counties the percent of the population that was African American increased from 2.03% in Quartile 1, least deprived counties, to 29.20% in Quartile 4, most deprived counties). Additionally, positive deviant counties had the lowest percent of the population that was African American (0.64% in Quartile 1 to 3.27% in Quartile 4) while negative deviant counties had the highest precents. Others have noted that blacks experience higher mortality rates compared to whites in rural areas and that mortality predictors (i.e., access to health care) do not affect black populations as strongly as white populations (James & Cossman, 2016).

Social and economic metrics varied significantly between Quartiles and somewhat between positive, negative, and non-deviant counties. The five metrics used to create the area deprivation index (median household income, percent of population with less than high school diploma, percent of population unemployed, percent of population in poverty, and percent of population that are single parents) did show similarities within Quartiles (e.g., not all of the metrics were significantly different within each Quartile). The only metric that was significantly different between positive and negative deviant and non-deviant counties for all four Quartiles was percent of population in poverty. The other four metrics showed some similarities between positive and negative deviant and non-deviant counties in at least one quartile.

This means that the area deprivation index was moderately successful in ensuring that differences in health outcomes were not only driven by differences in the social and material conditions of counties. If health outcomes differences were driven only by social and material differences, the expectation would be that all metrics would be statistically significantly different between positive and negative deviant and non-deviant counties for every quartile, which is not the case.

There are several limitations to this study. First, the small population size of positive and negative deviant counties limits the ability to draw definite conclusions from these data. This study is also cross-sectional which does not allow for analysis of causality (i.e., if economic and social conditions drive health or if health drives economic and social conditions). Data for this study come from a variety of sources collected over differing periods of time. This may have a limited impact on the conclusions, though, as this affects all data regardless of Quartile or deviance.

Further research should endeavor to identify whether differences in local health care and public health systems exist between positive, negative, and non-deviant rural counties. In future research it is imperative to identify if quartile categorization differences exist within deviance categories (e.g., how similar were positively deviant local public health system metrics between Quartile 1 and Quartile 4). Identification of similarities within quartile categorization or within deviance categorization for health care and public health system indicators could help determine which conditions must be met for best practices to be transferrable. While the aim of a positive deviance methodology is to identify and implement strategies to improve health, it is imperative to understand the conditions which must exist for these strategies to be transferred. Therefore, careful consideration of county deprivation must be included in any planned analysis of health care and public health differences between positive, negative, and non-deviant counties.

Conclusions

This study compared how positive and negative deviant and non-deviant counties differed on a variety of material and social conditions. The creation of an area deprivation index, used to separate counties into Quartiles, moderated the impact of material and social conditions within Quartiles. By ensuring that the health outcome differences experienced by counties in positive, negative, and non-deviant categories were not entirely driven by these material and social conditions, one can begin to question what other underlying factors could account for differences. Likely differences in local public health and healthcare systems exist and may contribute to better health experienced within positive deviant counties and worse health in negative deviant counties. The next two chapters examine differences in local public health and healthcare systems by deviance category and Quartile.

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Chapter 3. Using A Positive Deviance Framework to Identify Local Public Health System Differences Among Rural Deviant Counties

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Abstract

Purpose: Local health department (LHD) characteristics vary drastically between rural communities. This study investigated differences in local public health systems in rural counties with better than and worse than expected health outcomes using a positive deviance (PD) framework.

Methods: An area deprivation index was used to divide counties into quartiles and deviance designation was determined using five health outcomes metrics. Multivariate analysis by deviance designation was conducted as was multinomial logistic regression.

Findings: Positive deviant counties were more likely to have their next year's budget exceed their current budget compared to non-deviant and negative deviant counties in all quartiles. Negative deviant counties had much lower rates of completed community health assessments, community health improvement plans, and strategic plans and were less likely to have a non-profit hospital in their jurisdiction. LHDs overseen by their local government were 6.20 (p=.001) times more likely to be positive deviant than those with a shared governance structure compared to non-deviant counties and negative deviant counties were much less likely (OR=0.12, p<.001) to have a local government structure compared to non-deviant counties.

Conclusions: There were significant differences between positive, negative, and non-deviant counties on factors known to predict LHD performance including jurisdiction size, jurisdiction type, staffing patterns, presence of local boards of health (LBOH), and per capita spending. By knowing what LHD factors in rural counties are associated with better than expected health outcomes, local and state governments can funnel funding and resources to those practices or infrastructure components that are associated with better outcomes.

Introduction

Public health in the United States (US) has progressed through several eras since the first public health office opened in Baltimore in 1798 (Berkowitz, 2004). Today, population health improvement is driven by three core functions (IOM, 1988) and ten essential public health services (Public Health Functions Steering Committee, 1994). The original public health services were agreed upon in 1994 and recently updated (The Public Health National Center for Innovations, 2020). With the recent update the essence of the ten essential public health services remains the same with alterations in language and scope for each service and the addition of equity at the center of the 10 essential services.

Within rural America, infrastructure of local health departments (LHDs) varies greatly, directly influencing LHDs' ability to provide services to their communities. Issues of workforce capacity, organizational capacity, and information systems (Berkowitz, 2004) are widespread concerns, and performance in these areas differs between counties and states. Additionally, LHD governance structure may affect health system functioning, however it is contested whether decentralized government structures (i.e., LHDs are local government entities) are better at providing services than centralized government structures (i.e., LHDs are state government entities), shared government structures (i.e., LHDs are both state and local government entities), or mixed models (i.e., LHDs are either state or local government entities) (NACCHO, 2020). Important characteristics of LHDs include infrastructure, workforce, budgets and revenue sources, policy-making efforts, community health assessments, and health department accreditation.

Oftentimes, the ten essential public health services are used to assess LHD performance (Corso et al., 2000). Key factors that predict performance include: jurisdiction size, jurisdiction type, staffing patterns, presence of local boards of health, per capita spending, presence of executives holding advanced degrees, and partnerships with outside organizations (Bhandari et al., 2010; Erwin, 2008; Hyde & Shortell, 2012). Performance relative to the ten essential services has been associated with county health status (Hyde & Shortell, 2012), therefore, understanding the key factors that predict performance is vital.

Rural areas often face greater difficulty delivering public health services and LHDs' ability to provide the ten essential public health services is mixed (Harris et al., 2016). Rural LHDs experience lower levels of funding (Beatty et al., 2010; Beatty et al., 2020; Berkowitz, 2004; Hajat et al., 2003), fewer staff (Beatty et al., 2010; Rosenblatt et al., 2002) and greater difficulty in recruiting and retaining staff (Berkowitz, 2004; Hajat et al., 2003). Along with limited transportation options within communities (Berkowitz, 2004) and technology access issues (Harris et al., 2016), it is easy to understand the difficulty in delivering public health services in rural areas.

This study focused on rural counties and sought to identify key differences in LHDs' structural capacity and processes between counties with better than expected and worse than expected health outcomes. Key factors that predict LHD performance were utilized to investigate if and how local public health systems differ. Identification of differing conditions, capacities, and processes between LHDs in counties with better than expected and worse than expected health may point to structural features or actions that could potentially be driving these differences.

Methods

Data Sources

This analysis focused on rural counties in the US and rural counties were identified from the US Department of Agriculture, Economic Research Service 2013 Rural-Urban Continuum Codes (USDA, n.d.).

Area deprivation index indicators were from the US Census Bureau, 2015 American Community Survey 5-year Estimates (US Census Bureau, n.d.). Data used to identify deviance in counties came from several sources: male and female life expectancies came from the 2014 Institute of Health Metrics and Evaluation, US County Profiles (IHME, 2016), while years of potential life lost, fair or poor health, and poor physical health days outcome data come from the 2017 County Health Rankings National Data (University of Wisconsin Population Health Institute, 2017).

All local public health system data were obtained from the 2016 National Profile of Local Health Departments (Profile Study) which was collected by the National Association of County and City Health Officials (NACCHO) (NACCHO, 2017b). Metrics were mapped onto the Handler et al. (2001) framework.

Creation of an Index

An area deprivation index was used to divide counties into quartiles, enabling their comparison. The primary reason for its use was to ensure that counties were similar on several material and social indicators, rather than just one primary indicator. Utilizing several indicators to create an index helps to ensure that differences in health are not just driven by economic differences, but potentially by other, underlying differences such as differences in LHDs.

It was beyond the scope of this research project to create an original material and social deprivation index, therefore, the metrics included in the Hale et al. (2015) index were used. These metrics were median household income, percent of population with less than high school diploma, percent of population unemployed, percent of population in poverty, and percent of population that are single parents. This particular index's methods were replicated because of Hale et al. (2015) focus on health care services in rural communities. Z-scores for each metric were summed to create the final county index score.

Positive and Negative Deviant Counties

The methodology utilized to identify counties performing better or worse than expected was a positive deviance (PD) framework. While the traditional PD framework focuses on individual behaviors that lead to positive health outcomes (Wishik & Vynckt, 1976), several researchers have created modifications of the framework specifically for population-level data (Rose & McCullough, 2017; Walker et al., 2007).

To determine which counties were positive and negative deviants, all counties were divided into quartiles based on area deprivation index scores. Five health metrics were used to identify deviant counties: male life expectancy, female life expectancy, years of potential life lost, fair or poor health, and physically unhealthy days. A process similar to the one used to create the deprivation index was used to determine deviancy. However, county z-scores for each metric were averaged and those below -0.8 became positive deviant counties while those above 0.8 became negative deviant counties. Male and female life expectancy values were reverse coded to ensure consistency with the other metrics as a higher life expectancy score was more desirable, while higher scores for the other metrics were less desirable. Deviance is the outcome measure in this study.

Framework

The framework used to examine the relationship between public health practice and deviance (e.g., population outcomes) was the Handler, Issel, and Turnock conceptual framework for measuring public health system performance (Handler et al., 2001). This framework provides a conceptual basis to examine relationships between public health system components and encourages a systematic approach to understanding local public health system performance.

There are five main components of the framework (Table 3.1). Outside forces that could affect a system, including political, economic, and social forces, are included in the macro context (Handler et al., 2001). Mission and purpose, structural capacity, and processes are the components that measure public health system characteristics. Mission refers to the goals of the public health system and how these can be operationalized via the three core functions of public health (Handler et al., 2001). Structural capacity are the functions public health systems carry out in order to operate including organization, information, human, physical, and fiscal resources (Handler et al., 2001). The process component is often considered to be the essential public health services (Handler et al., 2001). The outcome is the final component of the Handler et al. (2001) framework, which is generally considered to be improved health status of constituents. However, the link between structural capacity, processes, and health outcomes can be difficult to establish. This is especially true if the focus is on an entire public health system rather than a specific program or intervention that system may provide.

Table 3.1.

Handler Public Health System Framework and Associated Data Elements[1]

Macro Context	Structural Capacity	Processes
Area Deprivation index	Population served	New public health ordinance
Non-profit hospital serving residents in jurisdiction	Part of combined Health and Human Services agency	Participated in PHAB's national accreditation program
	Jurisdiction type	Community health assessment completed
Mission	Governance category	Developed health improvement plan
No metrics	Local Board of Health (LBOH)	Developed comprehensive strategic plan
	LBOH adopts regulations	Revised public health ordinance
	Next fiscal year's budget compared to current budget	
Outcomes	Executive with doctoral degree	
Deviance	Executive with nursing degree	
	LHD total FTE Employees	

[1]Handler et al., 2001

Data Measures

Many of the variables of interest were recoded from the original data in the 2016 NACCHO Profile Study. Size of population served was divided into a five-level categorical variable; population size often undergoes this transformation (Hale et al., 2016). The number of full-time equivalents (FTEs) was transformed into a per capita rate (per 10,000 population) – the population estimate used to calculate the per capita rate was the population included in the 2016 NACCHO Profile Study. Top executive with a nursing degree was coded *yes* when it was indicated the top executive had an ASN, BSN, MSN, or DNP. Top executive with a doctorate degree was coded *yes* when it was indicated the top executive had any of the doctoral degrees listed in the Profile Survey.

