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Rurality and Race: Inequities in Access to Five Types of Healthcare Services

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Rurality and Race:

Inequities in Access to Five Types of Healthcare Services

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requirements for the degree Doctor of Philosophy

in Public Health

by

Julia Thornton Caldwell

2015

ABSTRACT OF THE DISSERTATION

Rurality and Race:

Inequities in Access to Five Types of Healthcare Services

by

Julia Thornton Caldwell

Doctor of Philosophy in Public Health

University of California, Los Angeles, 2015

Professor Chandra L. Ford, Chair

Background. Rurality may influence racial/ethnic disparities in access to healthcare. This study sought to: (1) compare and contrast measures used to assess rurality and urbanicity; (2) determine if racial/ethnic disparities in access to healthcare differ for rural vs. urban areas; and, (3) determine if residential segregation and access to healthcare differ for rural vs. urban areas.

Sample. The sample was adult respondents to the 2005-2010 Medical Expenditure Panel Survey (MEPS), a nationally representative sample of U.S. households. Each aim had five samples; sample size ranged from 49,839 to 112,125.

Measures. Aim 1 involved five measures used to identify rurality relative to urbanicity. Aim 2 and aim 3 involved five self-reported MEPS outcomes indicating whether respondents had (1) a usual source of healthcare, (2) unmet need for healthcare, (3) cholesterol screenings, (4) cervical cancer screenings, or (5) dental visits. The main explanatory factors, which were based on respondents' residential location, were rurality and residential segregation, which were examined separately for blacks and Hispanics using the isolation index. Respondents' residential areas were characterized by using geographic identifiers to link the MEPS data with

census tract and county information available via the American Community Survey (2005-2010), the Area Health Resource File (2010), and five publically available rurality indicators.

Analysis. The descriptive analysis explored variable characteristics and bivariate associations. The main analysis involved multi-level, random intercept logistic regression to estimate disparities in each access to healthcare outcome while controlling for confounders.

Results. One outcome, unmet healthcare need, changed depending on the measure used to assess rurality. With respect to disparities, relatively more blacks than whites had preventive screenings in the fully adjusted models; this difference was smaller in rural than urban areas. Rural blacks and Hispanics had fewer screenings than urban ones did. Across rural and urban areas, blacks and Hispanics in segregated areas had lower levels of unmet need.

Discussion. Unadjusted estimates suggest disadvantaged rates for certain measures of access to healthcare by rurality and segregation, while adjusted models attenuated some of these disparities.

Conclusion. Place-based factors (rurality, segregation) and racial factors may jointly affect access to healthcare among diverse U.S. populations.

The dissertation of Julia Thornton Caldwell is approved.

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2015

To my family, who from an early age instilled in me the value of education.

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LIST OF ACRONYMS

ACS	American Community Survey
AHRF	Area Health Resource File
ERS	Economic Research Service: U.S. Department of Agriculture
HPSA	Health Professional Shortage Area
MEPS	Medical Expenditure Panel Survey
MSA	Metropolitan Statistical Area
NCHS	National Center for Health Statistics
NHIS	National Health Interview Survey
RUCA	Rural-Urban Commuting Area Code

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CHAPTER 1

INTRODUCTION TO THE DISSERTATION

1.1 Purpose

The purpose of this research is to improve understandings of how place, as captured by assessments of rural and urban areas, is associated with disparities in access to healthcare among vulnerable populations in the United States.

1.2 Statement of Problem

Rural populations experience higher premature mortality, more chronic conditions, and overall poorer health when compared with urban populations. Among adults age 25 to 64, the age-adjusted death rate among rural populations is 32% higher when compared to non-rural populations.[1] Disparities in access to healthcare may provide one explanation for the rural health disadvantage, as ensuring access to primary care corresponds with better health outcomes, greater satisfaction, reduced costs, and decreased emergency department use.[2-4] For this study, *access to healthcare* reflects both an individuals' ability to obtain care and their use of the healthcare system as assessed by adherence of preventive screenings. Research suggests that rural populations report less access to healthcare, with fewer visits for preventive screenings and access to specialists, compared to urban populations.[5-9] Characteristics of rural or urban areas may be pertinent determinants of preventable differences in assessments of healthcare access.

Rural and urban areas are defined as a person's immediate residential environment which are classified as either rural or urban, or somewhere in between (semi-urban). Rural and urban areas represent a continuum reflecting differences in area level characteristics including the local economy, infrastructure, and social context. Growing research suggests that where

someone lives can directly influence health and healthcare.[10, 11] Due to issues with the conceptualization and measurement of geographical areas, however, less is known about how living in an rural compared to an urban area may exacerbate differences in access to healthcare.

Relative to urban areas, racial and ethnic disparities in the utilization of medical services may differ in rural areas. For instance, compared to whites, while Hispanic and Non-Hispanic blacks are more likely to report preventive screenings, the odds of these screenings decrease with rurality.[12-14] Among rural racial/ethnic minority populations, differential access to healthcare has implications for undetected cancer, inadequate treatment of hypertension, and fewer visits to physicians.[14] Despite these findings, rural minority populations generally remain invisible or are believed to mirror urban racial/ethnic minority groups in public health research. In both rural and urban areas of the United States, the social status of racial/ethnic groups, of either oppression or privilege, manifest in disparities in health and healthcare. Racial/ethnic residential segregation, the geographic and social isolation of racial/ethnic minorities, may provide one explanation for the continued perpetuation of racial/ethnic disparities in access to healthcare services. While research continues to establish that racial/ethnic disparities exist in urban neighborhoods and cities,[15, 16] relatively little is known regarding the association between segregation and access to healthcare within rural areas.

1.3 Specific Aims

This study has one overarching research question: What is the relationship between residing in a rural vs. urban residential area and access to healthcare? To answer this question, the study draws from the Andersen's Behavioral Model of Health Services Use and the theory of fundamental causes offered by Link and Phelan.

The dissertation study had three specific aims:

Aim 1: To compare and contrast five measures commonly used to characterize an area as rural or urban, and learn if the relationship between rurality and the dissertation study's access to healthcare variables varies across the five measures.

Aim 2: To determine whether racial and ethnic disparities in access to healthcare differ by rural vs. urban area.

Aim 3: To examine the association between racial/ethnic residential segregation and access to healthcare in rural vs. urban areas.

1.4 Significance

Facilitating access to healthcare services for vulnerable populations in the United States remains a persistent policy challenge. Using nationally representative survey data, this study explored how area level characteristics may create and maintain disparities in access to healthcare among working age adults. Addressing the health of working age adults is a particularly relevant goal for public health because adults play critical social roles as economic providers and caretakers.

Understandings about the relationship between place and access to healthcare reflect the measures and methods of the empirical studies on which they are based. Therefore, this study explored how assessments of rural and urban area level characteristics can shape conclusions drawn about access to healthcare. The study's examination of racial/ethnic disparities and residential segregation in access to healthcare in rural vs. urban areas expands the fields disproportionate focus on individual-level determinants of health. By targeting "upstream" geographical and social factors that influence disparities in healthcare, rather than "downstream" individual behaviors or poor health, the study captures contextual factors that create disparities in health. Finally, the study provides evidence that can inform the

development of future structural or contextual interventions to improve access to health in diverse rural communities.

1.5 Overview of Dissertation

This dissertation is comprised of eight chapters. Chapter 2, the Literature Review, discusses the literature on factors known to influence access to healthcare. It also explores healthcare disparities among rural and urban populations, and key relationships between contextual factors and access to healthcare. Chapter 3 presents the study's conceptual model, which guided the conceptualization of the hypothesized relationships and the analysis. The model integrates Andersen's Model and the theory of fundamental causes, offered by Link and Phelan. It also relies on distinctions between contextual and compositional factors. Chapter 4, Methodology, describes the study's data sources, measures, sample, and analysis plan. Chapter 5 through Chapter 7 presents the results of the analyses for Aims 1 through 3, respectively. Lastly, Chapter 8, Discussion, interprets the study's findings and implications, discusses its strengths and limitations, and proposes recommendations for future research.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter is composed of six sections and reviews the literature from public health, sociology, and geography and identifies gaps and limitations in these fields to which this study responds. Section 2.2 explores the literature on access to healthcare. Next, Section 2.3 examines the current research on the relationship between rural and urban areas and access to healthcare. Section 2.4, reviews research on racial and ethnic disparities in access to healthcare. Next, Section 2.5 examines the association of poverty and access to healthcare and Section 2.6 explores the healthcare system. The chapter closes with Section 2.7, which provides a short summary and gaps in the literature.

2.2 Access to Healthcare

For this study, access to healthcare reflects both the *ability to access* and *actual use* of the healthcare system.[17] The healthcare system includes the delivery of medical care but does not include population-based strategies such as health promotion. Operationally, *the ability* to access to healthcare assesses the availability of medical services for treatment, the detection of conditions before illness becomes apparent, or to prevent illness altogether. Having the ability to access healthcare may include the availability of regular source of healthcare, barriers and facilitators of care, the travel time to care, capacity to get an appointment in a reasonable amount of time, or in-office waiting time. For this study, the ability to access to healthcare is assessed by whether an individual has a usual source of healthcare or has reports of unmet healthcare needs.

Actual use assesses the utilization of medical services needed both for prevention and addressing illness. Actual or realized use might include patient satisfaction, preventive screenings, quality of care, or utilization of ambulatory care or outpatient care. Preventable hospitalizations, known as ambulatory care-sensitive conditions, may also indicate poor realized access to healthcare. For this study actual use is assessed with timely adherence to three preventive screening services, including cholesterol screenings, dental visits, and cervical screenings. To provide a more comprehensive understanding of access to the broader healthcare system these preventive services capture access to primary care, the oral healthcare system, and reproductive care.

It is important to differentiate these two dimensions of access to healthcare, as the ability to access healthcare does not necessarily correspond with utilization. For instance, healthy individuals with generous health insurance plans may have the capacity to access healthcare but no actual use. Alternatively, unhealthy individuals with no insurance and poor capacity to access healthcare may have substantial utilization out of necessity. Together, the ability and healthcare utilization patterns are dependent on the fit of individual, sociocultural, economic, and health system-related characteristics. The degree to which these characteristics align, inhibit or facilitate the populations ability to obtain timely, needed, continuous, and satisfactory access to healthcare.[18]

Generally, having a usual source of healthcare better ensures the ability to access the healthcare system. A usual source of healthcare is a health provider or location that a person usually goes to when they are sick or in need of medical advice. Having this provider or location may contribute to the continuity of healthcare, a health management process by which patients and physicians are cooperatively involved to ensure high quality and cost-effective medical care.[19] Having a usual source of healthcare is associated with a number of positive outcomes associated with better health outcomes, more timely and appropriate utilization of preventive and primary care services, improved chronic disease management, lower costs, increased

satisfaction with care, and decreased emergency department use.[2, 3, 20-22] Those reporting a doctor's office in a health maintenance organization as a usual source of care may achieve the highest continuity of care when compared to those reporting a hospital emergency department.[23] A usual source of healthcare can also be considered an indicator of access to ambulatory care, or outpatient services.[24] Recent estimates suggest that over 25% of all adults and children do not have access to a usual primary healthcare provider.[20] In 2010, the Centers for Disease Control reported that among U.S. adults, females and older adults were more likely to have a usual source of healthcare. Those with lower educational attainment, lower incomes, and those who had never been married were less likely to have a usual source of healthcare.[25]

Without a usual source of healthcare to address medical concerns, populations may report higher unmet needs or delays in seeking medical care.[26] Measures of unmet healthcare need provide an alternative indicator of the ability to access healthcare and indicates missing or delaying medical care, prescription medications, or dental care that an individual or physician believed was necessary.[26] Unmet need may be due to a myriad of short-term or long-term conditions and decisions that result from healthcare supply issues, individual beliefs, or the result of intermediaries or gatekeepers which may prevent the individual from seeking care.[27, 28] Health status and outcomes deteriorate as individuals delay or fail to receive needed medical services and preventive screenings.[29] Estimates suggest that approximately 10% all persons in the United States were unable to obtain or delayed getting the necessary medical care, dental care, or prescription medicines that they or their physician believed were necessary.[20]

Use of routine check-ups and clinical preventive screenings offer broad indicators of realized use of the healthcare system. Visits might include screenings for blood pressure, cholesterol, cervical cancer, mammograms, Prostate-Specific Antigen (PSA) tests, and dental visits. Created by numerous federal agencies, national prevention guideline recommendations acknowledge that immunizations, screenings, and counseling are associated with a number of positive health outcomes, with early detection being linked to decreased mortality and

disability.[20, 30] Despite these national recommendations, a sizable portion of the population does not meet timely adherence of evidence-based preventive care and screenings.[31, 32] According to the National Health Interview Survey, 15% of females aged 21 to 65 years did you not receive a cervical cancer screening in the past 3 years, and 25% of adults age 18 years and older had not had their blood cholesterol checked within the preceding 5 years. Nearly 55% of persons aged 2 years and older had no dental visit in the past year. Ensuring equitable access to these preventive, evidence-based screenings offers a broad, cost-effective approach to improving the health of populations.[33]

In order to more adequately address disparities in access to healthcare, research continues to document characteristics that determine the ability to access and actual use of the healthcare system. Three key characteristics, racial/ethnic minority status, low educational attainment, and income, are known to have a negative association with having a regular source of healthcare, use of ambulatory care, and dissatisfaction with healthcare services.[26, 34-36] For instance, racial/ethnic minorities tend to receive lower quality healthcare than non-minorities do, even when insurance status and income are controlled for.[34] Major contributors to realized use have been attributed to an individual's ability to pay for healthcare, lack of insurance, willingness to seek healthcare, or recognize the need for preventive services.[37-41] Language barriers are a disenabling characteristic, as those who do not speak English are likely to face more healthcare barriers in the U.S. healthcare system when compared to English speakers.[42] Individuals with high out of pocket healthcare expenditures and who are underinsured are more likely to forgo needed care.[43] The need for healthcare services also depends on the individual's current health status. Out of necessity, those with poor health and with chronic conditions may be more likely to use the healthcare system.[44]

2.3 Access to Healthcare in Rural and Urban Areas

In public health research, there is growing and renewed interest in investigating how place, or area level characteristics, influence the health of populations.[10, 45] A larger body of research suggests that area level characteristics such as healthcare supply and concentrated disadvantage, directly and indirectly influence individual health and healthcare.[46-49] In studying access to healthcare, assessments of rural and urban area characteristics may provide one key dimension by which to capture the influence of place.[38, 50]

In this section, I examine the literature on access to healthcare for rural vs. urban populations, define the concepts of rural and urban as used in this study, and describe how previous public health research characterizes areas as rural or urban.

2.3.1 Access to Healthcare. To date, findings on access to healthcare for rural compared to urban populations are inconsistent.[5, 8, 9, 51] Compared to urban populations, rural populations are significantly more likely to report a usual source of healthcare, yet report fewer visits for preventive screenings and access to specialists.[5-9] Another study, however, suggests that residents in rural communities had lower odds of having a regular medical visit, receiving a flu shot, and reporting unmet need.[52] This may indicate that rural populations have different expectations of the healthcare system or a different threshold by which they report needing healthcare.

A majority of studies examine rural and urban population differences with medical service utilization,[51, 53, 54] with a growing body of research exploring the process or "ability" to obtain services.[4, 6, 55] Populations in rural counties are less likely to receive a blood pressure screening, dental exam, and mammogram during the past two years when compared to those in urban counties.[8, 9, 56, 57] Evidence suggests no rural-urban differences exist for influenza and pneumonia vaccination for persons 65 years and older.[8] Lower levels of screening and delayed diagnosis for certain health problems due to poorer access to services contribute to adverse health outcomes, with rural populations having decreased chances of surviving cancer due to

poorer access to detection, screening, treatment, and support services.[58] Compared to urban populations, access to specialists for rural populations is lower, with Medicare enrollees who reside in isolated rural areas having 10% fewer medical specialist visits, compared to the most urban populations.[7]

The utilization of outpatient (ambulatory care) and inpatient (hospitalization) care remains mixed when considering rural and urban population differences. Some studies have found minimal geographic variation in the proportion of persons with at least one ambulatory visit.[59] Others suggest that populations in the most rural areas reported fewer ambulatory visits during the year.[6] Rural populations may be more likely to report being hospitalized and having a higher number of hospital visits.[37] Rural populations who need to be hospitalized often must travel to urban hospitals to receive the necessary care, with one study identifying that one-third of rural resident hospitalizations occurred in urban hospitals.[53] Rural patients often require more resources or have been found to be more likely to have mental health diagnoses.[53] Hospitalization rates for injury generally increase as counties become more rural with higher rates for unintentional injuries and self-inflicted injuries being higher in rural counties.[60] Among Medicare beneficiaries, those in remote rural areas may be less likely to visit emergency department (EDs) than those in urban areas.[61] Rates of preventable hospitalizations, known as ambulatory care-sensitive conditions, are higher in rural areas. One study found that the adjusted rate of preventable hospitalizations was 90% greater for rural populations ages 18-64 and 45% greater for adults ages 65+, compared to preventable hospitalizations among urban populations.[38]

To date, most health services research has focused on individual and behavioral-level determinants such as insurance status and transportation barriers as primary explanations of rural and urban differences for various healthcare outcomes. The employment structure of rural areas –including “lower wages, fewer hours worked, smaller employers, greater reliance on agriculturally related industries, and self-employment” increases the likelihood of having

uninsured rural workers.[39] A smaller proportion of rural populations obtain private insurance through their workplaces than suburban populations.[1] Nearly 21% of rural populations, age 65 and under report being uninsured compared with 12% of suburban populations, and 15% of urban populations, a characteristic negatively associated with the utilization of healthcare services.[62, 63] In addition, transportation barriers and lack of time in rural areas may inhibit the ability of particular groups to obtain medical care.[64-67] Rural populations may encounter higher financial and travel-time costs to receive specialized treatment, often substituting a local generalist for a specialist or reducing their overall use of healthcare services.[68] Treatment of injuries may be limited by distances emergency services must travel to reach injured people, along with delayed treatment or incomplete surgical resources within rural areas.[58] Rural populations in poor health may also face unique challenges. For instance, HIV-positive women living in rural areas may face greater difficulties in accessing necessary healthcare, than their urban or suburban counterparts, due to physical health problems that prevented travel, lack of transportation, and inability to navigate the healthcare system.[69]

Cultural and social differences between rural and urban areas may explain some of the variation in health seeking behaviors and perceptions of medical need. For instance, the perception of what is “healthy” and the need to use the healthcare system may differ for people residing in rural areas, when compared to urban areas.[40, 41, 70, 71] Cultural perceptions may also influence the course of treatment and how issues of health and illness are viewed by rural clinicians and patients, with rural populations being more likely to delay treatment.[72] Self-reliance and the idea that going to the healthcare provider is an option of last resort remains a valid explanation of differences in healthcare use in rural areas.[40] The perception that continuing to work is more important than seeking healthcare services may deter some rural populations from using the healthcare system.

2.3.2 Defining Rural and Urban Areas. With demographic transitions and globalization occurring across the United States, rural and urban areas remain heavily contested spaces. For instance, rural areas are not as detached from urban areas as historically they once were. In other areas, rural areas are witnessing new economic and demographic restructuring that are altering the prospects of local communities.[73] Recognizing the growing heterogeneity of rural areas, empirically based conceptualizations of rurality or urbanicity have recently adopted more refined conceptualizations of rural and urban, based on combinations of population density, the adjacency to major population centers, and commuting patterns.[74]

For this study, the term "area" refers to a person's immediate residential environment, which are classified as either rural or urban, or somewhere in between (semi-urban). *Rural and urban areas* represent two ends of a continuum, reflecting area level characteristics pertaining to the local economy, infrastructure, and social context. The following section explains these three overarching characteristics.

Local Economy: Economic Dependence, Metropolitan Adjacency, and Commuting Patterns

The first area level characteristic captures variations in the local economy, including the economic dependency of the land, adjacency to metropolitan areas, and commuting patterns. Economic dependency refers to the type and specialization of the economy of a given area. The economic dependency of both rural and urban areas are increasingly sensitive to demographic restructuring, globalization, and tourism.[73] The economy of rural areas typically are more specialized, often supported by natural resources, with less specialized industrial/retail economies in urban areas.[75, 76] The relative availability of natural resources in rural areas in the United States tends to facilitate agricultural production, although this linkage is not necessary or uniform. Arid and dessert areas also fall within this definition of rural; yet seldom sustain large-scale agricultural production. These areas may instead be a source of natural energy or tourism. At the same time, mountainous areas may be characterized by lumber or mining economies,

and not agriculture. Urban areas are characterized by local economies that become less reliant on the production of natural resources and land is utilized differently. Historically, there has been tension between rural and urban areas. For instance, rural economies that are supported by natural resources are often threatened by urbanicity as dependency on consumer and retail economies increases (e.g. expansion of Wal-Mart into rural areas).

The adjacency and physical proximity of an area to large cities and metropolitan areas influences the local economic dependency. Adjacency refers to meaningful access (not just physical adjacency) to urban areas that account for situations where natural physical barriers or the absence of roads may prevent real commercial and social connections. Thus, the most rural areas are the most physically isolated as typically, goods and services must travel further.

The local economy and adjacency to metropolitan areas also contribute to commuting patterns and an individual's life space. For instance, those living in remote rural areas may have difficulty locating employment, and thus must travel farther on a daily basis to hold a stable job.

Infrastructure: Built Environment and Population Density

The second area level characteristic captures manmade infrastructure that includes the built environment and the corresponding density of the population. With increasing rurality, the density of residential, healthcare, and commercial buildings decreases, along with declining availability of public infrastructure (e.g. sidewalks), and facilities for daily living (e.g. grocery stores).[77, 78]

The type and level of infrastructure is dependent on the population size and their needs. Thus, urban areas correspond to places with the highest population density, while at the opposite end the most rural areas correspond to places with the lowest population. What is "dense", however, is not always adequately captured with population counts and as such is highly dependent on geography and culture, characteristics that are defined and appear to operate differently in various regions throughout the United States.[79]

Social Context

The third area level characteristic pertains to self-perceived and ascribed social contexts of areas. Self-perceived social context creates understanding and meaning to the areas where people live. The varied functions and meanings attributed to rural and urban areas are often ambiguous and complex, but areas may differ in personal values, attitudes, and identities.[40, 80-82] For instance, rural populations may see themselves as hardworking individuals with a strong sense of family, community and traditional religious beliefs. The social context of areas also pertains to ascribed social context and labeling by "outsiders". For instance, urban populations may positively stereotype rural populations (e.g. virtuous, hard-working, simple) or negatively stereotype (e.g. hillbillies, red-staters, backward). Alternatively, rural populations may positively stereotype urban or city people (hard-working, conscientious) or negatively stereotype them (e.g. elitists, leftist, dangerous).

2.3.3 The Measurement of Rural and Urban Areas. While prior public health research has done little to explicitly conceptualize what distinguishes rural from urban areas, research has helped refine the instruments (rural-urban measures) used to evaluate the rurality or urbanicity of places.[74] Care is essential in selecting the appropriate rural-urban measure because different measures may produce biased estimates or generate misleading conclusions.[83] For instance, Hart and colleagues, report that the importance of selected measures, as these measures influence conclusions about access to healthcare and the allocation of resources.[74]

Quantitative approaches to capturing rural vs. urban characteristics of areas predominate in the public health literature. Quantitative measures have inherent limitations, which become more apparent as understandings about what constitutes "rural" or "urban" become more nuanced. For instance, today many people in the U.S. live in areas that are not clearly rural or urban.[40] The federal government (and other entities) differentially classifies the levels of rurality in these areas. So-called comparable federal measures can vary by more than

10% to 28% of the nation's total population (i.e. a population of 29-79 million).[74] Thus, seemingly small differences in the degree to which an area is rural may significantly influence how the area and its populations are defined.

Rural-urban measures may comprise the characteristics of an area (i.e., how rural or urban it is), the geographic or governmental boundaries that define the area or both. Most measures are based on existing legal or administrative boundaries. Currently, various federal agencies including the United States Department of Agriculture, determine several designations that identify areas mostly based on population density, but also include the degree of urbanization, adjacency to urban cores, and commuting patterns.[84-87] Geographically-bounded designations include counties, census tracts, and zip codes. Measures might include the 9-level county-level Rural-Urban Continuum Code[85] or the 6-level Rural-Urban Classification Scheme[84] developed by the National Center for Health Statistics. Overall, these measures appear underutilized in the public health literature, particularly outside of the urban/rural health literature. Due to its simplistic nature, researchers and the government often utilize the Office of Management and Budgets (OMB) Metropolitan Statistical Area (MSA) designations.[86] For instance, the government uses the MSA measure to determine eligibility and reimbursement for 30 programs, including Medicare reimbursement levels and programs designed to resolve provider shortages in rural areas.[74] Although the underlying geographic unit at the county level is very stable over time, the definition may mask heterogeneity of areas.