NACCHO Profile Study questions regarding community health assessments (CHA), community health improvement plans (CHIP), and development of strategic plans were all dichotomized in the following manner. The responses 'yes, within the last three years' and 'yes, more than three but less than five years ago' became *yes* while 'yes, five or more years ago', 'no, but plan to in the next year' and 'no' became *no*. LHD's participation in the Public Health Accreditation Board's (PHAB's) accreditation program was recoded into three variables (Beatty et al., 2018). The responses 'my LHD has been accredited by PHAB' and 'my LHD is part of a PHAB-accredited centralized state integrated local public health department system' became *PHAB accredited*. 'My LHD has submitted an application for PHAB accreditation', 'my LHD has registered in e-PHAB in order to pursue accreditation', 'the state health agency has registered in e-PHAB in order to pursue accreditation as an integrated system that includes my LHD', 'my LHD plans to apply for PHAB accreditation, but has not yet registered in e-PHAB', and 'the state health agency plans to apply for PHAB accreditation as an integrated system that includes my LHD, but has not yet registered in e-PHAB' became *seeking accreditation*. Meanwhile, 'my LHD has not decided whether to apply for PHAB accreditation' and 'my LHD has decided not to apply for PHAB accreditation' became *not seeking accreditation*.

Governance category, jurisdiction type, LHD part of combined health and human services agency, presence of local board of health (LBOH), LBOH adopts regulations, next fiscal year's budget compared to current budget, new public health ordinance, revised public health ordinance and non-profit hospital serving residents in jurisdiction were not recoded.

Data Analysis

The characteristics of the study population were described by material and social deprivation index quartile (Appendix B.1) and multivariate analysis by deviance was conducted (for each quartile, positive, negative, and non-deviant counties were compared). Nonparametric analyses were computed using Kendal Tau-b test for ordinal predictors and Cramer's V for nominal predictors.

A multinomial logistic regression was computed based on the results of the multivariate analysis. Odds ratios (ORs) and the corresponding 95% confidence intervals (CIs) were reported along with the significance of the likelihood ratio test and overall Nagelkerke pseudo-R^2. Variables were examined for multicollinearity with a cutoff of ± 0.8 (Berry & Feldman, 1985; Field, 2009); however, no variables were correlated this strongly, so no variables were excluded (Appendix B.2). Data analysis software, SPSS Statistics 25, was used (IBM Corp, 2017).

Results

1896 rural counties were included in the analysis; Quartile 1 had 306 counties, Quartile 2 had 481 counties, Quartile 3 had 495 counties, and Quartile 4 had 614 counties. There were several statistically significant differences between positive, negative, and non-deviant counties within quartiles, Table 3.2 and 3.3. While differences in population were not significant in Quartile 1, more than half of negative deviant counties had a population less than 25,000 (Table 3.2) while population categories were similar in Quartile 2. Quartiles 3 and 4 had significant differences in population including almost one third of non-deviant counties having population over 250,000 in Quartile 4 (Table 3.3). While positive and non-deviant counties mostly had a decentralized government structure (i.e., local government oversees LHDs), negative deviant counties mostly had a centralized government structure (i.e., state government oversees LHDs) with a range from 44.1% in Quartile 1 to 76.6% in Quartile 3. Quartiles 2 and 3 had significant differences in jurisdiction type with ~ 75% of negative deviant counties having single county jurisdiction while positive and non-deviant counties were more equally split between single county and multi-county (Table 3.2 and 3.3).

Table 3.2.

LHD Characteristics by Positive and Negative Deviance of Quartile 1 and Quartile 2 Counties[a]

	Q1: Least Deprived Counties				Q2: Slightly Deprived Counties			
	Positive Deviant (n=35) %	**Non-Deviant** (n=237) %	**Negative Deviant** (n=34) %	***p***	**Positive Deviant** (n=75) %	**Non-Deviant** (n=218) %	**Negative Deviant** (n=47) %	***p***
Population Served								
≤24,999	34.3	36.3	52.9	NS	38.7	35.8	38.3	NS
25,000-49,999	31.4	26.6	8.8		25.3	23.4	29.8	
50,000-99,999	28.6	29.5	11.8		25.3	12.8	21.3	
100,000-249,999	0.0	3.4	8.8		6.7	12.8	4.3	
≥250,000	5.7	4.2	17.6		4.0	15.1	6.4	
Governance Category								
State	17.1	12.7	44.1	.001	16.0	23.4	51.1	.001
Local	80.0	84.0	52.9		82.7	71.6	34.0	
Shared	2.9	3.4	2.9		1.3	5.0	14.9	
Jurisdiction Type								
County	48.6	49.8	52.9	NS	52.0	62.4	74.5	.043
Multi-County	51.4	50.2	47.1		48.0	37.6	25.5	
Part of combined HHS agency	0.0	14.7	17.6	.043	23.6	19.4	15.2	NS
LBOH (yes)	80.0	71.9	64.7	NS	76.1	65.4	72.3	NS
LBOH adopts regulations	85.7	76.5	86.4	NS	75.9	69.3	60.6	NS
Next fiscal year's budget compared to current budget								
Less than	17.9	22.5	34.6	NS	20.9	24.6	38.7	NS
Approximately the same	50.0	51.5	50.0		55.2	55.9	58.1	
Greater than	32.1	26.0	15.4		23.9	19.6	3.2	
Top executive: doctoral degree	9.1	8.4	26.7	.008	7.6	20.3	7.0	.011
Top executive: nursing degree	45.5	55.3	50.0	NS	40.9	37.7	34.9	NS
LHD total FTE employees per capita (10,000)								
≤3.4753	42.4	39.0	10.0	NS	32.8	34.5	20.5	NS
3.4754-5.2562	9.1	15.1	36.7		15.6	25.0	25.0	
5.2563-7.7821	24.2	21.1	23.3		29.7	17.5	20.5	
>7.7822	24.2	24.8	30.0		21.9	23.0	34.1	
New public health ordinance	29.4	33.6	60.6	.007	34.7	28.7	27.3	NS
Revised public health ordinance	32.4	30.3	39.4	NS	25.0	19.9	18.2	NS
Completed CHA	88.6	85.3	75.8	NS	97.1	82.8	68.9	.001
Completed CHIP	82.9	80.4	56.7	.010	92.8	69.3	53.3	.001
Non-profit hospital	97.0	95.0	70.0	.001	89.4	87.0	54.8	.001
Developed strategic plan	60.0	59.0	46.7	NS	54.1	50.9	48.9	NS
PHAB Accreditation status								
PHAB accredited	0.0	4.1	0.0	NS	4.4	2.2	2.7	NS
Seeking accreditation	33.3	39.0	30.0		38.2	31.2	43.2	
Not seeking accreditation	66.7	56.9	70.0		57.4	66.7	54.1	

Abbreviations: CHA, community health assessment; CHIP, community health improvement plan; FTE; full-time equivalent; HHS, Health and Human Services; LOBH, local board of health; LHD, local health department; PHAB, Public Health Accreditation Board
[a]Performed Cramer's V and Kendal Tau-b test.

Table 3.3.

LHD Characteristics by Positive and Negative Deviance of Quartile 3 and Quartile 4 Counties[a]

	Q3: Moderately Deprived Counties				Q4: Most Deprived Counties			
	Positive Deviant (n=84) %	**Non-Deviant** (n=192) %	**Negative Deviant** (n=94) %	***p***	**Positive Deviant** (n=76) %	**Non-Deviant** (n=313) %	**Negative Deviant** (n=83) %	***p***
Population Served								
≤24,999	29.8	27.1	39.4	.003	27.6	25.9	36.1	.001
25,000-49,999	28.6	21.9	31.9		21.1	15.7	18.1	
50,000-99,999	22.6	19.8	11.7		22.4	8.9	8.4	
100,000-249,999	10.7	15.1	4.3		10.5	18.8	19.3	
≥250,000	8.3	16.1	12.8		18.4	30.7	18.1	
Governance Category								
State	10.7	24.0	76.6	.001	11.8	48.2	71.1	.001
Local	88.1	63.0	7.4		77.6	25.6	12.0	
Shared	1.2	13.0	16.0		10.5	26.2	16.9	
Jurisdiction Type								
County	59.5	59.7	75.5	.022	47.4	42.9	54.2	NS
Multi-County	40.5	40.3	24.5		52.6	57.1	45.8	
Part of combined HHS agency	13.8	16.8	22.3	NS	29.3	20.6	13.4	.048
LBOH (yes)	81.3	72.0	53.3	.001	76.1	50.2	36.1	.001
LBOH adopts regulations	67.7	84.2	61.2	.002	90.7	73.2	70.0	.020
Next fiscal year's budget compared to current budget								
Less than	33.3	28.1	30.7	NS	28.8	42.4	59.4	NS
Approximately the same	47.8	55.6	53.3		60.6	47.5	34.8	
Greater than	18.8	16.3	16.0		10.6	10.1	5.8	
Top executive: doctoral degree	8.9	25.0	16.1	.007	17.6	31.1	8.9	.001
Top executive: nursing degree	34.2	26.7	19.5	NS	22.1	20.6	25.3	NS
LHD total FTE employees per capita (10,000)								
≤3.4753	35.6	23.0	14.5	NS	19.4	13.2	9.7	NS
3.4754-5.2562	23.3	27.6	39.8		31.3	28.8	23.6	
5.2563-7.7821	21.9	24.1	28.9		17.9	31.7	36.1	
>7.7822	19.2	25.3	16.9		31.3	26.3	30.6	
New public health ordinance	21.0	27.7	23.1	NS	27.0	41.5	35.0	NS
Revised public health ordinance	14.8	11.4	12.4	NS	20.3	22.9	21.5	NS
Completed CHA	82.7	81.4	68.8	.031	79.7	81.0	71.6	NS
Completed CHIP	75.0	64.5	53.3	.012	75.3	60.4	42.0	.001
Non-profit hospital	92.4	87.4	69.3	.001	87.5	79.0	58.0	.001
Developed strategic plan	54.9	52.2	46.7	NS	56.0	58.3	42.0	.031
PHAB Accreditation status								
PHAB accredited	5.4	5.3	2.9	.001	17.1	8.9	1.6	NS
Seeking accreditation	29.7	27.6	58.6		28.6	45.9	49.2	
Not seeking accreditation	64.9	67.1	38.6		54.3	45.1	49.2	

Abbreviations: CHA, community health assessment; CHIP, community health improvement plan; FTE; full-time equivalent; HHS, Health and Human Services; LOBH, local board of health; LHD, local health department; PHAB, Public Health Accreditation Board
[a]Performed Cramer's V and Kendal Tau-b test.