The selection of a rural-urban measure is heavily dependent on sufficient sample size, population size, and available geocoded data to obtain estimates at the sub-county level. As such, health researchers often default to using census designations or the Metropolitan Statistical Area (MSA) designations, both of which are rural/urban dichotomies [8, 9, 88] since this is often the only measure of rural and urban in public use data sets. The dichotomy is typically included as a covariate in multivariate models to capture something that is "unique" about rural and urban areas, despite the reality that health patterns are much more complicated and

typically do not follow a consistent binary rural vs. urban gradient.[62, 89] Some research recommends disaggregating categories to produce more refined approximations of social phenomena; however, some measures may be too sensitive. While twelve discrete categories may provide detailed health information, this may supply an unnecessary amount of categories.

As rural areas across the United States are diverse, operationalizing rural areas at smaller units significantly strengthens conclusions public health can make. Utilization of census tracts may resolve issues with under-bounding and over-bounding of the urban cores, issues that are common with other county-level taxonomies.[89] In rural areas, development is often also clustered and discontinuous. Large areas of undeveloped land within rural communities can result in highly irregular units of geography, so utilization of smaller designations may be necessary. However, healthcare supply data is often only available at the county level. Researchers may underutilize smaller census designations since census tracts or block groups are nested within counties requiring for complex multi-level analysis. Health data is often less available at the census tract or block group level, and geocoded data is often more difficult to access. If research can overcome these data limitations, census block groups or tracts may provide a better way in which to maintain the notion of area based units of analysis.[49, 90, 91]

Table 2.1 describes the most common measures in public health research used to capture rural and urban areas. The table also lists the organization that developed the measure, the number of categories the measure contains, and the geographic unit at which it is assessed. The measures may produce different estimates in different regions of the country. They may also be more useful for some research questions than for others. Therefore, researchers who apply these various measures must be attentive to the increasing nuances and complexities of rural and urban areas.

Designating rural areas based on settlement type, such as style and density of housing, and counties with commercial or agricultural purposes may provide insightful and unique approaches to understanding rurality. Qualitative work that focuses on a person's "life space"

(i.e. as they move throughout daily life), social networks, or resident perceptions of neighborhood boundaries may also be better able to adequately capturing important dimensions of rural and urban life.[92-95]

2.4 Racial and Ethnic Disparities in Access to Healthcare

In the United States, racial/ethnic disparities in health and in access to adequate healthcare continue to exist. This study refers to race/ethnicity as a socially constructed taxonomy reflecting complex historical and current social relations in the United States that produce and reproduce unearned disadvantages for minorities while producing unearned advantages for non-minorities. The social constructedness of race/ethnicity indicates a need to identify and understand the social mechanisms they index. Various intrapersonal, interpersonal, institutional and structural mechanisms contribute to racial/ethnic disparities in access to healthcare.[96]

This section first briefly examines individual-level racial/ethnic disparities in access to healthcare; describes in more detail how residential segregation, an area level characteristic, may perpetuate the disparities; and, compares the occurrence of the racial and ethnic disparities in the context of rural and urban residential areas.

2.4.1 Individual Level: Racial and Ethnic Disparities. Research continues to document racial and ethnic disparities in access to and receipt of quality healthcare.[35, 42, 97, 98] Compared to whites, fewer racial/ethnic minorities can identify a usual source of health care, a characteristic that contributes to poorer health outcomes.[21, 99] Hispanic adults are more than four times as likely to have never had contact with a health professional than either Non-Hispanic white adults or Non-Hispanic black adults.[25] Among adults age 18 and over, Non-Hispanic whites are more likely to have visited a dentist within the past 6 months (49%), than either non-Hispanic black adults (33%) or Hispanic adults (29%).[25] More black women, however, report a

cervical screening in past 3 years (77.9%), compared to white (72.8%) and Hispanic women (73.6%).[100]

Independent of clinical appropriateness, insurance status, treatment site, and other clinical and socioeconomic correlates, racial/ethnic disparities in medical care persist.[34, 42, 101] The clinical experiences of blacks and Hispanics differs from those of whites, as research documents high levels of stereotyping, biases, and poor-patient provider communication that contribute to unequal treatment in medical settings.[34, 102-105] Compared to whites, research suggests that blacks and Hispanics have low rates of trust in medical providers and higher rates of perceived discrimination in medical settings.[104, 106, 107] In general, these healthcare experiences are one reason why Hispanics and blacks report lower rates of health service use compared to whites.[42, 108] Lower health literacy, such as where to obtain the needed health services among certain racial/ethnic minority groups may also contribute to reports of unmet healthcare need.[109] Insurance also remains a significant barrier, as compared to whites, blacks and Hispanics are more likely to be uninsured or covered by Medicaid.[110] Minority groups, particularly immigrants, may also experience a range of other barriers including language and cultural familiarity with the healthcare system.[111]

2.4.2 Area Level: Racial/Ethnic Residential Segregation. Racial and ethnic residential segregation refers to the geographic and social isolation of racial/ethnic minorities within a given county in the United States, and is one institutional mechanism by which racism influences health.[48, 112, 113] Institutional racism is perpetrated by larger systems in comparison to racism at the interpersonal (e.g. discrimination) or intrapersonal (e.g. internalized) levels.

Racial/ethnic residential segregation remains a deeply embedded historical reality as a spatial manifestation of institutionalized discrimination expressing itself in complex geographical characteristics.[114, 115] During the Jim Crow Era (1876 – 1965), segregation was deliberately created through zoning laws, restrictive covenants to exclude blacks, and cooperative efforts

between the real estate industry, banking institutions, and neighborhood organizations.[113, 116] Although the Civil Rights Act (Fair Housing Act) of 1968 put an end to “de jure” segregation and the banned discrimination in the sale of homes, the norms set in place before this law continue to perpetuate residential segregation practices throughout the United States.

As an institutional form of racism, racial/ethnic residential segregation operates within a complex racialized social system, understood as structural racism.[117] Structural racism is defined as the macro-level systems, social forces, ideologies, and institutions that interact to generate and reinforce inequities among racial and ethnic groups.[118] Structural racism normalizes inequities in social mobility, and determines the cultural, political, economic, and social identities of people. For instance, structural racism is responsible for the “culture of poverty” or the normalization that black people cannot get jobs or do well in school. These realities partially emerged as a result of segregation and the historical redlining of neighborhoods. For instance, as black families could not purchase homes in white neighborhoods, many were forced to send their children to inferior schools. As black children grew, they were presented with more limited options for higher education and job opportunities, when compared to the white children who were able to attend better schools, and get better educations and jobs in return. Thus residential segregation functions as just one institutional dimension of structural racism, working in tandem with other racialized systems that may include the educational, employment, and criminal justice systems. Scholars suggest that to fully understand inequalities, structural racism must be understood as the intersectionality of racialized systems and ideologies.[119, 120]

Explaining the associations between residential segregation and health does not involve a one-step form of causation as segregation influences health through a number of mechanisms by creating and reinforcing racial differences in socio-economic, physical, and social neighborhood environments and shapes health behaviors.[113, 121] In public health research, five key pathways are often used to explain the sequence by which segregation influences health.

Specifically, segregation has the ability to produce inequalities that: determine access to education, restrict employment opportunities, influence wealth and assets, limit social mobility, and create unequal access to goods and social services in a community.[112, 113, 116, 122] As socio-economic status determines prestige, money, power and social connectedness of the residents, populations who live in segregated areas have limited access and control over those resources. Among some racial and ethnic groups, some evidence suggests that as income rises segregation decreases, but this may not be the case with blacks.[123] Populations in segregated, poor communities are in a worse position to avoid risks, diseases, and the consequences of diseases. As such, evidence suggests blacks that live in highly isolated black areas have increased odds of reporting poor health.[124]

Segregated neighborhoods are at a significant disadvantage in accessing quality resources.[15, 113, 125] Segregation partially influences access to healthcare through the supply of healthcare providers, with fewer providers locating in minority communities because of lower provider reimbursement rates.[15] The lower supply of health professionals in minority communities may also be due to lower quality community amenities such as public schools, transportation services, and public safety.[112] Segregation in hospital care results in minorities receiving less healthcare and lower quality care when compared with whites.[126, 127] Segregation reduces minority access to physicians and hinders physician referrals for other medical services.[128] In addition to reduced healthcare supply, those residing in segregated neighborhoods lack the health resources, such as health information needed to avoid disease.[15]

Racial/ethnic minorities who reside in segregated areas are deprived of educational and social opportunities because of their racial/ethnic identity. At the same time these same minorities also reside in areas that do not offer similar quality resources and public services available in white neighborhoods.[15] High concentrations of racial/ethnic minority populations are not universally associated with poor access to healthcare. For instance, one study determined that blacks and Hispanics perceive fewer barriers to healthcare when they live in a county with a

high proportion of people of a similar race/ethnicity, while whites may perceive more difficulty receiving care when they lived in an area with a high proportion of racial/ethnic minority groups.[129] This finding however, may not account for ethnic and cultural differences or lower perceived need that may influence healthcare use.

Measurement of Segregation in Public Health Research

Residential segregation is typically measured based on geography and is used to make inferences about structural and institutional forms of racism. Formal measures of residential segregation often refer to the five geographic processes and patterns outlined in the seminal work by Massey and Denton;[115] evenness, exposure, concentration, centralization, and clustering. These formal measures may be more sensitive to capturing the social processes and dynamics of racial inequality in housing, education, and labor markets.[130] One recent study tested all five dimensions of segregation and found that metropolitan segregation measures were weakly associated with differences in risk of later-stage breast cancer and strongly associated with survival rates among black and white women.[131] The segregation and health services literature however, lacks consistency in the use of formal vs. proxy measures. Much of the health services literature uses racial and ethnic composition as a proxy for segregation.[115, 132] Calculation of formal segregation measures requires census tract and block group data, data that is often not accessible to many researchers. Proxy measures only partially represent segregation since it does not capture the relative locations of racial/ethnic groups within an area.[133] However, in one decomposition analysis, racial and ethnic composition of counties accounted for a significant and sizable proportion of disparities in access to healthcare. Compared with non-Hispanic whites, Hispanics are 18% more likely to be dissatisfied in their families ability to get healthcare, and 7% of this difference was accounted for by differences in racial and ethnic composition of the individuals census block group.[35]

The ways in which research incorporates formal or proxy measures of segregation varies. Researchers may dichotomize measures of segregation in order to determine a

threshold effect. These methods may not only limit the ability to understand segregation and its linear relationship with healthcare, but the methods limit comparability across studies. If researchers' hypothesize that segregation has a linear relationship with health, then researchers should test continuous segregation variables. Alternatively, if there are hypothesized threshold effects, then the variables should be categorized.[134] The choice of using a dichotomous vs. a continuous variable should be guided by the underlying assumption regarding how segregation operates in conjunction with the specific health access, utilization, or quality outcome.[132]

A methodological concern is the variation in the formal measures of segregation which describes the distribution of individuals of a micro-unit nested within a macro-unit.[133] For instance, in a recent review of 45 papers on black segregation and health published; there was considerable variation in the macro-area unit of analysis.[133] Most studies utilize the metropolitan statistical area (48%), followed by the state (11%), city (25%) and county (9%). Additionally, research typically uses census tracts as the micro-unit of segregation, although census tract have recently come under scrutiny as proxies for neighborhoods.[135] Testing the sensitivity of results to different spatial scales may influence the magnitude and direction of residential segregation.[133, 135]

2.4.3. Racial and Ethnic Disparities in Access to Healthcare in Rural and Urban Residential Areas. Whether racial and ethnic disparities in access to healthcare are more pronounced in rural or urban areas are not well understood.[12-14] Most of racial/ethnic healthcare research of rural areas has focused on women and older adults, with a heavy emphasis on the study of differences in preventive cancer screenings.[9, 56, 136-138] As rural racial/ethnic minority populations are generally not examined separately by health disparities researchers, frequently federal reports present analyses by race/ethnicity and by rural and urban areas, but few examine race across areas.[98, 139] "Rural" is often believed to be areas of racial and ethnic homogeneity – "rural America is where white people live", which may be one explanation of the

gap in research. As such, rural racial/ethnic minorities become an invisible population assumed to mirror urban population groups.

Although characteristics such as low education, poverty, and poor health are higher among *all* racial/ethnic minority populations compared to whites, these characteristics are particularly common among rural Non-Hispanic black and Hispanic adults, and are associated with higher mortality rates.[140] Relative to their urban counterparts, rural racial/ethnic minorities may face problems of limited access to medical care, colorectal cancer screenings, and physician visits.[12, 14, 137] Findings from another study show that rural racial/ethnic minority populations are at a greater disadvantage in obtaining health insurance, having a regular health care provider, and having reduced visits for preventive health, when compared to racial/ethnic minorities who reside in urban areas.[14]

Blacks in rural counties report fewer colorectal screenings than do blacks in urban counties (45% vs. 52%), with a similar disparity occurring among Hispanics.[137] Alternatively, more rural black women report timely screenings for cancer compared to urban white women,[13] however the researchers did not test for the within group difference and whether cancer screenings were significantly less for rural black women compared to urban black women. Strickland and Strickland identified many barriers among lower income blacks in rural areas, including the ability to pay for healthcare, differences in the perception of need, and experiences of racism.[65] Rural American Indians/Alaska Natives are less likely to have health insurance beyond the Indian Health Service, less likely to use health services, and more likely to have longer travel times to a usual source of care compared to their urban counterparts.[141, 142] No significant differences have been found between rural and urban Asians and American Indian/Alaska Natives in preventive screenings.[137] Cost remains a significant issue, with 24% of rural blacks, 25% of rural Hispanics, and 21% of American Indian rural adults reporting deferring healthcare due to cost, compared to 13% of rural whites and 9% of urban whites.[5]

Rural residence and factors related to immigration and race/ethnicity add additional layers of complexity to understanding access to healthcare. Despite the large body of literature alluding to the "healthy immigrant effect", immigrants continue to experience social and economic inequalities,[143] a factor contributing to disparities in healthcare.[144] Socio-demographic barriers including insurance, language, and cultural expectations may explain part of the disparities in rural settings. Ethnographic evidence suggests that rural populations with Mexican ancestry may be more likely to use safety net providers because they lack health insurance coverage.[145] Findings from a study of older adults in Texas showed that rural Hispanics were significantly less likely to report a usual place to go for healthcare and less likely to have a personal doctor or nurse.[146] Additionally, among non-metropolitan U.S. Mexicans, English language ability, foreign born status, and socio-demographic characteristics explain a substantial portion of the overall disadvantage of rural Mexicans in accessing care, but do not explain any of the added disadvantage of being Mexican *and* living in a rural area.[147] This may be the result of lower expectations of the healthcare system, which was found among foreign-born immigrants in a nationally representative sample.[148]

In rural areas, residential segregation and emerging settlement patterns may explain observed differences in access to healthcare services. Historically many parts of rural America have been home to large concentrations of racial and ethnic minority groups, with settlement patterns scattered across the United States. The research on residential segregation and its association with health has primarily focused attention on where a majority of racial/ethnic minorities reside: urban neighborhoods and cities.[10, 11, 113] Historical and current settlement patterns may be influenced by racial and ethnic residential segregation, as evidence suggests that segregation is not restricted to large cities.[149, 150] While some literature provides a more hopeful view of declining racial residential segregation and accelerated minority suburbanization in America's largest cities during the 1980s and 1990s,[151, 152] declining segregation in urban neighborhoods may increase segregation in other areas, such as suburban and rural areas. For

instance, estimates suggest that suburban and rural destinations with recent and high Hispanic growth appear to be highly segregated when compared to established Hispanic areas.[125] Civil rights legislation may have abolished formal barriers to integration, but many small rural communities may still experience “invisible” barriers in local housing markets. Some suggest that the political and economic processes that maintain racial separation in rural areas parallel those found in inner-city neighborhoods.[153] The potential influence of segregation and how it operates through other proximal causes within the neighborhood, health care systems, providers, and individual-level characteristics, may vary for rural and urban areas.[154]

Burton and Garrett-Peters explain how racial/ethnic segregated clusters are easily recognizable in small rural areas, particularly when the majority population is working, middle-class whites.[80] Although rural populations may live in small towns or areas where neighbors are farther away, rural minorities often reside in persistently poor neighborhoods with long histories of racial and economic oppression.[155, 156] As such, rural minorities residing in rural areas may be limited in opportunities for upward mobility. One-half of all rural blacks and one-third of rural Hispanics are located in high-poverty areas, which are likely segregated from whites and non-poor populations.[157] This means that poor racial/ethnic minorities are geographically concentrated and segregated from low-income as well as affluent whites. Moreover, although strides towards racial intolerance have generally declined over time, Southerners and rural populations appear to lag behind their metropolitan counterparts, even when measures or education and income are taken into consideration.[158]

Although race has a played a prominent role in shaping settlement patterns in rural areas, the residential patterns of rural blacks, Hispanics, and American Indians have evolved along different historical and demographic lines. Figure 2.1 is a map of the United States that highlights non-metropolitan counties and regions with high concentrations of racial/ethnic minority groups. The map shows that blacks living in rural areas are primarily concentrated in the South, a result of old plantation economy and slavery. These areas also have undergone

recent demographic changes with a return migration of blacks back to the South.[159] Demographic settlement patterns of blacks are captured in work by geographer Charles Aiken, who identified a new form of rural ghetto in the Yazoo Mississippi Delta.[160] Rural ghettos arise when failing economies create towns that are completely poor and black. The key structural elements of the ghettos include residential segregation, higher population density, and minority populations concentrated in public or subsidized housing.[161] These issues reveal themselves when researchers identify that nationally, rural Non-Hispanic blacks are the most highly segregated racial minority.[149] Estimates from 2000, suggest that more than 65% of rural Non-Hispanic blacks would have to move to other blocks in their community in order to ensure parity in the distribution of blacks and white across all blocks, estimates that are 30% higher than for Hispanics and 40% higher than the indices observed American Indians.[149]

More recently, rural areas in the Midwest and Southern United States have witnessed an unprecedented demographic influx of foreign-born Hispanic immigrants, particularly from Mexico and other parts of Latin America. About one-half of rural Hispanics now reside outside of the rural Southwest.[162] Research suggests that the dissimilarity index of white –Hispanic segregation in rural areas is nearly 50, when compared to white – Hispanic segregation in urban areas which was 42.[149] Recent research also suggests that the migration of Hispanic populations into new destinations (e.g. areas with rapid Hispanic growth rates) is correlated with higher levels of segregation.[125]

More research is needed to identify why racial/ethnic disparities in access to healthcare continue, particularly in understudied contexts such as rural areas. In order to allocate resources for the most vulnerable groups in the United States, public health professionals and policy makers must work to understand the determinants of access to healthcare. Clearly focusing just on race/ethnicity and its association with health and healthcare access in the absence of place will not suffice.

2.5 Poverty

Poverty refers to the geographic concentration of low-income households and associated social and structural conditions that may influence health and healthcare. The proportion of households who are in poverty provides an indicator of households who are unable to meet basic living standards according to federal guidelines. This provides a suitable estimate of overall area-level disadvantage as it counts for earned income as well as household size, compared to measures of just income.[163] Generally, living in a poor, deprived, or socioeconomically disadvantaged neighborhood is associated with poor health outcomes.[164-166] To date, the conceptualization of poverty has included many dimensions including concentrated poverty, deprivation, and collective efficacy.[90, 167-170] In public health research, concentrated poverty is often conceptualized as the distribution of poverty across neighborhoods, as an attribute of an entire metropolitan area.[112, 171]

Evidence suggests, a higher proportion of households below the federal poverty level is negatively associated with having a usual source of healthcare and limited access to resources.[46, 88]Among low-income individuals living in the one hundred largest metropolitan statistical areas, those living in areas with high rates of poverty are less likely to have seen a doctor in the previous year than those living in higher income areas.[47] Among Los Angeles residents, controlling on health status, the utilization of surgical procedures rates varies significantly across zip codes, with low SES zip codes having fewer procedures.[172]

The study of rural-urban differences in access to healthcare is commonly operationalized at the county level and has focused on the role of area level poverty.[28] Additionally, evidence suggests that rural populations tend to live in persistently poor counties.[173, 174] An estimated 386 rural counties in the U.S. experience consistently high rates of poverty (over 20%) for the last three decades.[173] Some research suggests that the spatial concentration of rural poverty is the primary explanation for differences in unmet healthcare need and access to mammograms.[28, 175] A unique feature of rural poverty is that the poor are distributed unevenly across larger units,

such as counties, multi-county labor market areas, and sub-regions, a phenomenon that is often masked by aggregated data, with rural poverty rates remaining highest in the South.[176] In both rural and urban counties in Ohio, a higher proportion of households below the Federal Poverty Line was associated with higher unmet healthcare need.[28] This research may have found a significant difference between rural and urban counties if they had considered concentrated disadvantage (counties with >40% of households at or under the Federal Poverty Level).

Racial/ethnic minorities who live in rural areas may have an increased disadvantage than their urban or suburban counterparts, as on average these groups are significantly more likely to reside in high poverty counties.[157] With the exception of the Appalachian region, which is predominantly white, persistently poor rural counties are known to have heavy concentrations of racial and ethnic minority populations. These counties remain clustered within several high-need rural regions such as the Lower Mississippi Delta and southern Black Belt, the Colonias along the U.S. Mexican border, Central Appalachia, and Native American reservations.[80] Rural racial/ethnic groups reside in some of the most impoverished counties in the United States.

2.6 Healthcare System

The healthcare system refers to the formal medical system comprising private and public providers that deliver secondary, tertiary and, to a lesser degree, primary services to enhance the health and extend the life of those with the means to obtain the services. The healthcare system should be distinguished separately from population-based strategies that deliver primary prevention such as health promotion campaigns. Access to healthcare (i.e., cancer screenings, usual source of healthcare) is facilitated by residence in an area where the supply of primary care providers and other healthcare resources is high.[46, 49, 147, 177]

Historically, access to healthcare has been shaped by urban versus rural distinctions within the healthcare system.[41] Long-standing problems of resource distribution and the distinction between “rural” and “urban” healthcare systems have roots in early public health

initiatives and policies. Dating back to the 1700s, the field of public health saw “rural” areas as clean and healthy areas, compared to “urban” areas, which had higher population density, sanitation issues, and were susceptible to communicable diseases. With increased mobility and the spread of communicable diseases, by the late 1800’s there was a need for public health service in rural areas. While the number of health departments began to grow, it was estimated that in 1929, nearly 77% of rural Americans still lacked access to adequate healthcare services.[178] By the 1950’s and 1960’s, rural physicians began to retire or move to urban areas, skewing the distribution of physicians. Physicians departed from both rural areas and inner-city neighborhoods to join affluent medical practices offering better compensation and more technologically sophisticated facilities, with rural areas had difficulty creating, recruiting, and sustaining an adequate healthcare workforce.[41]

The Emergency Health Personnel Act of 1970, created the National Health Service Corp (NHSC) and Health Primary Shortage Area (HPSA) designations. The HPSA designations placed physicians and dentists in underserved areas, including rural areas. HPSA designations are now used by more than thirty federal programs and numerous state programs to identify areas and populations eligible for assistance, which includes support for training and recruitment of health professionals, enhanced payment through Medicare and Medicaid, and immigration waivers for foreign-born physicians. More than 65% of rural counties today are whole or partial HPSAs.[12] With concentrated poverty among rural racial/minorities remaining exceptionally high,[157] Health Professional Shortage Areas (HPSA) are more common in counties where racial/ethnic minorities represent more than half of the population. Four out every five rural counties (81%) in which Hispanics are the majority are HPSA, as are 83% of counties with a black majority, and 92% of counties with an American Indian/Alaska Native majority.[12]

Shortage areas directly influence healthcare organizational characteristics including staffing, hours, or physical amenities.[7, 179] After adjusting for age, 70% of women residing in a

"whole" health professional shortage area report a mammogram and 84% of women report a cervical cancer screening, compared to 77% and 86% respectively of women not in HPSA.[50] While a greater proportion of specialists is not uniformly associated with better access to healthcare,[35] other evidence suggests that specialist availability contributes to longer life expectancy in rural areas, but not urban areas.[180] Due to geographical differences in resources, nurse practitioners and physicians assistants have increasingly taken on broader and more effective roles in many rural areas.[181]