Counties were similar in whether they had local boards of health (LBOH) and whether they were able to adopt regulations in Quartiles 1 and 2 (Table 3.2) while significantly more positive deviant counties had LBOH in Quartiles 3 and 4 (Table 3.3). While positive deviant counties were more likely to have their next year's budget greater than their current budget compared to non-deviant and negative deviant counties in all Quartiles, this difference was not significant. It is also important to note that in Quartile 4, the most deprived counties, 59.4% of negative deviant counties reported that their next fiscal budget would be less than their current budget, while 42.4% of non-deviant and 28.8% of positive deviant counties reported similar budget reductions.

Negative deviant counties were most likely to have a new public health ordinance, 60.6%, while positive and non-deviant counties had much lower rates (29.4% and 33.6%, respectively) in Quartile 1. Within Quartiles 2-4, counties had similar rates of new public health ordinances. Rates for revised public health ordinances were similar within all Quartiles (Table 3.2 and 3.3). Negative deviant counties had much lower rates of completed CHA, CHIP, and development of strategic plans in all Quartiles. Compared to positive and non-deviant counties they were also significantly less likely to have a non-profit hospital in their jurisdiction as well (all Quartiles) (Table 3.2 and 3.3).

Negative and positive deviant counties in Quartile 1 had comparable rates of not seeking PHAB accreditation compared to non-deviant counties (Table 3.2). Rates of PHAB accreditation were similar and not statistically different in Quartiles 2 and 4, although the percent of counties with PHAB accreditation generally increased for positive and non-deviant counties so that Quartile 4, the most deprived counties, actually had the highest percent of PHAB accreditation at 17.1% for positive deviant counties and 8.9% for non-deviant counties. However, in Quartile 3 negative deviant counties were more likely to be seeking PHAB accreditation, 58.6%, compared to positive, 29.7%, and non-deviant, 27.6%, counties (Table 3.3).

The overall multinomial logistic regression model predicting positive and negative deviance was significant ($\chi^2_{10} = 261.692$, $p < .001$). The Nagelkerke pseudo-R2 was 0.30, which indicated that the model reduced the badness of fit by 30% compared with a model with the intercept alone. The model's goodness-of-fit, measured by the Pearson chi-square was 1043.02, $p = .271$ (not statistically significant) indicating that the model fits the data well. The baseline for the model was non-deviant counties. This analysis is a series of comparisons between two categories (Field, 2009): positive deviant to non-deviant and negative counties to non-deviant.

LHDs governed by their local government were 6.20 times (95% CI, 2.54-15.13) more likely to be positive deviant than those with a shared government structure. LHDs with a multicounty jurisdiction were 1.83 times (95% CI, 1.41-2.95) more likely to be positive deviant than those with a single county jurisdiction (Table 3.4).

Table 3.4.

Multinomial Logistic Regression of Positive and Negative Deviance (All Quartiles)

	Positive Deviant Counties			Negative Deviant Counties		
	Odds Ratio	**95% CI**	**p**	**Odds Ratio**	**95% CI**	**p**
Population Served (ref= ≤24,999)						
25,000-49,999	.83	.49-1.40	NS	.97	.49-1.90	NS
50,000-99,999	.71	.39-1.27	NS	1.04	.45-2.37	NS
100,000-249,999	.50	.22-1.15	NS	.22	.07-.71	.011
≥250,000	.89	.31-2.55	NS	.24	.07-.84	.026
Governance Category (ref=shared)						
State	.48	.14-1.71	NS	1.85	.84-4.08	NS
Local	6.20	2.54-15.13	.001	.12	.06-.25	<.001
Jurisdiction Type (ref=county)	1.83	1.14-2.95	.013	.88	.41-1.90	NS
Part of combined HHS agency (ref=no)	2.06	1.24-3.41	.005	.82	.40-1.65	NS
LBOH (ref=no)	1.30	.76-2.22	NS	1.13	.61-2.11	NS
Next fiscal year's budget compared to current budget (ref=less than)						
Approximately the same	.87	.57-1.32	NS	.41	.25-.69	<.001
Greater than	.87	.51-1.49	NS	.47	.23-.98	.044
Top executive: doctoral degree (ref=no)	1.34	.74-2.44	NS	.55	.27-1.11	NS
Top executive: nursing degree (ref=no)	.82	.53-1.25	NS	.79	.45-1.38	NS
LHD total FTE employees per capita (ref=≤3.4753)						
3.4754-5.2562	.99	.56-1.76	NS	1.35	.63-2.90	NS
5.2563-7.7821	.90	.53-1.52	NS	1.33	.60-2.96	NS
>7.7822	.82	.47-1.44	NS	1.06	.45-2.47	NS
New public health ordinance (ref=no)	.85	.55-1.32	NS	1.02	.57-1.83	NS
Revised public health ordinance (ref=no)	1.03	.64-1.65	NS	1.42	.72-2.79	NS
Completed CHA (ref=no)	.94	.47-1.84	NS	1.24	.62-2.50	NS
Completed CHIP (ref=no)	1.83	1.02-3.29	.042	.63	.35-1.11	NS
Non-profit hospital (ref=no)	.90	.50-1.64	NS	.77	.42-1.43	NS
Developed strategic plan (ref=no)	.79	.53-1.18	NS	.64	.38-1.07	NS
PHAB Accreditation status (ref=not seeking accreditation)						
PHAB accredited	2.48	1.07-5.73	.034	.34	.08-1.51	NS
Seeking accreditation	1.00	.65-1.52	NS	.50	.29-.85	.011
Abbreviations: CHA, community health assessment ;CI, confidence interval; CHIP, community health improvement plan; FTE; full-time equivalent; HHS, Health and Human Services; LOBH, local board of health; LHD, local health department; PHAB, Public Health Accreditation Board						

Being a part of a combined Health and Human Services agency increased the odds (OD=2.06, 95% CI, 1.24-3.41) of being positive deviant compared to non-deviant. A completed CHIP also increased the odds (OD=1.83, 95% CI, 1.02-3.29) of being positive deviant compared to non-deviant. Positive deviant counties were much more likely to be PHAB accredited (OD=2.48, 95% CI, 1.07-5.73) compared to non-deviant counties (Table 3.4). When comparing negative deviant counties to non-deviant counties the following odds were seen. Negative deviant counties were much less likely (OR=0.12, CI .06-.25) to have a local government structure than a shared government structure and had decreased odds of their next year's fiscal budget greater than or approximately the same as their current budget (OR=.47, 95% CI, .23-.98, OR=.41, 95% CI, .25-.69, respectively) compared to non-deviant counties (Table 3.4). Negative deviant counties were also much less likely to be seeking PHAB accreditation (OD=.50, 95% CI, .29-.85) compared to non-deviant counties.

Conclusion

Overall, the strongest predictor of deviance was governance structure. Positive deviant counties were more likely to have a local government structure, while negative deviant counties were less likely to have a local governance structure when compared to non-deviant counties. In the US, 30 states have a decentralized government structure (i.e., LHDs are local government entities), seven states have a centralized government structure (i.e., LHDs are state government entities), three states have a shared government structure (i.e., LHDs are both state and local government entities) and nine states have a mixed model (i.e., LHDs are either state or local government entities) (Rhode Island was excluded) (NACCHO, 2020). While it is thought that a decentralized government structure should improve decision making (e.g., it allows LHDs to focus on substantiated issues in their community), there are currently few empirical studies that examine how decentralization effects health system performance. This has led to "the debate on whether or not decentralization improves equity, efficiency, accountability and quality of services" (Panda & Thakur, 2016, 562). While this study was not equipped to investigate decentralization, it is an important finding that positive deviant counties were significantly more likely to be decentralized while negative deviant counties were significantly less likely. One potential explanation for the relationship between deviance and governance structure is endogeneity bias. Deviant designation was determined using five health outcome metrics and rural counties in the South tend to have worse health outcomes leading to more counties in Southern states classified as negative deviant. Simultaneously, Southern states are more likely to have a centralized governance structure which could lead to high correlation between deviance designation and governance structure. Future studies should further examine the relationship between governance structure and health outcomes to better understand how decentralization effects health system performance.

Several variables that were significantly different in the quartile comparisons were not statistically significant in the multinomial logistic regression. Among these were the lower rates of completed CHA, CHIP, strategic plans, and lack of non-profit hospitals in negative deviant counties. While these variables were not significant in the model, they are still important to consider. Lack of health care access at the macro context level, such as lack of non-profit hospitals, can illuminate conditions within communities that make better health harder to achieve. While lack of access to services does not, itself, lead to poor health, the inability to access services does make it harder to limit the effects of poor health. Additionally, the lack of process activities (i.e., those activities public health systems complete to improve the health of their constituents) (Handler et al., 2001) in negative deviant counties, compared to positive and non-deviant counties, highlights an area where LHDs could implement changes to improve the health of constituents.

Limitations of this study included the cross-sectional nature of the study that limits ability to investigate if LHD differences were driving health outcome differences. There were also difficulties in obtaining necessary data for all of the framework's components. For example, no clear, distinct, agreed-upon metrics for public health system mission are readily available. Indeed, other research utilizing the Handler et al. (2001) framework excludes measurement of this component (Scutchfield et al., 2004) as we did here. It can also be difficult to measure the processes component of this framework. The 2016 NACCHO Profile Study did not investigate LHDs' completion of the ten essential public health services (NACCHO, 2017a); therefore, our focus was on the key factors that predict their performance. Additionally, the NACCHO Profile Study was self-reported and voluntary. Consequently, data on positive, negative, and non-deviant counties are limited, as not all LHDs completed the survey, nor do they answer all questions. While this is a significant limitation, the NACCHO Profile Study is the only survey that aims to identify an accurate accounting of LHD infrastructure and practices.

Future studies should consider using the PD approach when conducting research on local public health system components – this approach does not focus on identifying deficits within rural communities, but rather on identifying what functional, innovative systems, practices, or infrastructure may exist that could be associated with positive health outcomes. Much research is focused on what is negative within rural communities, especially in comparison to urban communities, and while information on rural-urban differences is valuable, a more holistic view that includes positive traits found in rural communities is needed. Future research should also focus on the process outcomes that were found to be significant in this study (CHA, CHIP, and strategic plans) to provide insight on how their completion may affect population level health outcomes.

This study has identified how local public health system factors differ between counties with better and worse than expected health outcomes. Positive deviant counties were more likely to have their next year's budget greater than their current budget and more likely to governed locally (decentralized government structure). Negative deviant counties had much lower rates of completed CHA, CHIP, and strategic plans and were less likely to have a non-profit hospital in their jurisdiction. By knowing what LHD factors, in rural counties, are associated with better than expected health outcomes local and state governments can funnel funding and resources to those practices or infrastructure components that are associated with better outcomes. Additionally, these associations provide evidence for state-level policies that could be enacted to improve LHDs performance. For example, states could require that all LHDs complete a CHA, CHIP, and strategic plan that are updated systematically. In order to be PHAB accredited LHDs must complete of a CHA, CHIP, and strategic plan which provides additional support for their importance and some states already require that all LHDs undertake these processes.

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Chapter 4. Using A Positive Deviance Framework to Identify Local Healthcare System Differences Among Rural Deviant Counties

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Abstract

Objective: This study investigated whether differences existed in healthcare system enabling factors between communities with better than and worse than expected health outcomes in the United States.

Data sources: All data were from secondary sources - US Census Bureau American Community Survey, Institute of Health Metrics and Evaluation, County Health Rankings, and The Health Resources and Services Administration's Area Health Resource File.