Closures of rural hospitals throughout the 1980s and national health policies designed to address urban health delivery problems only compounded the health professional shortage. Almost 500 rural hospitals have closed in the past 30 years due to a variety of reasons, one being an increased percentage of non-reimbursed or poorly reimbursed healthcare services.[1] The smaller size of rural hospitals and distance from urban centers requires rural hospitals to pay more for goods and services than larger urban facilities. Hospital availability and size has a direct association with access to healthcare, as living in a county with a greater proportion of hospital beds is positively associated with report of a usual source of healthcare.[49, 88]

Rural areas are not alone in their struggle for an adequate healthcare infrastructure. Although urban areas may have a large proportion of physicians and a greater amount of healthcare facilities, health services are often not equally distributed in inner city areas and many poor urban and racial/ethnic minority populations lack the resources to access them.[182] For instance, urban, segregated communities frequently face shortages of healthcare providers and disproportionately low rates of health insurance, both essential predictors of differential access to medical care.[182]

Significant federal and state programs provide healthcare resources for rural and inner city health centers in underserved areas, although there is significant variation in the governance structure, funding and services provided by local health departments. Those residing in rural state may also have a harder time qualifying for Medicaid coverage, as these

states typically have more restrictive Medicaid eligibility requirements.[183] To date, Medicaid expansion under the Affordable Care Act was denied in 21 states, including states that have sizable rural and racial/ethnic minority groups including Georgia, Texas, and North Carolina. Increasingly, rural healthcare systems must also meet the needs of an aging population and increasing socioeconomic hardships.[41, 184]

2.7 Summary

The evidence from a growing body of research suggests area level characteristics may contribute to disparities in access to healthcare. Living in a rural vs. an urban area may also affect access to various types of healthcare. The concepts of rurality and urbanicty are useful analytic and policy tools; however, considerable debate exists regarding how best to conceptualize and measure the degree to which an area is rural vs. urban. The studies identified in this review suggest complex, synergistic relations exist between where one lives (rural or urban) and their racial and ethnic identity. Contextual or area-level characteristics including residential segregation, poverty, and healthcare supply may help to explain some of the differences in access to healthcare.

To more fully understand why disparities in access to healthcare remain, this study considers the influence of contextual- and individual-level predictors of disparities in rural and urban areas, and it employs a multi-level, socio-ecologic approach. Further, the study attempts to understand determinants affecting racial/ethnic minorities within these social environments. Testing for pertinent contextual-level characteristics, beyond healthcare supply and poverty, may be key to understanding why disparities in access to healthcare remain.

CHAPTER 3

THEORETICAL FRAMEWORK & RESEARCH AIMS

3.1 Introduction

This chapter's five sections present the theoretical framework and research aims of this dissertation. Section 3.2 describes the Andersen's Behavioral Model of Health Services Use that serves as the study's conceptual foundation. The theory of fundamental causes is examined in Section 3.3, which was used to distinguish social conditions that may influence disparities in access to healthcare. In Section 3.4, the conceptual model is presented, which was guided by contextual and compositional factors, which simultaneously examined the influence of both area and individual level characteristics. This is followed by an explanation of theoretical bases for the study's main constructs, *access to healthcare* and *rural and urban areas*. Finally, Section 3.5 presents the three aims of the study and their corresponding hypotheses.

3.2 Andersen's Behavioral Model of Health Services Use

Andersen's Behavioral Model of Health Services Use, hereafter the Andersen Model, is the most widely applied model in health services research and is used to explain factors that predict health service use and health outcomes.[17, 185] Health service use can broadly be characterized in terms of its type, site, purpose, and the time period involved.[185] Although Andersen's Model has evolved over time, the "predisposing", "enabling", and "need" factors that determine access to healthcare and health have remained. Figure 3.1 shows key aspects of the model.[17]

At the individual level, as shown under the "population characteristics" subheading in Figure 3.1, *predisposing* factors are biologically or socially constructed factors that influence the

likelihood of an individual needing healthcare, such as gender, educational attainment, and racial and ethnic identity. *Enabling* factors are resources that enable or impede the use of healthcare. These factors may include insurance status, income, affordability, and distance to a healthcare provider. *Need* captures the objective and subjective need for health services. Objective factors may include clinically evaluated health conditions such as having a chronic condition. Subjective factors may include self or socially evaluated health needs. These population characteristics influence health behaviors and health service utilization, which are intermediaries to the individual's health status outcome.

Andersen's Model also captures the influence of the larger environment as distinguished both within and outside of the healthcare system. According to the model, area demographic and social characteristics are considered predisposing factors, whereas healthcare organizational and financial characteristics are considered enabling factors. Healthcare system characteristics typically include resources, policies, organization, and financial arrangements that influence accessibility, availability, and acceptability of medical care services in a given area.[186] Area demographic and social characteristics may include economic climate, politics, or even prevailing norms of society.[186] Both the external environment and healthcare system factors are intertwined. For example, having a rural county with a higher poverty rate may predispose the county to be a health professional shortage area.

Each component of the Andersen Model might be conceived of as making an independent contribution to predicting health behaviors or healthcare use. The model, however, also outlines an explanatory process or causal ordering, where for instance predisposing factors might be exogenous, where some enabling factors are necessary but not sufficient for use, and some need must be defined for health service use to actually take place.[17]

Over time, Andersen's Model gained complexity by the addition of feedback loops. These loops emphasize the recursive nature of health services' use. The first feedback loop arrow, which moves from right to left on the very top of Figure 3.1, specifies how perceived and

evaluated health status may influence health behaviors, predisposing factors, and perceived need for services. For instance, an individual who is diagnosed with a chronic condition may have to pay more to have comprehensive health insurance, a key-enabling factor. The second main feedback arrow of Andersen's Model is represented on the bottom of the figure and moves from right to left connecting "health behavior" to "population characteristics". This might mean for instance, increased use of health services may influence health beliefs, a "need" factor.

Andersen's Model helpfully structures an assessment of individual health behavior within the larger "contextual" environment. The framework works to conceptualize the interconnectedness of healthcare system characteristics and social/economic factors, which have the ability to support or deter access to healthcare services.[47]

3.3 Theory of Fundamental Causes

Developed by Link and Phelan, the theory of fundamental causes of health explains why social conditions and their association to health have persisted through time.[48, 187] Social conditions are factors that involve a person's relationship to other people or positions occupied within the social and economic structures of society. Whether a social condition is a fundamental cause of disease depends on if the social condition fulfills four essential elements.[188]

First, the social condition must be associated with multiple diseases, and as such is not limited to one disease or health problem. For instance, poor socioeconomic status is strongly associated with not one medical condition, but a variety of diseases and other causes of death.[188] Second, the social condition must influence disease outcomes through multiple risk factors. Lutfey and Freese[189] described this component as involving a "massive multiplicity of mechanisms," since there are numerous processes that connect socioeconomic status to health including behaviors such as smoking,[190] stressful life conditions,[191] and preventive healthcare screenings.[192]

A third feature of a fundamental cause is that it must involve access to resources that can be used to avoid risks or to minimize the consequences of disease once it occurs. Resources such as knowledge, money, power, prestige, and beneficial social connections, help an individual to avoid illness and death.

The last and unique feature of a fundamental cause is that the association between the social condition and health is reproduced over time even when the intervening mechanisms change. As such, resources are transportable to new situations, causing the social condition and its association to health to remain. For instance new medical technologies that target the intervening mechanisms such as prevention become available, the medical field has a greater ability to control disease advances.[48] According to the theory, those who have access to resources will benefit more from this new information gained and take advantage of the new interventions and consequently experience better health, which reinforces health disparities. Thus, despite medical technology advances, the association between fundamental causes and disease does not diminish over time.

The theory of fundamental causes helps to determine the social factors that persistently recreate inequalities in access to healthcare across time. Specifically, understanding what particular social conditions in rural and urban areas are associated with access to healthcare helps provides clues to the causes and proliferation of inequalities.

3.4 Conceptual Model

The conceptual model is also informed by the literature on contextual vs. compositional factors. Researchers use the terms ‘context’ and ‘composition’ to index complementary levels of focus. Compositional characteristics are often individual level characteristics (e.g., gender, race) that are routinely assessed in public health research. All individuals and their risk exposures occur within broader contexts, however, and those contexts may influence risks and outcomes.

Accordingly, contextual characteristics characterize areas or other macro-level units without regard to consideration of the characteristics of the individual level elements within them.

A *contextual* focus refers to taking an ecological approach to understanding health, by considering the characteristics of an area or the collective behaviors of an area.[193] "Context" constitutes and contains social relationships of areas, as individuals living in a particular locality share similar behavioral patterns and social norms. Context also constitutes and contains physical spaces and resources, such that individuals living within the same neighborhood are exposed to similar local factors that influence health. Contextual characteristics may include levels of air pollution or structural aspects of areas such as healthy food options, parks, health service provision, residential segregation or the labor market.[78, 194-196] Increasingly, public health research is working to consider how context influences health, particularly in subfields such as social epidemiology.[197] For instance, the Public Health Geocoding Project suggests that context plays an important role in our understanding of indicators such as socio-economic status, as people in poor areas have poor health because the concentration of poverty creates and exacerbates harmful social interactions.[198]

In contrast to a contextual focus, a *compositional* focus relates to the characteristics of individuals, though it may also apply to larger units such as communities. A compositional focus hypothesizes that differences in health and healthcare outcomes derive from individuals who live in the same area tending to be more similar to one another than to those in other areas (i.e. race or ethnicity). For instance, people in low-income areas have poor health because low-income people as individuals have poor health. A purely compositional focus might also imply that similar types of people have similar access to healthcare, no matter where they live, meanwhile ignoring the association that the number or quality of healthcare facilities may have on access to healthcare.[194, 199] Much of public health and epidemiologic theory defaults to using a compositional focus, by suggesting that "population health" results from individual level biological characteristics, exposures, and behaviors.[200]

Some public health research assumes that composition and context are mutually exclusive categories, created and maintained in isolation.[46, 50, 193] Conceptualizing context and composition in this manner however, may mask how area level characteristics influence individual characteristics of the residents. Some have even argued that the use of the separate terms “context” and “composition” creates a false dualism and dismisses the process and interactions that occur between people and the social and physical resources in their environment.[193] For instance, children’s experiences are inherently shaped by the built environment and educational system of the areas in which they are raised. At the same time the behavioral and social interactions of children, and how as adults they operate in the same area also shapes the ‘context’ for surrounding neighbors.[193]

The complex interactions between context and composition are often conceptually difficult for quantitative research to disentangle. If community contexts are causally related to health, the pathways involved are likely to be complex and involve reciprocal causation, much like the feedback loops in Andersen’s Model as discussed in Section 3.2. Often research with a biomedical and lifestyle approach treats “context” as a nuisance whose effect is controlled only through statistical adjustment.[200] Alternatively, others assume that context is what remains after accounting for all possible individual level factors.[45] The limited theoretical development and corresponding measurement issues of ‘context’ often mean that public health research is only able to explain a small proportion of health variation when compared to conventional, individual level risk factors.[164] While representing complementary levels of focus, context and composition inherently have tight interrelationships, which are not easy to conceptualize and capture. Research must be explicit about the causal pathways believed to connect context and composition to health.[164]

Primary Research Question: What is the relationship between residing in a rural vs. urban residential area and access to healthcare?

The theoretical framework works to understand the relationship between rural and urban areas and access to healthcare. To examine these relationships, the study's conceptual model integrates elements of the Andersen Model, the theory of fundamental causes, and Contextual and Compositional factors. Informed by these models and the literature reviewed previously in Chapter 2, the conceptual model for this study is provided in Figure 3.2. The conceptual model is grouped into two broad dimensions, contextual factors and compositional factors. The two main constructs of the study are *access to healthcare* and *rural and urban areas.*

For this study, *access to healthcare* reflects an individuals' ability to obtain care and their actual use of the healthcare system.[17, 201] These two dimensions fit within broader understandings of access to healthcare as a socially constructed concept. Other key dimensions of access to healthcare might include characteristics of community resources (the availability of healthcare providers and facilities) or characteristics of the individuals themselves (income, insurance coverage, attitudes toward medical care).[201]

Five proxies provide objective and broad assessments of the capacity and use of primary care, the oral healthcare system, and reproductive health services. Two proxies were selected to represent an individuals' ability to obtain care (having a usual source of healthcare and unmet healthcare need) and three proxies represent an individuals' actual use of services (cholesterol, dental, and cervical preventive screenings). These preventive screenings were selected to correspond to services that are routinely administered in the healthcare setting and which offer cost-effective ways to prevent disease and enhance health. These screenings also represent adherence of primary and secondary prevention, instead of tertiary healthcare prevention.