Study Design: An area deprivation index was used to divide counties into quartiles (Quartile 1 counties were least deprived, while Quartile 4 counties were most deprived). Deviance of counties was determined using five health outcomes metrics. Using summed z-score values of these metrics, a cut point was used to identify counties as positive, negative, or non-deviant.

Principal Findings: There were high rates of health professional shortage areas (HPSAs) for mental health professionals; for '*all the county designated as a mental health HPSA'* the rates for positive, negative, and non-deviant counties in all Quartiles (1-4) were above 64.9%. Quartile 1 counties had the fewest counties that had both federally qualified health centers (FQHC) and community health centers, while Quartile 4 counties had the most. Positive deviant counties were more likely to have more physicians per capita in all Quartiles. The overall multinomial logistic regression model predicting positive and negative deviance was significant (χ210 = 230.166, p < .001). Positive deviant counties were 2.98 (p<.001) times more likely to have higher physician per capita rates (> 17.28 physicians per 10,000 population), while negative deviant counties were less likely (OR=.35, p<.001) compared to non-deviant counties. However, negative deviant counties exhibited higher nurse practitioner per capita rates (OR=1.47, p=.38) compared to non-deviant counties.

Conclusions: There were significant differences between positive, negative, and non-deviant counties for healthcare system enabling factors including FQHCs and community health centers, physicians per capita, nurse practitioners per capita, and hospital beds per capita.

Keywords: positive deviance, deviance, health care service systems, rural, area deprivation index

Introduction

Approximately 46.1 million Americans live in rural counties, a number that has held steady for the past decade (Cromartie et al., 2020). Rural populations often experience higher rates of unintentional injuries, obesity, and cardiovascular disease (Deligiannidis, 2017; Probst et al., 2002) and worse health outcomes compared to urban residents (Deligiannidis, 2017; Douthit et al., 2015) culminating in shorter life expectancies which have not increased relative to urban areas (Singh & Siahpush, 2014). Additionally, access to health care services is a major concern for those in rural areas; Rural Healthy People 2020 found that access to health care services was the most frequently cited concern among those surveyed (Bolin et al., 2015). While access to health care services does not prevent disease, it is an important factor to consider in order to understand health outcomes in rural areas.

This study used the Andersen Behavioral Model of Health Services Use as the framework to examine healthcare capacity in rural populations. The model originally dates to the 1960s and it has gone through extensive redevelopment to become the model currently used (Andersen, 2008). In the current model, health behaviors that lead to health outcomes are driven by contextual and individual characteristics. Contextual characteristics consist of three factors: predisposing, enabling, and need factors. Predisposing factors include the broad social, cultural, and demographic characteristics of an area (similar to the macro environment). Enabling factors include an area's available resources and organizations while need factors describe the collective need for healthcare services in an area (Andersen & Newman, 1973). Similarly, individual characteristics focus on an individual's personal predisposing, enabling, and need factors (Andersen, 2008). Historically most versions of the model, and previous studies, have focused on individual factors rather than contextual factors. This has changed in the most recent phase of the model though and more consideration is given to the larger context in which healthcare systems exist. This study focused on these enabling factors, specifically resources (capacity), to examine if differing rates of capacity factors between counties with better and worse than expected health outcomes may point to structural features that could be driving differences.

Previous research has identified enabling factors affecting access to health care services in rural areas that are particularly salient including shortages in the number of primary care physicians (Brundisini et al., 2013; Deligiannidis, 2017; Douthit et al., 2015; Goins et al., 2005; Harris & Leininger, 1993; Weinhold & Gurtner, 2014; Woods et al., 2003) and scarcity of clinics and hospitals (Douthit et al., 2015).

Most studies compare these enabling factors (number of primary care physicians and scarcity of clinics and hospitals) between rural and urban areas. However, this study focused on how rural counties compare to one another by using a positive deviance (PD) framework to identify rural counties that performed better or worse than expected. PD is a framework that can be used to identify underlying conditions that drive differences in populations. The framework was created in the 1970s, though it did not gain widespread popularity until the 1990s (Marsh et al., 2004; Wishik & Vynckt, 1976) and has been used for many public health and healthcare issues of concern (Baxter et al., 2016; Foster et al., 2015; Marty et al., 2015; Pascale et al., 2010; Shafique et al., 2016; Sharifi et al., 2015). While the framework has primarily been used to identify extra-ordinary behaviors of individuals, more recently it has been used to discover county-level differences that may confer advantages to populations (Canavan et al., 2016; Klaiman et al., 2016). In fact, Walker et al. (2007) created a modified PD framework specifically for working with existing public health data and Rose and McCullough (2017) modified the classic PD framework for use within the field of health services research.

This modified PD framework was used to examine capacity variations within rural healthcare systems to identify whether key differences exist between communities with better than expected and worse than expected health outcomes. Identification of differing capacity factors between counties with better and worse than expected health may point to healthcare access features that could be driving these differences.

Methods

Data Sources

Median household income, percent of population with less than a high school diploma, percent of population unemployed, percent of population in poverty, and percent of population that are single parents were the measures used to create the area deprivation index and all measures came from the US Census Bureau, 2015 American Community Survey (5-year estimate) (US Census Bureau, n.d.). Rural counties were those identified as non-metro by the US Department of Agriculture, Economic Research Service 2013 Rural-Urban Continuum Codes (USDA, n.d.). Statistics on male and female life expectancy came from the 2014 Institute of Health Metrics and Evaluation, US County Profiles (IHME, 2016). 2017 County Health Rankings National data were used to identify years of potential life lost, fair or poor health, and poor physical health days (University of Wisconsin Population Health Institute, 2017).

Healthcare capacity data came from U.S. Department of Health and Human Services, Health Resources and Services Administration (HRSA) 2016-2017 Area Health Resource File (AHRF) (HRSA, n.d.). County-level indicators included were: 1) health professional shortage area (HPSA) – primary care practitioners, 2) HPSA – dental practitioners, 3) HPSA – mental health professionals, 4) number of Joint Commission on Accreditation of Healthcare Organizations (JCAHO) certified hospitals, 5) number of rural health clinics, 6) number of federally qualified health centers (FQHCs), 7) number of community health centers, 8) number of physicians (active M.D.s and D.O.s, federal and non-federal), 9) number of nurse practitioners, 10) number of hospital beds, and 11) number of hospitals (HRSA, n.d.).

Creation of an Index

To compare subsets of counties, an area deprivation index originally developed by Hale et al. (2015) was utilized. An index was used, as opposed to one income- or poverty-related variable, because an index is more robust than a single variable and can reduce the possibility that differences in health outcomes were attributable to economic differences rather than other underlying factors (Messer et al., 2006; Singh, 2003). Hale et al. (2015) examined healthcare capacity in rural communities. The metrics included in the index were median household income, percent of population with less than a high school diploma, percent of population unemployed, percent of population in poverty, and percent of population that are single parents. The final county index score was created by summing the z-scores for each metric.

Positive and Negative Deviant Counties

To identify positive and negative deviant counties all counties were first divided into quartiles by area deprivation index scores. Counties in Quartile1 were the least deprived counties, Quartile 2 counties were slightly deprived, Quartile 3 counties were moderately deprived, and Quartile 4 counties were the most deprived counties. Deviancy was determined in a similar manner to how the area deprivation index was created using the following health metrics: male life expectancy, female life expectancy, years of potential life lost, fair or poor health, and physically unhealthy days. Once z-scores for the health metrics were averaged those counties with an average below -0.8 became positive deviant counties, those above 0.8 became negative deviant counties, and counties between -0.80 and 0.80 were classified as non-deviant.

To ensure consistency, male and female life expectancy values were reverse coded because a higher life expectancy score was more desirable, while higher scores for the other metrics were less desirable.

Data Measures

Many of the variables of interest were recoded from the original data in the 2016-2017 AHRF. Number of JCAHO certified hospitals and number of rural health clinics were recoded into dichotomous variables. These variables were coded *yes* if there was one or more of that type of facility in the county and coded *no* when there were none of that type of facility in the county. Number of FQHCs and number of community health centers were combined into one variable (due to high correlation between these variables); variables were coded *both CHC and FQHC* when there was one or more of both types of facility in the county, coded *FQHC but no CHC* when there was one or more FQHCs but no community health centers in the county, coded *CHC but no FQHC* when there was one or more community health centers but no FQHCs in the county, and coded *neither FQHC nor CHC* when there neither type of facility in the county. The variables number of physicians, number of nurse practitioners, number of hospital beds, and number of hospitals were transformed into per capita rates (per 10,000 population) – the population estimate used to calculate the per capita rates was the population included in the 2016-2017 AHRF. The per capita rates were then broken into quartiles; quartile 1 included the lowest per capita rates (per 10,000 population) for physicians, nurse practitioners, hospital beds, and hospitals while quartile 4 had the highest per capita rates.

HPSA – primary care practitioners, HPSA – dental practitioners, and HPSA – mental health professionals were not recoded (HPSA codes in the 2016-2017 AHRF included: none of the county designated as a shortage area, the whole county designated as a shortage area, and one or more parts of the county designated as a shortage area) (HRSA, n.d.).

Data Analysis

Study population characteristics were described by material and social deprivation index quartile (Appendix C.1). Multivariate analysis was conducted by deviance – for each quartile, positive, negative, and non-deviant counties were compared – and nonparametric analysis were undertaken (Kendal Tau-b test was used for ordinal predictors and Cramer's V for nominal predictors).

Then a multinomial logistic regression was computed based on the results of the multivariate analysis. The significance of the likelihood ratio test and overall Nagelkerke pseudo-R^2 were reported as well as odds ratios (ORs) and the corresponding 95% confidence intervals. To ensure multicollinearity was not an issue, variables were examined with a cutoff of $\pm$ 0.8 (Berry & Feldman, 1985; Field, 2009); due to multicollinearity it was determined that FQHCs and community health centers should be combined into one variable (Appendix C.2). Data analysis software, SPSS Statistics 25, was used (IBM Corp, 2017).

Results

1970 rural counties were included in the analysis; Quartile 1 had 380 counties, Quartile 2 had 481 counties, Quartile 3 had 495 counties, and Quartile 4 had 614 counties. There were several statistically significant differences between positive, negative, and non-deviant counties within Quartiles (see Tables 4.1 and 4.2). Differences in the HPSA for primary care practitioners were significant in Quartile 1, with only 27.3% of positive deviant counties designated as a shortage area for the entire county and 31.8% of counties not designated as a shortage area, compared to 49.1% of negative deviant counties designated as a shortage area for the entire county and only 1.9% of counties not designated as a shortage area (Table 4.1). Overall, negative deviant counties were more likely to have all or part of the county designated as a HPSA for primary care practitioners. Differences in HPSA for dental practitioners were similar with negative deviant counties having more counties that were designated as a HPSA for all or part of the county. However, differences in the HPSA for dental practitioners were significant in Quartile 4 only (Table 4.2). There were high rates of HPSA for mental health professionals regardless of deviant status or quartile with rates of all the county designated as a mental health HPSA above 64.9% for all quartiles and deviant statuses (Table 4.1 and 4.2) and the only statistically significant difference between deviance status was in Quartile 4.

Table 4.1.

Local Healthcare System Characteristics by Positive and Negative Deviance of Quartile 1 and 2 Counties[a]

	Q1: Least Deprived Counties				Q2: Slightly Deprived Counties			
	Positive Deviant (n= 44) %	**Non-Deviant** (n= 283) %	**Negative Deviant** (n= 53) %	***p***	**Positive Deviant** (n= 99) %	**Non-Deviant** (n= 298) %	**Negative Deviant** (n= 84) %	***p***
HPSA – Primary Care Practitioners								
None of county designated HPSA	31.8	17.3	1.9	.048	15.2	10.7	8.3	NS
Part of county designated HPSA	40.9	53.0	49.1		56.6	64.1	51.2	
All of county designated HPSA	27.3	29.7	49.1		28.3	25.2	40.5	
HPSA – Dental Practitioners								
None of county designated HPSA	47.7	33.6	28.3	NS	18.2	20.1	25.0	NS
Part of county designated HPSA	36.4	54.8	43.4		65.7	67.4	52.4	
All of county designated HPSA	15.9	11.7	28.3		16.2	12.4	22.6	
HPSA – Mental Health Professionals								
None of county designated HPSA	9.1	4.6	1.9	NS	1.0	5.4	3.6	NS
Part of county designated HPSA	4.5	7.8	9.4		10.1	13.1	25.0	
All of county designated HPSA	86.4	87.6	88.7		88.9	81.5	71.4	
JCAHO Certified Hospital	22.7	21.6	17.0	NS	31.3	37.9	39.3	NS
Rural Health Clinic	50.0	55.8	58.5	NS	56.6	60.4	67.9	NS
Federally Qualified Health Center and Community Health Center								
Neither FQHS nor CHC	77.3	77.0	64.2	NS	63.6	53.0	50.0	.043
FQHC but no CHC	0.0	1.1	1.9		1.0	1.7	0.0	
CHC but no FQHC	2.3	3.9	1.9		6.1	4.4	0.0	
Both FQHC and CHC	20.5	18.0	32.1		29.3	40.9	50.0	
Physicians per capita (10,000)								
Quartile 1 (<4.947)	34.1	28.3	41.5	.048	26.3	22.8	27.4	NS
Quartile 2 (4.948-9.270)	11.4	27.6	34.0		19.2	30.2	42.9	
Quartile 3 (9.271-17.277)	22.7	27.2	26.3		26.3	33.2	21.8	
Quartile 4 (17.278<)	31.8	17.0	16.3		28.3	13.8	8.3	
Nurse Practitioners per capita (10,000)								
Quartile 1 (<2.671)	43.2	31.8	45.3	.003	38.4	32.2	32.1	NS
Quartile 2 (2.672-4.368)	31.8	26.5	26.4		19.2	25.2	16.7	
Quartile 3 (4.369-6.705)	9.1	20.5	20.8		16.2	21.5	29.8	
Quartile 4 (6.706<)	15.9	21.2	7.5		26.3	21.1	21.4	
Hospital Beds per capita (10,000)								
Quartile 1 (<7.61)	43.2	24.0	39.6	<.001	22.2	21.8	16.7	NS
Quartile 2 (7.62-19.60)	20.5	19.4	20.8		23.2	23.5	22.6	
Quartile 3 (19.61-36.7)	18.2	16.6	15.1		18.2	27.9	39.3	
Quartile 4 (36.8<)	18.2	39.9	24.5		36.4	26.8	21.4	
Hospitals per capita (10,000)								
Quartile 1 (<0.0956)	38.6	20.1	39.6	<.001	18.2	19.1	15.5	NS
Quartile 2 (0.0957-0.2834)	9.1	8.8	7.5		6.1	17.4	15.5	
Quartile 3 (0.2835-0.6283)	22.7	17.3	13.2		30.3	26.5	32.1	
Quartile 4 (0.6284<)	29.5	53.7	39.6		45.5	36.9	36.9	

Abbreviations: CHC, Community Health Center; FQHC, Federally Qualified Health Center; HPSA, health professional shortage area; JCAHO, Joint Commission on Accreditation of Healthcare Organizations
aPerformed Cramer's V and Kendal Tau-b test.

Table 4.2.

Local Healthcare System Characteristics by Positive and Negative Deviance of Quartile 3 and 4 Counties[a]

	Q3: Moderately Deprived Counties				Q4: Most Deprived Counties			
	Positive Deviant (n=108) %	**Non-Deviant** (n= 273) %	**Negative Deviant** (n=114) %	***p***	**Positive Deviant** (n= 95) %	**Non-Deviant** (n= 410) %	**Negative Deviant** (n= 109) %	***p***
HPSA – Primary Care Practitioners								
None of county designated HPSA	2.8	5.9	6.1	NS	1.1	5.6	1.8	NS
Part of county designated HPSA	77.8	70.7	71.9		73.7	50.7	48.6	
All of county designated HPSA	19.4	23.4	21.9		25.3	43.7	49.5	
HPSA – Dental Practitioners								
None of county designated HPSA	11.1	19.0	8.8	NS	3.2	9.8	0.9	.020
Part of county designated HPSA	85.2	60.4	74.6		77.9	55.6	48.6	
All of county designated HPSA	3.7	20.5	16.7		18.9	34.6	50.5	
HPSA – Mental Health Professionals								
None of county designated HPSA	0.9	4.4	0.9	NS	1.1	2.4	0.9	.010
Part of county designated HPSA	16.7	17.6	34.2		11.6	19.0	12.8	
All of county designated HPSA	82.4	78.0	64.9		87.4	78.5	86.2	
JCAHO Certified Hospital	35.2	45.8	55.3	.011	30.5	41.0	31.2	NS
Rural Health Clinic	65.7	68.1	60.5	NS	74.7	65.9	76.1	NS
Federally Qualified Health Center and Community Health Center								
Neither FQHS nor CHC	45.4	41.0	32.5	NS	29.5	22.4	10.1	.026
FQHC but no CHC	5.6	3.3	3.5		4.2	2.7	3.7	
CHC but no FQHC	2.8	4.4	2.6		7.4	5.4	5.5	
Both FQHC and CHC	46.3	51.3	61.4		58.9	69.5	80.7	
Physicians per capita (10,000)								
Quartile 1 (<4.947)	25.0	23.4	30.7	NS	27.4	40.0	34.9	NS
Quartile 2 (4.948-9.270)	21.3	30.4	35.1		24.2	32.7	42.2	
Quartile 3 (9.271-17.277)	41.7	34.1	21.9		32.6	20.0	17.4	
Quartile 4 (17.278<)	12.0	12.1	12.3		15.8	7.3	5.5	
Nurse Practitioners per capita (10,000)								
Quartile 1 (<2.671)	22.2	23.1	17.5	.007	24.2	21.0	12.8	.009
Quartile 2 (2.672-4.368)	32.4	28.9	14.9		17.9	27.8	20.2	
Quartile 3 (4.369-6.705)	27.8	27.8	32.5		32.6	24.9	28.4	
Quartile 4 (6.706<)	17.6	20.1	35.1		25.3	26.3	38.5	
Hospital Beds per capita (10,000)								
Quartile 1 (<7.61)	25.0	22.0	17.5	NS	31.6	28.5	30.3	NS
Quartile 2 (7.62-19.60)	25.9	26.7	22.8		29.5	25.1	13.8	
Quartile 3 (19.61-36.7)	23.1	28.6	29.8		13.7	25.1	25.7	
Quartile 4 (36.8<)	25.9	22.7	29.8		25.3	21.2	30.3	
Hospitals per capita (10,000)								
Quartile 1 (<0.0956)	16.7	18.7	14.0	NS	27.4	24.1	31.2	NS
Quartile 2 (0.0957-0.2834)	25.9	17.2	20.2		9.5	12.2	0.9	
Quartile 3 (0.2835-0.6283)	25.0	34.8	39.5		27.4	32.7	30.3	
Quartile 4 (0.6284<)	32.4	29.3	26.3		35.8	31.0	37.6	

Abbreviations: CHC, Community Health Center; FQHC, Federally Qualified Health Center; HPSA, health professional shortage area; JCAHO, Joint Commission on Accreditation of Healthcare Organizations
aPerformed Cramer's V and Kendal Tau-b test.

Rates of JCAHO certified hospitals were similar within quartiles with the only statistically significant difference in Quartile 3 (35.2% of positive deviant counties had a JCAHO certified hospital compared to 55.3% of negative deviant counties). Presence of rural health clinics were also similar within quartiles with rates ranging from 50.0% of positive deviant counties in Quartile 1 to 76.1% of negative deviant counties in Quartile 4 having a rural health clinic. Quartile 1 counties had the fewest counties with both FQHCs and community health centers while Quartile 4 counties had the most and there were statistically significant differences between deviance in Quartiles 2 and 4 (Table 4.1 and 4.2). In Quartile 4 positive deviance counties were less likely to have both a FQHC and community health center, only 58.9% of counties, compared to negative deviance counties, 80.7% of counties.

Per capita rates of physicians, nurse practitioners, hospital beds, and hospitals (per 10,000) were broken into quartile ranges. Positive deviant counties were more likely to have higher rates of physicians per capita (> 17.3 physicians per 10,000 population) in all Quartiles (Least Deprived to Most Deprived counties) though these differences were only statistically significant in Quartile 1 (Table 4.1). Nurse practitioner per capita differences between deviant status were significant in Quartile 1, 3, and 4. In Quartiles 3 and 4 (Moderately Deprived and Most Deprived counties) negative deviant counties had higher rates of nurse practitioners per capita (> 6.7 nurse practitioners per 10,000 population) compared to positive deviant counties (Table 4.2). Hospital beds per capita had similar rates between deviance categories for Quartiles 2-4, however there was a statistically significant difference in Quartile 1. Table 4.1 shows that 39.9% of non-deviant counties in Quartile 1 had the highest rate of hospital beds per capita (> 36.8 hospital beds per 10,000 population) while 43.2% of positive deviant counties in Quartile 1 had the lowest per capita rate (< 7.6 hospital beds per 10,000 population). Likewise, hospitals per capita had similar rates between deviance categories for Quartiles 2-4, however there was a statically significant difference in Quartile 1. 53.7% of non-deviant counties in Quartile 1 had the highest rate of hospitals per capita (> 0.63 hospitals per 10,000 population) while only 29.5% of positive deviant counties and 39.6% of negative deviant counties had the highest per capita rate (> 0.63 hospitals per 10,000 population) (Table 4.1).

The overall multinomial logistic regression model predicting positive and negative deviance was significant (χ^2_{10} = 230.166, p < .001). The Nagelkerke pseudo-R2 was 0.132, which indicated that the model reduced the badness of fit by 13% compared with a model with the intercept alone. The model's goodness-of-fit, measured by the Pearson chi-square was 2684.74, p = .547 (not statistically significant) indicating that the model fits the data well. The baseline for the model was non-deviant counties. This analysis is a series of comparisons between two categories (Field, 2009): positive deviant to non-deviant and negative counties to non-deviant.

Positive deviant counties were more likely (OR=1.80, CI, 1.23-2.63) to have part of the county be designated as a HPSA for dental practitioners than none of the county designated as a shortage area (Table 4.3). Positive deviant counties were much less likely to have a JCAHO certified hospital (OD=.66, 95% CI, .48-.92) compared to non-deviant counties. Table 4.3 showed positive deviant counties had increased odds of having the highest physician per capita rate (> 17.3 physicians per 10,000 population) (OR=2.98, 95% CI, 1.83-4.84) compared to non-deviant counties. However, positive deviant counties had decreased odds of having higher hospital beds per capita rates (19.6-36.7 hospital beds and > 36.8 hospital beds per 10,000 population) (OR=.34, 95% CI, .18-.67, OR=.40, 95% CI, .20-.78, respectively) compared to non-deviant counties (Table 4.3).