Together each of the five access to healthcare proxies contributes to understandings of the multi-dimensionality and complexity of access to the broader healthcare system. While some contextual and compositional factors may be salient for some outcomes over others, in order to test the primary research question, the study's conceptual model postulates that rural

and urban areas and residential segregation are pertinent contextual factors influencing all five outcomes.

Rural and urban areas are based on a person's immediate residential environment which are classified as either rural or urban, or somewhere in between (semi-urban). As explained in greater detail in Section 2.3.2, rural and urban areas remain heavily contested spaces. While rural and urban areas may be understood as separate places that share a unique association with health and healthcare, rural and urban areas are not maintained in isolation. As geographic areas are increasingly dependent on one another, for this study urban and rural areas are understood as a relative term, representing a continuum of differences in area-level characteristics, including the local economy, infrastructure, and social context. The local economy of an area refers to changes in the economic dependency of the land, whether the area is adjacent to metropolitan areas, and how far residents must commute for work. Infrastructure refers to a decline in the built environment and corresponding density of the population. Social context pertains to changes in the self-perceived and outsider perceptions of where people live.

These dimensions are not intended to be restrictive, but directive, helping to orient understandings of rurality or urbanicity as a broader socially constructed concept. These specific dimensions were selected as they are hypothesized to be key drivers of disparities in health, with each dimension playing a more or less important role depending on the outcome. For instance, one dimension, the social context of an area, may be the primary reason for differences in self-perceptions of need and may overshadow the other two dimensions. Even more so, regional variations in the United States will contribute to the relevancy of these three dimensions, such that being a rural Southerner has strong implications for self-perceptions of healthcare need. At the bottom of Figure 3.2, the bold line moving unidirectionally from access to healthcare captures the direct relationship between an area's rurality or urbanicity and access to healthcare. Adults living in rural areas are expected to be the most disadvantaged in regards

to access to healthcare, due to specialized local economies, limited infrastructure, and differing social context.

Conceptually, the constellation of contextual factors that characterize residential areas constitutes fundamental causes of health as these factors have the ability to persistently recreate inequalities. With respect to the conceptual model, rural areas, racial/ethnic residential segregation, and poverty are characteristics pertaining to areas, with each qualifying as a fundamental cause of health. These characteristics reflect social stratification, indicating the gradation of opportunity, prosperity and position within society. As fundamental causes they are able to determine access to important resources, and can affect multiple disease and healthcare outcomes through multiple mechanisms. The healthcare system is not a fundamental cause according to the study's conceptual model, due to its close and proximal relationship to access to healthcare.

Taken together, contextual factors have a direct association with access to healthcare as identified by the unidirectional arrow on the bottom of the conceptual model. This arrow indicates that above and beyond individual characteristics, health and access to healthcare decline as contextual factors reflect greater disadvantage and limited social services.[28, 46, 202]

Compositional factors, which are the individual level predictors, are more proximal determinants of access to healthcare when compared to contextual factors. Compositional factors may serve as intervening mechanisms between contextual factors and access to healthcare. As such, residing in rural or urban area influences the compositional factors. For instance, adults in rural areas who are employed are significantly less likely to be offered employment-related health insurance compared to adults in urban areas who are employed.[39] In turn, being uninsured is associated with differences in access to healthcare.[39, 184] Differences in compositional, individual level predisposing, enabling, and need factors are evidence of how individuals interact with the areas in which they live. The two-sided arrow connecting compositional and contextual factors reflects individuals' agency in the model. This cross-level

relationship shows that people have the ability to shape the contextual factors or areas in which they live. Framed in this manner the model determines whether compositional factors influence access to healthcare across all areas, or whether compositional factors are more important in some types of areas compared to others.

Additionally, compositional factors are placed into three categories, predisposing, enabling, and need factors as outlined by the Andersen Model. Pertinent for this study, key predisposing factors associated with poor access to healthcare include racial/ethnic minority status, poor educational attainment, low-income status, unemployment, and family size.[26, 36] Enabling factors such as lack of insurance, limited English proficiency, and out-of-pocket healthcare expenses are associated with reduced access to healthcare.[42, 203] In particular, out-of pocket healthcare expenses are a barrier for low-income individuals and those without insurance. Need factors, include poor self-reported health and chronic conditions change the frequency in which people access healthcare services.[44] Chronic conditions capture evaluated health status; while self-reported health captures perceived health status, key components of the Andersen Model. The dotted line connecting predisposing, enabling, and need factors indicate the close correlation that the compositional factors share. One example is that individual employment status and income are closely tied to health insurance status.[204] Compositional factors also have a bi-directional association with access to healthcare, such that access to healthcare can influence compositional factors. For instance, reduced access to ambulatory care services may exacerbate chronic or acute conditions, leading to hospitalizations that might have been preventable.[24] A more detailed description of the study variables is provided in Chapter 4.

3.5 Research Aims and Hypotheses

In this section, I provide a detailed description of the study's three aims and corresponding hypotheses. Figures 3.3, 3.4, and 3.5 visually convey the relationships under

consideration for Aim 1, Aim 2 and Aim 3, respectively. Each of these figures fits within the broader conceptual model as depicted in Figure 3.2.

Aim 1: To compare and contrast five measures commonly used to characterize an area as rural or urban, and learn if the relationship between rurality and the dissertation study's access to healthcare variables varies across the five measures.

It is unclear which dimensions of rurality and urbanicity are most pertinent to health; therefore, this aim evaluates the extent to which area-level external and healthcare system characteristics vary depending on the instrument used to assess these characteristics. It also examines how the choice of rural-urban measures might influence estimates of access to healthcare.

The choice of measures used may reflect implicit or explicit assumptions about rurality or urbanicity. While a variety of measures are used to define areas as rural or urban, poor conceptualization hampers progress toward understanding the mechanisms by which they affect outcomes. This aim determines the adequacy by which each of five rural-urban measures captures the study's conceptualization of rural and urban areas.

Hypothesis 1.1: The greater number of categories an rural-urban measure has, the stronger its association will be with socio-demographic and healthcare supply characteristics at the census tract and county levels.

Of the five rural-urban measures used in this study to capture rurality vs. urbanicity, the number of categories ranges from two to nine. This study hypothesizes that rural-urban measures with fewer categories mask important socio-economic and healthcare supply characteristics at the county and tract-level. Rural-urban measures with a greater number of categories may capture more nuanced aspects of place. Thus, the binary measure of urban/rural, the Metropolitan Statistical Area, will be limited in its ability to provide a comprehensive measure of area level characteristics.

Hypothesis 1.2: Regardless of the rural-urban measure utilized, adults in the most rural areas will have significantly poorer access to healthcare after adjusting for age, when compared to other categories.

Regardless of the rural-urban measure utilized to capture rural and urban areas, studies generally find that rural, and particularly remote rural areas are significantly more likely to be uninsured, defer healthcare due to cost, and poor/fair self-rated health.[5, 205] This aim compares various rural-urban measures with the same sample and same outcomes. The hypothesis is that every rural-urban measure will predict poorer access to healthcare for adults in the more rural vs. more urban areas. Hypothesis 1.2 builds on findings from Hypothesis 1.1, as it is expected all of the rural-urban measure roughly capture similar area level characteristics, except for the binary Metropolitan Statistical Area.

Hypothesis 1.3: When stratified by region, the association between each of the rural-urban measures and access to healthcare will not differ after adjusting for age; adults residing in the rural South will experience the worst access and those in the rural Northeast will experience the best.

Access to healthcare has been documented by region (South, West, Northeast, Midwest).[1, 82] Most studies, however, that focus on rural and urban area differences in health study one region or state in the United States, and do not use nationally representative data.[38, 54] Adults residing in the rural South are expected to report the lowest access to healthcare when compared to those in the other regions. Historically, the southern United States is an agricultural region characterized by (its own perhaps) “rural” which may contribute to issues with accessing healthcare services.[65, 160] Adults living in the urban Northeast are expected to experience the best access to healthcare based on other findings.[6] This hypothesis seeks to understand if the aggregation of data in national studies masks regional differences in the relationships between rurality, urbanicity and access to healthcare.

Aim 2: To determine whether racial and ethnic disparities in access to healthcare differ by rural vs. urban area.

This aim explores the relationship between living in a rural or urban area and access to five types of healthcare. It also examines whether this relationship varies by individual level race and ethnicity. This study conceptualizes *race/ethnicity* as a socially constructed taxonomy that represents complex historical and current cultural experiences that are produced and reproduced through race relations in the United States. Depending on ascribed and self-perceived racial/ethnic identity, individuals embody the social status of oppression or privilege within the broader society.[206] Thus, race/ethnicity does not offer biological or physiological explanations for racial and ethnic differences in health; rather it serves as an indicator of racialized social status and risk for exposure to racism.

Hypothesis 2.1: The difference in access to healthcare between Non-Hispanic blacks and Hispanics compared to Non-Hispanic whites will be larger in rural areas compared to urban areas.

Beyond other contextual and compositional level characteristics, this hypothesis tests how disparities by race/ethnicity may differ depending on whether the individual lives in a rural or urban area. Racial/ethnic differences in access to healthcare are expected to be significantly worse in rural compared to urban areas. I suspect that the differences in access to healthcare can be explained by two primary factors: *poor clinical experiences* and *low expectations* of the healthcare system.

Compared to non-Hispanic whites, research continues to document that racial and ethnic minority groups report poorer clinical experiences within the healthcare system, often characterized by poor patient-provider communication, high levels of implicit bias, stereotyping, and perceived discrimination.[34, 102-104, 207] Findings point to interpersonal and intrapersonal forms of discrimination and racism. Compared to social settings, these clinical experiences offer some explanation for the differences in access to healthcare for members of racial/ethnic minority

populations.[21, 35, 208] Poor clinical experiences may also be more pronounced in different types of healthcare environments and residential areas.[34] Race/ethnicity is closely tied to other predisposing factors including income and educational attainment, which may also lead to unequal treatment across all medical settings.[34] Identifying racial and ethnic differences even after controlling for socioeconomic status however does not suggest that biological differences explain the racial and ethnic differences.[209]

The second primary factor to explain this hypothesis is that rural populations and certain racial and ethnic groups may have overall lower expectations of the healthcare system. Particularly in rural areas, lower expectations of the healthcare system might be explained by self-reliant rural adults who when sick, still believe they are "healthy".[40, 70, 71] Second, lower expectations of the healthcare system may be more common among racial/ethnic minority groups due to low rates of trust of the medical system, factors that could contribute to differences in health use.[106] Lower expectations of the healthcare system may influence the course of treatment and how issues of health and illness are viewed by rural clinicians and patients.[72]

> *Hypothesis 2.2: Within each racial/ethnic group (whites, blacks, and Hispanics), adults in rural areas will have poorer access to healthcare, compared to their counterparts in urban areas.*

Within each racial/ethnic group, those who live in rural areas will have the poorest access to healthcare, highlighting the synergistic association of living in a rural area and the experience of racial/ethnic minorities in these contexts. These differing experiences can be explained primarily by *lower expectations* of the healthcare system based on findings which suggest barriers among low income blacks in rural areas, including the ability to pay for healthcare and lower perceptions of need.[65] In order to tease out the underlying processes that produce within group racial and ethnic differences in access to healthcare, it is important to emphasize that socio-economic differences within each racial group are substantially larger than

overall racial differences.[208] For instance, most blacks are not poor and most people living in poverty are not black. Thus controlling for socio-economic status will better determine the within group racial/ethnic disparities in access to healthcare.

Hypothesis 2.3: The difference in access to healthcare between blacks and Hispanics will be larger in rural areas, compared to urban areas.

In rural areas, this study hypothesizes that Hispanics may experience poorer access to healthcare than blacks due to both *poor clinical experiences* and even *lower expectations* of the healthcare system. Research indicates that compared to Non-Hispanic blacks, significantly fewer Hispanics have any healthcare coverage and a specific source of ongoing care, regardless of age, sex, employment status, marital status, and general health status.[210] This disparity is expected to be more drastic in rural areas, as these areas may not have adequate infrastructure, including a reliable safety net with appropriate language services to address the needs of a growing Hispanic population.[145] By changing the reference category away from whites this aim will expose how the selection of a reference group needs careful consideration. When research is quick to default to using urban whites as the reference category, meaningful differences between disadvantaged populations may be lost.