Table 4.3.

Multinomial Logistic Regression of Positive and Negative Deviance (All Quartiles)

	Positive Deviant Counties			Negative Deviant Counties		
	Odds Ratio	**95% CI**	***p***	**Odds Ratio**	**95% CI**	***p***
HPSA – Primary Care Practitioners (ref=none of county designated HPSA)						
Part of county designated HPSA	.92	.57-1.48	NS	1.39	.77-2.48	NS
All of county designated HPSA	.77	.45-1.31	NS	1.54	.84-2.83	NS
HPSA – Dental Practitioners (ref=none of county designated HPSA)						
Part of county designated HPSA	1.80	1.23-2.63	.002	1.03	.70-1.52	NS
All of county designated HPSA	.90	.56-1.45	NS	1.45	.95-2.22	NS
HPSA – Mental Health Professionals (ref=none of county designated HPSA)						
Part of county designated HPSA	1.51	.62-3.70	NS	2.66	1.06-6.68	.037
All of county designated HPSA	2.21	.96-5.10	NS	1.59	.66-3.87	NS
JCAHO Certified Hospital (ref=no)	.66	.48-.92	.013	1.23	.89-1.71	NS
Rural Health Clinic (ref=no)	1.07	.82-1.41	NS	1.06	.81-1.39	NS
Federally Qualified Health Center and Community Health Center (ref=neither FQHC nor CHC)						
FQHC but no CHC	1.08	.51-2.28	NS	1.65	.74-3.69	NS
CHC but no FQHC	.91	.50-1.65	NS	.83	.40-1.70	NS
Both FQHC and CHC	.75	.56-.99	.045	1.51	1.14-1.99	.004
Physicians per capita (10,000) (ref=Quartile 1)						
Quartile 2 (4.948-9.270)	.79	.54-1.15	NS	1.14	.83-1.59	NS
Quartile 3 (9.271-17.277)	1.63	1.10-2.43	.015	.53	.35-.81	.003
Quartile 4 (17.278<)	2.98	1.83-4.84	<.001	.35	.19-.62	<.001
Nurse Practitioners per capita (10,000) (ref=Quartile 1)						
Quartile 2 (2.672-4.368)	.78	.55-1.10	NS	.73	.50-1.07	NS
Quartile 3 (4.369-6.705)	.82	.57-1.20	NS	1.31	.92-1.86	NS
Quartile 4 (6.706<)	.75	.51-1.11	NS	1.47	1.02-2.11	.38
Hospital Beds per capita (10,000) (ref=Quartile 1)						
Quartile 2 (7.62-19.60)	.59	.31-1.11	NS	2.68	.99-7.31	NS
Quartile 3 (19.61-36.7)	.34	.18-.67	.002	4.36	1.60-11.87	.004
Quartile 4 (36.8<)	.40	.20-.78	.008	4.38	1.57-12.18	.005
Hospitals per capita (10,000) (ref=Quartile 1)						
Quartile 2 (0.0957-0.2834)	1.36	.69-2.72	NS	.34	.12-.95	.039
Quartile 3 (0.2835-0.6283)	1.40	.70-2.81	NS	.34	.12-.94	.038
Quartile 4 (0.6284<)	1.60	.79-3.24	NS	.25	.09-.71	.009
Abbreviations: CHC, Community Health Center; CI, confidence interval; FQHC, Federally Qualified Health Center; HPSA, health professional shortage area; JCAHO, Joint Commission on Accreditation of Healthcare Organizations						

When comparing negative deviant counties to non-deviant counties the following odds were seen. Negative deviant counties were more likely (OR=2.66, CI, 1.06-6.68) to have part of the county be designated as a HPSA for mental health providers than none of the county designated as a shortage area compared to non-deviant counties. Negative deviant counties were much more likely to have both a FQHC and community health center (OD=1.51, 95% CI, 1.14-

1.99) compared to non-deviant counties (Table 4.3). Negative deviant counties had decreased odds of having the highest physician per capita rate (> 17.3 physicians per 10,000 population) (OR=.35, 95% CI, .19-.62, respectively) compared to non-deviant counties. However, negative deviant counties had increased odds of having the highest nurse practitioner per capita rate (> 6.7 nurse practitioners per 10,000 population) (OR=1.47, 95% CI, 1.02-2.1) compared to non-deviant counties (Table 4.3). Table 4.3 showed negative deviant counties had increased odds of having higher hospital beds per capita rates (19.6-36.7 hospital beds and > 36.8 hospital beds per 10,000 population) (OR=4.36, 95% CI, 1.60-11.87, OR=4.38, 95% CI, 1.57-12.18, respectively) compared to non-deviant counties; however, negative deviant counties had decreased odds of having the highest hospitals per capita rate (> 0.63 hospitals per 10,000) (OR=.25, 95% CI, .09-.71) compared to non-deviant counites.

Discussion

Overall, the strongest predictor of deviance was physicians per capita. Positive deviant counties, counties with better than expected health outcomes, were more likely to have the highest physician per capita rates while negative deviant counties were significantly less likely to have the highest physician per capita rates when compared to non-deviant counties. This aligns with previous studies that found that physician shortages (very low number of physicians), which can directly affect one’s ability to access health care services, were associated with higher mortality rates (Krakauer et al., 1996). Physician shortages and subsequent increases in patient caseloads can also affect the average time physicians spend with patients during visits; Harris and Leininger (1993) found that, on average, rural physicians conducted 14.3 more office visits per week while working the same number of hours as urban physicians. This can lead to fragmented care that is not comprehensive, coordinated, nor continuous in rural areas (Weinhold

& Gurtner, 2014) and lead to worse health outcomes. However, little difference was found in primary care practitioner HPSA between positive and negative deviant and non-deviant counties (and the miniscule differences that did exist were not statistically significant). This result could be attributable to the number of practitioners, other than primary care physicians, such as nurse practitioners, within counties.

Nurse practitioner per capita rates were also found to be significant – negative deviant counties were more likely to have higher nurse practitioner per capita rates than non-deviant counties. Studies have found higher rates of nurse practitioners in rural counties compared to urban, however, as this study only investigated rural counties, the finding of significantly higher per capita rates of nurse practitioners in negative deviant counties is worth noting. This finding needs to be further investigated to better understand why there are higher per capita rates of nurse practitioners, though a potential explanation could be higher rates of nurse practitioners in counties with fewer physicians.

This study was cross-sectional so causality could not be investigated (i.e., questions on whether healthcare system differences were driving health outcome differences - deviance categorization - could not be investigated). The use of secondary data limits how the Andersen Behavioral Model of Health Services Use can be applied – individual level factors were not available, so this analysis only focused on healthcare system factors. Furthermore, the study would have been stronger with the inclusion of additional healthcare systems specific enabling factors, but these factors are also not consistently available across the US.

Key enabling factors that are associated with healthcare system utilization were investigated. This study found that there were significant differences between positive, negative, and non-deviant counties for the following enabling healthcare systems metrics: HPSA dental practitioners, HPSA mental health providers, presence of a JCAHO certified hospital, presence of a FQHC and community health center, physicians per capita, nurse practitioners per capita, hospital beds per capita, and hospitals per capita. This study has identified how healthcare system factors differ between counties with better and worse than expected health outcomes.

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Chapter 5. Conclusion

Differences in health outcomes vary significantly by location (local, state, vs region) and by rurality in the US. It has been established that many of these differences are associated with health disparities attributable to historic economic and social inequities. The article "Health and Social Conditions of the Poorest Versus Wealthiest Counties in the United States" (Egen et al., 2017) reinforced the association between income and health outcomes, however the researchers also discovered several unexpected findings. In the article all US counties were ranked based on median household income and separated into 50 hierarchical subgroups (Egen et al., 2017). Researchers found vast discrepancies in several health outcomes within subgroups (life expectancy, years of potential life lost, prevalence of poor or fair health, and diabetes). Essentially, some counties experienced health outcomes that were unexpectedly positive and others experienced health outcomes that were unexpectedly negative compared to other counties they were similar to in respect to income.

The current study focused on rural counties that perform better than or worse than expected on a myriad of health measures and aimed to: 1) create an area deprivation index and divide counties into quartiles, 2) identify positive, negative, and non-deviant counties using health outcome metrics, 3) analyze differences between positive deviant, negative deviant, and non-deviant counties on a variety of local public health system metrics and 4) analyze differences between positive deviant, negative deviant, and non-deviant counties on a variety of health service system metrics.

Results indicated that the five health metrics used to initially determine deviance (male life expectancy, female life expectancy, years of potential life lost, fair or poor health, and physically unhealthy days) were all significantly different between positive and negative deviant and non-deviant counties within each quartile. This underscores that those counties deemed positive and negative deviant counties vary significantly from those considered non-deviant and therefore reinforces empirical analysis by deviance.

Social and economic metrics only varied somewhat between positive, negative, and non-deviant counties. Within the social and economic metrics used to create the index (median household income, percent of population with less than high school diploma, percent of population unemployed, percent of population in poverty, and percent of population that are single parents) the only metric that was significantly different between positive and negative deviant and non-deviant counties for all four Quartiles was percent of population in poverty. The other four metrics showed some similarities between positive and negative deviant and non-deviant counties in at least one quartile and the percent of population with less than high school diploma did not follow the expected pattern of positive deviant counties performing better than non-deviant, which perform better than negative deviant in several quartiles (although these differences were not statistically significant). Essentially, the area deprivation index was moderately successful in ensuring that differences in health outcomes were not only, or primarily, driven by differences in social and material conditions of counties. If health outcome differences were driven only by social and material differences, the expectation would be that all metrics would be statistically significantly different between positive and negative deviant and non-deviant counties for every quartile, which is not the case.

Identifying positive, negative, and non-deviant counties within quartiles (utilizing an area deprivation index) ensures that the health outcome differences experienced by counties in positive, negative, and non-deviant categories are not entirely driven by underlying material and social conditions, which allows for consideration of other differences that exist that may be present in local health care and public health systems that are associated with positive or negative deviant counties.

When looking at key factors within local public health systems the strongest predictor of deviance was governance structure. Positive deviant counties were more likely to have a local government structure compared to non-deviant counties while negative deviant counties were less likely to have a local governance structure. Results also indicated significant differences between positive, negative, and non-deviant counties for LHD jurisdiction size, jurisdiction type, staffing patterns, presence of a LBOH, and per capita spending – which are all factors known to predict LHD performance. While several variables that were significantly different in Quartile comparisons were not statistically significant in the multinomial logistic regression (including lower rates of completed CHA, lower rates of development of strategic plans, and lack of non-profit hospitals in negative deviant counties) the lack of these activities deemed process activities - activities public health systems complete to improve the health of their constituents - in negative deviant counties highlight changes LHDs could implement to improve the health of constituents.

When looking at key factors within local healthcare systems the strongest predictor of deviance was physicians per capita. Positive deviant counties were more likely to have higher physician per capita rates while negative deviant counties were significantly less likely to have higher physician per capita rates when compared to non-deviant counties. Nurse practitioner per capita rates were also found to be significant – negative deviant counties were more likely to have higher nurse practitioner per capita rates than non-deviant counties. Results also indicated significant differences between positive, negative, and non-deviant counties for HPSA for dental practitioners, HPSA for mental health providers, presence of JCAHO certified hospital, presence of a federally qualified health center, and hospital beds per capita.

There were several limitations to this study. First was the small number of positive and negative deviant counties, which limits the ability to draw definite conclusions from these analyses. However, strict positive and negative deviant cut-off points are needed otherwise counties would not be outliers and a positive deviance methodology could not be used to identify differences. Another limitation is the cross-sectional nature of the study which does not allow for analysis of causality (i.e., if economic and social conditions drive health or if health drive economic and social conditions). Additionally, LHD factors come from the 2016 NACCHO Profile Study which did not collect data on all Handler et al. (2001) framework components and the NACCHO Profile Study was self-reported and voluntary (NACCHO, 2017a). Therefore, data on positive, negative, and non-deviant counties were limited as not all LHDs completed the survey, nor do they answer all questions. While this is a significant limitation, the NACCHO Profile Study is the most extensive data source on LHD infrastructure and practices.

One significant limitation to this study was the potential endogeneity bias. Endogeneity bias is present when independent variables are partially determined by or highly correlated with dependent variables. Deviant designation was determined using five health outcome metrics which are likely to be moderately to highly correlated with some of the local public health system and local healthcare system metrics. For instance, rural counties in the South are more likely to have been classified as negative deviant because of their worse health outcomes and a centralized governance structure is more likely to exist in Southern counties. This could cause deviance designation and governance structure to be highly correlated resulting in endogeneity bias. However, even with limitations, this study sought to explore how county-level differences in health outcomes may be associated with key factors within local public health systems and local healthcare systems.

Future studies should continue to utilize the positive deviance methodology in population-level studies in addition to individual-level studies. As additional population-level studies utilize this method, more research into best practices will accumulate and result in more acceptance of this methodology in population-level studies and identification of the most effective methods to identifying deviance at the population level (e.g., county level). Research efforts should also focus on how decentralization effects health system performance. There is "debate on whether or not decentralization improves equity, efficiency, accountability and quality of services" (Panda & Thakur, 2016, p.562) because of the lack of empirical studies that examine decentralization. While the results found in this study may be due to endogeneity bias the findings are still valuable and worth further research. Another finding from this study that merits further research was the significantly higher per capita rates of nurse practitioners in negative deviant counties compared to non-deviant counties. While other studies have identified higher rates of nurse practitioners in rural counties compared to urban, this study only investigated rural counties and gives no indication as to why negative deviant counties (those with worse health outcomes) had higher rates than non-deviant counties.

This research has several implications for public health policy and practice. The study adds to literature on the utilization of the PD approach at the population versus individual level. Several deviance categorization strategies were investigated which is an important addition to public health practice as no agreed upon, universal approach to identifying deviance at the population-level exists. Additionally, the underlying tenant of using a PD approach (identification of assets within communities that can be used by others improve health outcomes) is an important step for public health research to take. Too often research focuses on identifying deficits within rural communities rather than identifying functional, innovative systems, practices, or infrastructure that may exist. Additionally, innovative practices that are found in rural areas may be more likely to be accepted by other rural communities as the practice was discovered in rural America and not brought by outside experts.

There are also important policy implications of the research on LHD factors. This study found that negative deviant counties were more likely to have not completed a CHA, CHIP, or to have developed a strategic plan. This highlights potential policy options that states could enact to increase the completion of these activities by LHDs and ultimately improve the health of constituents. This study found that there were significant differences between positive, negative, and non-deviant counties for a variety of local public health system and healthcare systems metrics. The study was able to show that a PD approach can, and in fact should, be used to investigate how counties with better and worse than expected health outcomes differ using population-level metrics.

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APPENDICES

Appendix A: Comparison of Deviance Identification Strategies

Table A.1.

All Health Metrics Excluding Mentally Unhealthy Days Compared to Life Expectancy

			Life Expectancy			
Quartile			0	1	2	Total
First Quartile	All Health Metrics excluding Mentally Unhealthy Days	0	509	35	27	571
		1	33	70	0	103
		2	19	0	91	110
	Total		561	105	118	784
Second Quartile	All Health Metrics excluding Mentally Unhealthy Days	0	474	26	25	525
		1	38	88	0	126
		2	48	0	85	133
	Total		560	114	110	784
Third Quartile	All Health Metrics excluding Mentally Unhealthy Days	0	438	16	23	477
		1	51	102	0	153
		2	44	1	109	154
	Total		533	119	132	784
Fourth Quartile	All Health Metrics excluding Mentally Unhealthy Days	0	492	34	19	545
		1	37	83	0	120
		2	33	0	86	119
	Total		562	117	105	784
Total	All Health Metrics excluding Mentally Unhealthy Days	0	1913	111	94	2118
		1	159	343	0	502
		2	144	1	371	516
	Total		2216	455	465	3136

0 = non-deviant counties

1 = positive deviant counties

2 = negative deviant counties

Table A.2.

All Health Metrics Excluding Mentally Unhealthy Days Compared to All Health Metrics

Quartile			All Health Metrics 0	1	2	Total
First Quartile	All Health Metrics excluding Mentally Unhealthy Days	0	539	20	12	571
		1	14	89	0	103
		2	12	0	98	110
	Total		565	109	110	784
Second Quartile	All Health Metrics excluding Mentally Unhealthy Days	0	511	8	6	525
		1	15	111	0	126
		2	15	0	118	133
	Total		541	119	124	784
Third Quartile	All Health Metrics excluding Mentally Unhealthy Days	0	460	8	9	477
		1	26	127	0	153
		2	16	0	138	154
	Total		502	135	147	784
Fourth Quartile	All Health Metrics excluding Mentally Unhealthy Days	0	530	10	5	545
		1	13	107	0	120
		2	9	0	110	119
	Total		552	117	115	784
Total	All Health Metrics excluding Mentally Unhealthy Days	0	2040	46	32	2118
		1	68	434	0	502
		2	52	0	464	516
	Total		2160	480	496	3136

0 = non-deviant counties

1 = positive deviant counties

2 = negative deviant counties

Table A.3.

All Health Metrics Excluding Mentally Unhealthy Days Compared to Threshold of 2 or More Metrics

Quartile			Threshold of 2 or More Metrics 0	1	2	Total
First Quartile	All Health Metrics excluding Mentally Unhealthy Days	0	523	28	20	571
		1	37	66	0	103
		2	17	0	93	110
	Total		577	94	113	784
Second Quartile	All Health Metrics excluding Mentally Unhealthy Days	0	480	21	24	525
		1	30	96	0	126
		2	22	0	111	133
	Total		532	117	135	784
Third Quartile	All Health Metrics excluding Mentally Unhealthy Days	0	440	14	23	477
		1	54	99	0	153
		2	42	0	112	154
	Total		536	113	135	784
Fourth Quartile	All Health Metrics excluding Mentally Unhealthy Days	0	507	28	10	545
		1	29	91	0	120
		2	21	0	98	119
	Total		557	119	108	784
Total	All Health Metrics excluding Mentally Unhealthy Days	0	1950	91	77	2118
		1	150	352	0	502
		2	102	0	414	516
	Total		2202	443	491	3136

0 = non-deviant counties

1 = positive deviant counties

2 = negative deviant counties

Table A.4.

Threshold of 2 or More Metrics Compared to Life Expectancy

Quartile			Life Expectancy 0	1	2	Total
First Quartile	Threshold of 2 or More Metrics	0	503	42	32	577
		1	32	62	0	94
		2	26	1	86	113
	Total		561	105	118	784
Second Quartile	Threshold of 2 or More Metrics	0	476	31	25	532
		1	34	83	0	117
		2	50	0	85	135
	Total		560	114	110	784
Third Quartile	Threshold of 2 or More Metrics	0	464	35	37	536
		1	30	83	0	113
		2	39	1	95	135
	Total		533	119	132	784
Fourth Quartile	Threshold of 2 or More Metrics	0	499	33	25	557
		1	35	84	0	119
		2	28	0	80	108
	Total		562	117	105	784
Total	Threshold of 2 or More Metrics	0	1942	141	119	2202
		1	131	312	0	443
		2	143	2	346	491
	Total		2216	455	465	3136

0 = non-deviant counties

1 = positive deviant counties

2 = negative deviant counties

Table A.5.

Threshold of 2 or More Metrics Compared to All Health Metrics

Quartile			All Health Metrics 0	1	2	Total
First Quartile	Threshold of 2 or More Metrics	0	526	37	14	577
		1	22	72	0	94
		2	17	0	96	113
	Total		565	109	110	784
Second Quartile	Threshold of 2 or More Metrics	0	495	22	15	532
		1	20	97	0	117
		2	26	0	109	135
	Total		541	119	124	784
Third Quartile	Threshold of 2 or More Metrics	0	466	36	34	536
		1	14	99	0	113
		2	22	0	113	135
	Total		502	135	147	784
Fourth Quartile	Threshold of 2 or More Metrics	0	514	27	16	557
		1	29	90	0	119
		2	9	0	99	108
	Total		552	117	115	784
Total	Threshold of 2 or More Metrics	0	2001	122	79	2202
		1	85	358	0	443
		2	74	0	417	491
	Total		2160	480	496	3136

0 = non-deviant counties

1 = positive deviant counties

2 = negative deviant counties

Table A.6.

All Health Metrics Compared to Life Expectancy

Quartile			Life Expectancy 0	1	2	Total
First Quartile	All Health Metrics	0	494	42	29	565
		1	46	63	0	109
		2	21	0	89	110
	Total		561	105	118	784
Second Quartile	All Health Metrics	0	478	32	31	541
		1	37	82	0	119
		2	45	0	79	124
	Total		560	114	110	784
Third Quartile	All Health Metrics	0	439	29	34	502
		1	46	89	0	135
		2	48	1	98	147
	Total		533	119	132	784
Fourth Quartile	All Health Metrics	0	490	39	23	552
		1	39	78	0	117
		2	33	0	82	115
	Total		562	117	105	784
Total	All Health Metrics	0	1901	142	117	2160
		1	168	312	0	480
		2	147	1	348	496
	Total		2216	455	465	3136

0 = non-deviant counties

1 = positive deviant counties

2 = negative deviant counties

Appendix B: Additional Tables for Chapter 3

Table B.1.