Aim 3: To examine the association between racial/ethnic residential segregation and access to healthcare in rural vs. urban areas.

This aim examines how racial/ethnic residential segregation in the context of rural and urban residential areas may persistently reconstitute the conditions necessary for the perpetuation of inequality in health.[48, 113] *Racial/ethnic residential segregation* refers to the geographic and social isolation of racial/ethnic minorities within a given county in the United States. In this study, residential segregation is an institutional form of racism, and serves as a proxy for higher levels of structural racism.

Hypothesis 3.1: The association between racial/ethnic residential segregation and access to healthcare is similar in rural and urban areas.

Beyond the widespread income disparities among racial/ethnic groups, the relative geographic isolation of racial/ethnic minorities are expected to contribute to a declining local tax base (county or local municipality level), and this in turn leads to unequal access to social services, including healthcare.[113, 211, 212]

This study hypothesizes two key pathways linking segregation to a diminishing local tax base in both rural and urban areas: the economic and material impact of *migration* and political/cultural experiences of *disconnection*. To some extent, all geographical areas are categorized by migration. This study refers to both in- and out- migration (i.e. people moving into or out of an area) that may dramatically alter the economic or material prospects of the surrounding community. Fundamentally, the migration of whites to the suburbs ("white flight") is one integral contributor to the segregation of blacks in metropolitan areas. Since blacks on average have lower incomes, the out-migration of whites with higher incomes reduces the tax base and the ability for the area to provide a broad range of supportive social services to its residents.[116, 213] In a similar manner, rural areas may experience "brain-drains," the out-migration of the young and the non-poor, contributing to a declining local tax base. This type of out-migration may be particularly true for rural counties with a high proportion of blacks and Hispanic.[214, 215] The economic impacts, however, of recent in-migration of Hispanic immigrants into many rural areas may spur new tax increases.[125, 216] With a fragile tax base, coupled with a loss of federal funds, municipalities have trouble raising enough revenue to cover basic social service needs.[214, 217]

In addition to economic impacts, another explanation for a declining tax base results from various political and social processes within segregated areas. These processes are termed *disconnection*. Though isolation is generally framed as an indicator of social distance between groups, there is an inherent geographical element to the dimension of segregation

known as isolation; it literally leaves segregated areas and people detached from mainstream society. Areas that are geographically isolated may also be politically isolated.[213] Political alienation within segregated and poor neighborhoods may create feelings of abandonment by the government leading to a breakdown in local infrastructure, which may legitimize or normalize cuts in taxes and services.[116, 218] For areas in which Hispanics are segregated, experiences of disconnection may also be fueled by immigration policies.[120] Government leaders who do not encounter clear or vigorous community demands for public services may be more likely to cut spending, and with those cuts, services.[219] The focus of government leaders may lie elsewhere (e.g. in their own communities) and requests for increased spending and public services may be dismissed, further contributing and sustaining disparities in access to healthcare.

Disconnection however, also invokes a more supportive social element, corresponding to higher levels of community resiliency as a result of segregation. Creation of informal networks, ideologies, and cultural frameworks within minority communities may help to mitigate and undo the structural constraints segregated communities may face.[220] Experiences of disconnection may fuel community organizing, activism, and the election of leaders.[221] For instance at a national level, empirical research shows that political empowerment affects black health.[222] Disconnection forces minority communities to create autonomous institutions in order to lessen the effects a declining tax base, and help in facilitating access to healthcare in segregated communities.

Hypothesis 3.2: In both rural and urban areas, differences in access to healthcare will be explained by both racial/ethnic residential segregation and individual level race/ethnicity.

Blacks and Hispanics residing in highly segregated rural and urban areas are hypothesized to have poorer access than those residing in integrated areas, controlling for other county and individual characteristics. In other words, regardless of rurality or urbanicity the more segregated an area is, the greater the disparities in access to all five types of healthcare

services. This is based on evidence suggesting that racial/ethnic minorities residing in segregated urban neighborhoods are at a significant disadvantage when it comes to accessing quality resources.[15, 113, 125] These experiences may also be true for racial/ethnic minorities in rural areas based on research that indicates racial intolerance appears to be declining at a slower rate for rural residents and southerners compared to other regions.[158]

Both racial/ethnic residential segregation and experiences of interpersonal discrimination have been shown to influence health status.[96] Being a racial/ethnic minority and residing within a racially/ethnically segregated area may have a synergistic association on access to healthcare, which highlights the interrelatedness of composition and context as proposed in the study's conceptual model. Racial/ethnic minorities who reside in areas that do not offer quality resources and public services, may experience difficulties in accessing healthcare, when compared to racial/ethnic minorities who reside in more racially/ethnically integrated areas.[15] Thus this hypothesis will capture multiple levels of racism, including both interpersonal and institutional levels.

CHAPTER 4

METHODOLOGY

4.1 Introduction

This chapter is composed of six sections and presents the research methods used in this study. Section 4.2 provides an overview of the five data sources on which the individual, census tract and county level estimates were based. Next, Section 4.3, details how the non-public data file was constructed with the Agency for Healthcare Research and Quality and how the data file was accessed at UCLA. Then, Section 4.4 explains the measurement and operationalization of the constructs assessed in this study. Section 4.5 explains how missing data was handled and the analytic samples. Section 4.6 describes population weighting and design elements for this study. The chapter closes with Section 4.7, which provides an explanation of the statistical procedures used to address the study's three aims.

4.2 Data Sources

This section describes the five government-based sources that this study utilized. As a multilevel project, the five sources contained individual, census tract and county level estimates. Individual level data came from the Medical Expenditure Panel Survey (Section 4.2.1). Tract and county level data came from the American Community Survey (Section 4.2.2), the Area Health Resource File (Section 4.2.3), the United States Department of Agriculture (Section 4.2.4), and the National Center for Health Statistics (Section 4.2.5).

4.2.1 The Medical Expenditure Panel Survey. The Medical Expenditure Panel Survey (MEPS) is a nationally representative 2-year panel survey conducted by the Agency for Healthcare Research and Quality. There are three components to MEPS: a survey of individuals

and households, their medical providers (doctors, hospitals, pharmacies, etc.) and employers. The Full-Year Consolidated Household Components Files 2005 through 2010 provided the individual level data for this study. Every year, AHRQ draws the sampling frame for the Household Component File from a subsample of households that participated in the prior year's National Health Interview Survey (NHIS). Thus, a description of the NHIS sample design is first provided in order to understand the MEPS sample, followed by a description of MEPS.

The NHIS is a nationally representative sample of the U.S. civilian non-institutionalized population. The sampling frame is a multistage, area probability design that permits the representative sampling of households and non-institutional group quarters (e.g. college dormitories). The sample design consists of two stages. First, 428 Primary Sampling Units (PSUs) are drawn from approximately 1,900 geographically defined PSUs that cover the 50 States and the District of Columbia. NHIS defines a PSU as a county, a small group of contiguous counties, or a metropolitan statistical area, which are grouped into strata using social and demographic characteristics of the area. Depending on the year, NHIS samples one or more PSUs per strata, with the probability of selection for each PSU being proportional to its population size within strata. Large metropolitan areas are self-representing PSUs and are selected with certainty into the sample.

The second-stage sampling units include area segments and permit segments within a PSU. Area segments are geographically defined and contain an expected eight, twelve, or sixteen addresses. Permit segments contain an expected four addresses and cover housing units built after the 2000 Census. NHIS also oversamples blacks, Hispanics, and in 2006, Asians. Under Section 308(d) of the Public Health Service Act Survey, participation in NHIS was voluntary along with the confidentiality of responses. The annual response rate of NHIS is approximately 90% of the eligible households. Interviewers from the U.S. Census conduct the NHIS interview according to procedures specified by the National Center for Health Statistics.

The Agency for Healthcare Research and Quality (AHRQ) draws the MEPS sampling frame from a subsample of households that participated in the prior year's National Health Interview Survey (NHIS). The AHRQ selects the MEPS annual household panel sample from responding households in two of the four NHIS panels during calendar quarters 1 through 3 of the previous year. A sample representing about three-eighths of the NHIS responding households is generally made available for MEPS sampling. Additionally, based on the U.S. Department of Health and Human Services objectives alongside the MEPS budget resources, the sample size and subdomains oversampled for MEPS can vary from year to year. After selection of the NHIS households, the NHIS family units become reporting units (RUs) for MEPS. A reporting unit contains one or more family units, each with one or more individuals.

Using the NHIS sampling frame, the MEPS Household Data File is a complex national probability survey of the U.S. civilian non-institutionalized population living at any time during a calendar year within the 50 states or the District of Columbia. MEPS began in 1996 as a way for researchers and policy makers to estimate the cost and use of health care and health insurance coverage.[223] Data is collected through an overlapping panel design, by selecting a new panel of sample households each year, with data collection for each panel lasting two calendar years. AHRQ rearranges the data into yearly summary files, which provide summarized information for 1-year observation periods. Each MEPS respondent can contribute up to two person-year observations. Response rates for the Full-Year File from 2005- 2010 ranged from 56.9% to 61.3%, with an overall response rate of 57.8%. Table 4.1 provides the sampling frame and response rates for NHIS and MEPS for the 2005-2010 year period.

Under contract with AHRQ, the statistical survey organization Weststat administers MEPS in both English and Spanish. The Household Component fields questionnaires to individual household members to collect data on demographic characteristics, health conditions, health status, use of medical care services, charges and payments, access to healthcare, satisfaction with healthcare, health insurance coverage, income, and employment. A single

informant reports for each household during each interview round. This respondent is the family member most knowledgeable about health and healthcare use in the household. To accommodate the extensive array of questions covered, while minimizing the number of questions asked of each respondent; data are collected in-person using a computer-assisted personal interviewing (CAPI) on a laptop computer. Restricted, non-public MEPS data was used for this study as MEPS respondents were linked to data from the tract and county in which they resided.

4.2.2 American Community Survey. The American Community Survey (ACS) is an annual survey conducted by the United States Census Bureau to estimate common demographic and economic characteristics of the U.S. population.[224] The Census started conducting the ACS in 2005 due to declining response rates of the census long form. The ACS provides information for every state, county, city, town, place, American Indian Area, Alaska Native Area, and Hawaiian Home Land, as well as for tracts and block groups, and is publically available through the U.S. Census' Data Ferret Query System.[225] This study used the 2005-2009 ACS for county and tract level data. In addition, this study used block group level data from the ACS to calculate the isolation index, a measure of racial/ethnic residential segregation.

Each year, the ACS samples 3 million housing unit addresses, resulting in approximately 2 million final interviews of independent housing unit addresses in all 3,142 counties and county-equivalents in the United States, including the District of Columbia. The Census Bureau's Master Address File provides the sampling frame for the ACS. The Master Address File is the Census Bureau's official inventory of known living quarters and selected nonresidential units in the United States and Puerto Rico. Persons residing in-group quarters were included with persons in housing units for 2005-2009 ACS estimates. In 2009, completed ACS interviews represented 66.2% of the housing units initially selected for inclusion in the sample.

For the ACS, sampling occurs within various geographical units, primarily the county, and consists of two phases. The first-phase involves a series of processes that results in the annual ACS sample of addresses. First, the Census assigns each census block to sampling strata, the sampling rates are calculated, and then the Census selects the sample. Sampling rates are assigned independently at the block level within the following governmental units; counties, places, school districts, American Indian Areas, Minor Civil Divisions, Alaska Native Village Statistical Areas, and Hawaiian Homelands. The Census Bureau then assigns each block to the smallest measure of size from the set of all these governmental units. The Census calculates the measure of size by calculating the number of occupied housing units in an area then by multiplying the number of ACS addresses by an estimated occupancy rate at the block level and tract. Once this is completed, the Census conducts mail and telephone interviews.

During the second phase, the Census selects a sample of addresses for which neither a mail questionnaire nor a telephone interview was completed. The Census then selects these households for Computer Assisted Personal Interviewing. In total, response rates ranged from 97.3 to 98.0% over the five-year period. The collection of five year data for ACS was from January 1, 2005 to December 31, 2009 using three methods of data collection explained above: Mail out/Mail back, Computer Assisted Telephone Interview (CATI), and Computer Assisted Personal Interview (CAPI).