Characteristics of Local Health Departments by Area Deprivation Index Quartile

	Q1 - Least Deprived n (%) (n=306)	**Q2 - Slightly Deprived n (%) (n=481)**	**Q3 - Moderately Deprived n (%) (n=495)**	**Q4 - Most Deprived n (%) (n=614)**
Population Served				
≤24,999	116 (37.9)	125 (36.8)	114 (30.8)	132 (28.0)
25,000-49,999	77 (25.2)	84 (24.7)	96 (25.9)	80 (16.9)
50,000-99,999	84 (27.5)	57 (16.8)	68 (18.4)	52 (11.0)
100,000-249,999	11 (3.6)	35 (10.3)	42 (11.4)	83 (17.6)
≥250,000	18 (5.9)	39 (11.5)	50 (13.5)	125 (26.5)
Governance Category				
State	51 (16.7)	87 (25.6)	127 (34.3)	219 (46.4)
Local	245 (80.1)	234 (68.8)	202 (54.6)	149 (31.6)
Shared	10 (3.3)	19 (5.6)	41 (11.1)	104 (22.0)
Jurisdiction Type				
County	153 (50.0)	210 (61.8)	235 (63.7)	215 (45.6)
Multi-County	153 (50.0)	130 (38.2)	134 (36.3)	256 (54.4)
Part of combined HHS agency	40 (13.3)	66 (19.7)	64 (17.6)	97 (20.7)
LBOH	216 (72.0)	230 (68.7)	248 (69.3)	238 (51.6)
LBOH Adopts Regulations	170 (78.7)	158 (69.6)	186 (75.3)	182 (76.8)
Next fiscal year's budget compared to current budget				
Less than	60 (23.3)	70 (25.3)	91 (29.9)	169 (43.1)
Approx. same	132 (51.2)	155 (56.0)	162 (53.3)	186 (47.4)
Greater than	66 (25.6)	52 (18.8)	51 (16.8)	37 (9.4)
Top executive: doctoral degree	30 (10.4)	50 (15.8)	66 (19.1)	111 (25.1)
Top executive: nursing degree	155 (53.6)	120 (38.0)	92 (26.6)	96 (21.7)
LHD total FTE employees per capital (10,000)				
≤3.4753	102 (36.3)	99 (32.1)	78 (23.6)	57 (13.6)
3.4754-5.2562	47 (16.7)	71 (23.1)	98 (29.7)	119 (28.3)
5.2563-7.7821	61 (21.7)	63 (20.5)	82 (24.8)	127 (30.2)
>7.7822	71 (25.3)	75 (24.4)	72 (21.8)	117 (27.9)
New public health ordinance	108 (36.1)	99 (29.8)	89 (25.0)	175 (38.0)
Revised public health ordinance	94 (31.5)	69 (20.8)	44 (12.4)	102 (22.2)
Completed CHA	253 (84.6)	276 (83.9)	284 (78.5)	365 (79.2)
Completed CHIP	231 (78.3)	235 (72.1)	227 (63.9)	272 (59.5)
non-profit hospital	261 (92.6)	263 (83.2)	287 (83.9)	336 (76.5)
Developed strategic plan	173 (57.9)	170 (51.4)	183 (51.4)	255 (55.1)
PHAB Accreditation status				
PHAB accredited	9 (3.2)	8 (2.7)	15 (4.8)	35 (9.3)
Seeking accreditation	104 (37.4)	100 (34.4)	110 (35.0)	163 (43.2)
Not seeking accreditation	165 (59.4)	183 (62.9)	189 (60.2)	179 (47.5)

Abbreviations: CHA, community health assessment; CHIP, community health improvement plan; FTE; full-time equivalent; HHS, Health and Human Services; LOBH, local board of health; LHD, local health department; PHAB, Public Health Accreditation Board

Table B.2.

Strength of Association Between Characteristics of Local Health Departments (Cramer's V, Kendall's tau-b, phi Coefficient)

	Population served	Budget	FTE employees	PHAB	Governance Category	Jurisdiction Type	HHS Agency	LBH	LBH Adopt Regulations	Doctoral degree	Nursing degree	New PH Ordinance	Revised PH Ordinance	Completed CHA	Completed CHIP	Non-profit hospital	Strategic Plan
Population served		**-.081** *	**.661** *	**-.200** *	**.343** **	**.745** ***	**.109** ***	**.285** ***	**.160** ***	**.402** ***	**.349** ***	**.232** ***	**.218** ***	**.132** ***	**.154** ***	**.201** ***	**.187** ***
Budget			**-.075** *	**.106** *	**.145** **	**.176** ***	.045 ***	**.119** ***	.007 ***	.004 ***	**.108** ***	.054 ***	.032 ***	.049 ***	**.102** ***	.068 ***	**.077** ***
FTE employees				**-.200** *	**.279** **	**.565** ***	.059 ***	**.191** ***	**.138** ***	**.375** ***	**.334** ***	**.202** ***	**.159** ***	**.123** ***	**.095** ***	**.145** ***	**.225** ***
PHAB					**.265** **	**.202** ***	.047 ***	**.175** ***	**.084** ***	.065 ***	**.163** ***	.013 ***	.051 ***	**.104** ***	**.142** ***	.046 ***	**.272** ***
Governance						**.286** **	**.129** **	**.507** **	**.341** **	**.331** **	**.189** **	**.130** **	.025 **	**.201** **	**.237** **	**.199** **	**.084** **
Jurisdiction Type							-.004 ***	**-.132** ***	.032 ***	**.268** ***	**-.283** ***	**.187** ***	**.151** ***	**.104** ***	.014 ***	**.196** ***	**.078** ***
HHS Agency								**-.160** ***	**-.071** ***	**.087** ***	-.031 ***	.049 ***	**.116** ***	.024 ***	**.061** ***	-.043 ***	**.078** ***
LBOH									____	**-.138** ***	-.027 ***	.037 ***	.020 ***	**.162** ***	**.137** ***	**.111** ***	-.006 ***
LBOH Adopts Regulations										**.085** ***	.025 ***	.011 ***	.049 ***	**.092** ***	-.005 ***	.057 ***	-.036 ***
Doctoral degree											**-.233** ***	**.147** ***	**.091** ***	-.039 ***	**-.135** ***	**.121** ***	**-.134** ***
Nursing degree												**-.057** ***	**-.068** ***	.001 ***	.032 ***	.052 ***	-.013 ***
New PH ordinance													**.441** ***	**.177** ***	**.079** ***	**.067** ***	**.077** ***
Revised PH ordinance														**.121** ***	**.160** ***	.043 ***	**.109** ***
Completed CHA															**.538** ***	**.197** ***	**.205** ***
Completed CHIP																**.137** ***	**.364** ***
Non-profit hospital																	-.001 ***

Abbreviations: CHA, community health assessment; CHIP, community health improvement plan; FTE; full-time equivalent; HHS, Health and Human Services; LOBH, local board of health; LHD, local health department; PH, public health; PHAB, Public Health Accreditation Board
*Kendall's tau-b; **Cramer's V; ***phi coefficient; **p < .05**

Appendix C: Additional Tables for Chapter 4

Table C.1.

Characteristics of Local Healthcare Systems by Area Deprivation Index Quartile

	Q1 - Least Deprived n (%) (n=380)	Q2 - Slightly Deprived n (%) (n=481)	Q3 - Moderately Deprived n (%) (n=495)	Q4 - Most Deprived n (%) (n=614)
HPSA – Primary Care Practitioners				
None of county designated HPSA	64 (16.8)	54 (11.2)	26 (5.3)	26 (4.2)
Part of county designated HPSA	194 (51.1)	290 (60.3)	359 (72.5)	331 (53.9)
All of county designated HPSA	122 (32.1)	137 (28.5)	110 (22.2)	257 (41.9)
HPSA – Dental Practitioners				
None of county designated HPSA	131 (34.5)	99 (20.6)	74 (15.0)	44 (7.2)
Part of county designated HPSA	194 (51.1)	310 (64.4)	342 (69.1)	355 (57.8)
All of county designated HPSA	55 (14.4)	72 (15.0)	79 (15.9)	215 (35.0)
HPSA – Mental Health Professionals				
None of county designated HPSA	18 (4.7)	20 (4.1)	14 (2.8)	12 (2.0)
Part of county designated HPSA	29 (7.6)	70 (14.6)	105 (21.2)	103 (16.8)
All of county designated HPSA	333 (87.6)	391 (81.3)	376 (76.0)	499 (81.2)
JCAHO Certified Hospital	80 (21.1)	177 (36.8)	226 (45.7)	231 (37.6)
Rural Health Clinic	211 (55.5)	293 (60.9)	326 (65.9)	424 (69.1)
Federally Qualified Health Center & Community Health Center				
Both FQHC and CHC	77 (20.3)	193 (40.1)	260 (52.5)	429 (69.9)
CHC, but no FQHC	13 (3.4)	19 (4.0)	18 (3.6)	35 (5.7)
FQHC, but no CHC	4 (1.1)	6 (1.2)	19 (3.8)	19 (3.1)
Neither FQHC nor CHC	286 (75.3)	263 (54.7)	198 (40.0)	131 (21.3)
Physicians per capita (10,000)				
Quartile 1 (<4.947)	117 (30.8)	117 (24.3)	126 (25.5)	228 (37.1)
Quartile 2 (4.948-9.270)	101 (26.6)	145 (30.2)	146 (29.5)	203 (33.1)
Quartile 3 (9.271-17.277)	100 (26.3)	143 (29.7)	163 (32.9)	132 (21.5)
Quartile 4 (17.278<)	62 (16.3)	76 (15.8)	60 (12.1)	51 (8.3)
Nurse Practitioners per capita (10,000)				
Quartile 1 (<2.671)	133 (35.0)	161 (33.5)	107 (21.6)	123 (20.0)
Quartile 2 (2.672-4.368)	103 (27.1)	108 (22.5)	131 (26.5)	153 (24.9)
Quartile 3 (4.369-6.705)	73 (19.2)	105 (21.8)	143 (28.9)	164 (26.7)
Quartile 4 (6.706<)	71 (18.7)	107 (22.2)	114 (23.0)	174 (28.4)
Hospital Beds per capita (10,000)				
Quartile 1 (<7.61)	108 (28.4)	101 (21.0)	107 (21.6)	180 (29.3)
Quartile 2 (7.62-19.60)	75 (19.7)	112 (23.3)	127 (25.6)	146 (23.8)
Quartile 3 (19.61-36.7)	63 (16.6)	134 (27.8)	137 (27.7)	144 (23.4)
Quartile 4 (36.8<)	134 (35.3)	134 (27.8)	124 (25.1)	144 (23.4)
Hospitals per capita (10,000)				
Quartile 1 (<0.0956)	95 (25.0)	88 (18.3)	85 (17.2)	159 (25.9)
Quartile 2 (0.0957-0.2834)	33 (8.7)	71 (14.8)	98 (19.8)	60 (9.8)
Quartile 3 (0.2835-0.6283)	66 (17.4)	136 (28.3)	167 (33.7)	193 (31.4)
Quartile 4 (0.6284<)	186 (48.9)	186 (38.6)	145 (29.3)	202 (32.9)

Abbreviations: CHC, Community Health Center; FQHC, Federally Qualified Health Center; HPSA, health professional shortage area; JCAHO, Joint Commission on Accreditation of Healthcare Organizations

Table C.2.

Strength of Association Between Characteristics of Local Healthcare Systems (Cramer's V, Kendall's tau-b, phi Coefficient)

	HPSA – Primary Care	HPSA – Dentists	HPSA – Mental Health	JCAHO Certified	Rural Health Clinic	Federally Qualified HC	Community Health Center	Physicians per capita	Nurse Practitioner per capita	Hospital beds per capita	Hospitals per capita
HPSA – Primary Care		.302*	.096*	.251**	.201**	.154**	.135**	-.414*	-.109*	-.235*	-.112*
HPSA – Dentists			.043*	.164**	.136**	.250**	.247**	-.146*	.050*	-.066*	-.019*
HPSA – Mental Health				.123**	.156**	.170**	.163**	-.086*	-.065*	.046*	.107*
JCAHO Certified					-.069**	.175**	.194**	.414**	.257**	.352**	.591**
Rural Health Clinic						-.040**	-.060**	.154**	.074**	.154**	.216**
Federally Qualified HC							.865**	.089**	.184**	.121**	.260**
Community Health Center								.114**	.188**	.120**	.285**
Physicians per capita									.260*	.341*	.117*
Nurse Practitioner per capita										.245*	.090*
Hospital beds per capita											.607*
Hospitals per capita											

Abbreviations: HC, health center; HPSA, health professional shortage area; JCAHO, Joint Commission on Accreditation of Healthcare Organizations
*Kendall's tau-b; **phi coefficient; **$p < .05$**

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