The ACS conducts interviews in more than 30 languages and collects data on basic demographics including race and sex, as well as social and economic indicators including income, education, veteran status, and work place. In general, ACS estimates are period estimates that describe the average characteristics of population and housing over the five years of data collection. This means there is some margin of error attached to estimates provided by the ACS.

Instead of one or three year estimates, this study used five-year estimates from the ACS (2005 – 2009). Five year estimates were necessary to capture areas in the United States

(including geographic units with populations less than 65,000), provided the largest sample size, and gave the most reliable estimates when compared to the one or three year estimates. The five-year estimates were appropriate because the study included small populations and examined sub-county units. The five-year estimates also matched closely with the years of the MEPS pooled data file for 2005-2010.

Ideally, the Census would have provided the economic and demographic information as it captures information of all United States residents and is not based on estimates derived from a sample. In order to explore this option, this study had estimates from both the 2000 and 2010 Census merged with the 2005-2010 MEPS. After the 2000 Census was matched with MEPS, 5% of the sample was unable to be matched. Through discussions with committee members the 2000 Census was deemed outdated. When the 2010 Census was matched with MEPS, 30% of the sample was unable to be matched due to changes in tract designations or other undetermined factors. Based on these considerations, the American Community Survey 2005-2009 data provided the most timely and appropriate data at the county and tract levels.

4.2.3 The Area Health Resource File. The Area Health Resource File (AHRF) is a data file created by the Health Resources and Services Administration (HRSA), and estimates the number of healthcare professionals and healthcare facilities throughout the United States since 1980.[226] The AHRF is housed under the auspices of the U.S. Department of Health and Human Services, a federal agency concerned with improving access to health care services for people who are medically vulnerable. The AHRF is a publically available dataset available at both the county and state levels. This study utilized the county-level in order to provide a more proximate estimate of an individual's availability of healthcare facilities and providers.

The AHRF, which includes indicators from numerous healthcare data resources, contains approximately 6,000 healthcare indicators from 50 sources. These indicators assess the availability of health facilities, health professions, resource scarcity, health status, economic

activity, health training programs, and socioeconomic and environmental characteristics for each county within the United States. Provided below are a description of the two data sources that this study makes use of; the American Hospital Annual Survey of Hospitals and American Medical Association Physician Master Data File.

The ratio of hospital beds, which is an indicator of healthcare facilities, came from the American Hospital Annual Survey of Hospitals for 2008 conducted by the American Hospital Association. In 2008, the American Hospital Association reported data for 6,342 U.S. hospitals and 62 hospitals in U.S. territories for a twelve-month period. Each year, the survey's overall response rate averages approximately 85%. Of hospitals failing to report data, the American Hospital Association substitutes data from previous years of the Annual Survey of Hospital. Where missing data still remains, AHA uses regression models to predict the number of hospital beds.

The proportion of primary care physicians and proportion of specialists, indicators of healthcare supply, came from the American Medical Association Physician Master Data File for 2010, conducted by the American Medical Association. The estimates reflect the twelve-month period from January 1 to December 31, 2010. The Physician Master file includes current and historical data for more than 1.4 million physicians, residents, and medical students in the United States. This figure includes approximately 411,000 graduates of foreign medical schools who reside in the United States and who have met the educational and credentialing requirements necessary for recognition. Physicians age 75 and over are excluded.

4.2.4 National Center for Health Statistics. The National Center for Health Statistics creates data measures and tools that are used to provide national and state statistical information that will guide federal actions and policies. Housed under the Centers for Disease Control and Prevention, the National Center for Health Statistics is the United States principal health statistics agency.

This study used county level measures of rural and urban from the National Center for Health Statistics, the Rural-Urban Classification Scheme. The scheme was publically available and included county Federal Information Processing Standards (FIPS) Code to match onto MEPS respondents. The NCHS researchers specifically selected the levels of this measure for studying health differences across the rural and urban areas.

4.2.5 United States Department of Agriculture: Economic Research Service. The Economic Research Service (ERS), housed under the United States Department of Agriculture, provides economic research and information to inform public and private decision making on economic and policy issues related to agriculture, food, natural resources, and rural America. The ERS produces and maintains a number of measures that are used by policymakers and researchers to identify and describe rural and urban areas. This study used several county-level measures from the Economic Research Service.

The ERS develops multi-level county classifications to measure rural and urban status in detail and to assess the economic and social diversity of the rural United States. A majority of these classification schemes use the county as the geographic unit (local designation may be county, parish, borough), largely because of the relative stability of county boundaries. Some classification schemes determine eligibility for federal programs that assist rural areas. These schemes include the Rural-Urban Continuum Codes, Urban-Influence Codes, Natural Amenities Scale, and the ERS typology codes.

For some research and program applications, counties are too large to accurately distinguish rural and urban areas. And most counties, whether rural or urban, contain a combination of rural and urban populations. As a result, the ERS developed sub-county classifications to more accurately delineate differing levels of rural and urban and to address program eligibility concerns. These classifications include the Rural-Urban Commuting Areas and the Frontier and Remote Area Codes. The ERS supplied three measures of rural and urban

areas for this study including the Rural-Urban Continuum Codes, Typology Code, and the Rural-Urban Commuting Area Codes, which were all publically available. All measures included county Federal Information Processing Standards (FIPS) Codes or tract numbers in order to match onto MEPS respondents.

4.3 Creation of Data File, Project Management, Institutional Review Board and Human Subjects Protections

As this study involves individual, tract, and county level data this section describes the process by which the five data sources were merged. First this section explains how the Agency for Healthcare Research and Quality merged publically available tract and county level data (American Community Survey, Area Resource File, National Center for Health Statistics, and Economic Research Service) with individual level data (Medical Expenditure Panel Survey). As I was not permitted to access this data file on a public computer due to geographic identifiers, the section then explains how I accessed the data file at the UCLA California Census Research Data Center (CCRDC) in order to create the analytic samples and complete the analysis for the study.

As I did not have access to the geographic identifiers of MEPS respondents, this section explains how the five data sources for this study were merged by AHRQ. AHRQ and Social and Scientific Systems, Inc., a contractor with AHRQ, constructed the data file based on the instructions I gave them. The instructions I provided specified that the AHRQ programmers include six years of the Medical Expenditure Panel Survey Household Component – Full Year Consolidated Data Files. The data files included 2005 (HC- 097), 2006 (HC- 105), 2007 (HC-113) 2008 (HC- 121), 2009 (HC- 129), 2010 (HC- 138). To ensure sample sizes were sufficiently large enough to make stable estimates for racial/ethnic minority groups in rural areas I specified to the programmers to pool these six years of data. I also selected these specific

years to better match data from the American Community Survey in which the five-year estimates were used (2005-2009).

After the Social and Scientific Systems, Inc. programmers pooled the 2005-2010 MEPS data files, each respondent's tract and county identifier was linked to data from the American Community Survey and the Area Resource File. The programmers also merged the rural-urban measures at the tract and county levels. I emailed these outside, publically available data files to the programmers. Before emailing, I downloaded the data files from online and created the variables of interest. Once the programmers received the data files with the variables of interest, the programmers merged each MEPS respondent's by their tract and county FIPS code. The programmers were unable to match 5% of the MEPS sample (n = 6,221) to the ACS data at the tract level, which may have resulting in a change in tract designations from the Census 2000 to Census 2010. Some tracts in the ACS 2005-2009 used geographic definitions and/or identifiers from the Census 2010, and thus do not match those of the Census 2000.[227]

After the programmers merged the MEPS file with the outside data files, the programmers' then merged encrypted tract and county information for each MEPS respondent. AHRQ data security procedures prohibit release of actual geographic identifiers at the county and tract level to outside researchers. Thus, I used encrypted geographic identifiers in order to conduct the multi-level analysis portion of this study.

In order to gain access to this restricted non-public MEPS data file, the AHRQ Data Center guidelines required submission of the study proposal for approval. To access the MEPS data in a secure location at UCLA, the AHRQ Data Center required approval of the proposal by the UCLA California Census Research Data Center (CCRDC). As the study linked respondents to geographic identifiers at the tract and county level, approval from these centers brought the effort into compliance with their confidentiality requirements. I worked closely with the AHRQ Data Manager in Rockville, MD and the UCLA CCRDC Data Administrator to do this. It took approximately 6 months for the approval of the proposal from both AHRQ Data Center and the

CCRDC. In order to access the data I received Special Sworn Status (SSS) from the Census Bureau. This included a background check and making a signed, sworn statement about preserving the confidentiality of the data. The AHRQ Data Center and CCRDC granted me access to work on this study as a doctoral student, in the restricted-access laboratory at UCLA from Spring 2013 until Spring 2015.

The AHRQ Data Manager placed the complete data file in my Regional Data Center network folder. This folder, located in the UCLA CCRDC, is where I accessed the data file to run the study's analysis. In no circumstances was I able to remove data or output directly from UCLA CCRDC. Instead, all data output was reviewed by the AHRQ Data Manager in Rockville, MD before delivery, via email, back to me.

The UCLA Office of Human Research Protection Program (IRB) determined that this study meets the criteria for an exemption from IRB review (IRB#13-001219).

4.4 Study Measures

This section describes the measures used to operationalize the constructs in the conceptual model (Figure 3.2). Section 4.4.1 describes the five dependent variables, each reflecting access to particular healthcare services. Section 4.4.2, describes the contextual variables which were examined at the tract and county levels. Section 4.4.3 describes the compositional variables, which were examined at the individual level. Lastly, Section 4.4.4 explains the control variables.

4.4.1 Dependent Variables

Construct: Access to Healthcare. Access to healthcare is the ability to access care and actual use of the healthcare system.[17] Access to healthcare is not just needed for addressing illness, but can also be used to detect conditions before illness becomes apparent or to prevent illness altogether. To capture a more comprehensive measure of access, this study

used five self-reported measures. Table 4.2 presents the current recommendations by the United States Preventive Task Force, Healthy People 2020, and American Cancer Society of which each of these five dependent variables was based upon. The far right column in Table 4.2 specifies how the variables were created for this study.

Dependent Variable: Usual Source of Healthcare. This dichotomous variable indicated whether or not an individual had the ability to access care in the past 12 months. A usual source of healthcare identifies a specific location to access the healthcare system when sick, in need of medical advice, and to receive necessary preventive services. Having a usual source of healthcare is an important gauge as it indicates whether an individual can obtain healthcare if some event necessitates it, serving as a standard benchmark for access to healthcare.[23, 24] The MEPS item reads: "Is there a particular doctor's office, clinic, health center, or other place that you usually go to if you are sick or need advice about your health?" Possible responses included "Yes", "No", or "More than one place". This study coded the variable as "no" (coded as 0) or "yes" (coded as 1). Those who reported "more than one place" were coded as yes (coded as 1). The MEPS variable for usual source of healthcare is HAVEUS42.

Dependent Variable: Unmet Healthcare Need. This dichotomous variable indicated whether or not an individual had any perceived barriers that prevented them from seeking or delaying medical care, dental care, or prescription medication needs in the past 12 months. Unmet healthcare need provides one proxy for assessing the ability or capacity to access healthcare. When people delay or fail to receive healthcare, populations may become sicker and many suffer preventable deaths. Measures of access similar to this have been used widely in previous research.[49, 228] Unmet need was constructed using six related variables from MEPS which the study combined into a single variable reflecting a positive response to any of the six items. Only those who "needed" healthcare services in the past 12 months were administered the questions. The constructed variable categorized respondents as having unmet (or delayed) need if respondents affirmatively responded to one or more of the following six items: "In the last

12 months, was anyone in the family unable to obtain medical care, test, or treatments they or a doctor believed necessary?" And/or an affirmative response to "In the last 12 months, was anyone in the family delayed in getting medical care, tests or treatments they or a doctor believed necessary?" Dental and prescription medication unmet and delayed needs were asked in the same manner as the healthcare question. In MEPS, an affirmative response to any of the six variables categorized the respondent as having unmet or delayed need (MDDLAY42 = 1 or MDUNAB42 = 1 or DNUNAB42 = 1 or DNDLAY42 = 1 or PMUNAB42 = 1 or PMDLAY42 = 1). This study coded the variable as "no unmet need" (coded as 0) and "yes unmet need" (coded as 1).

Dependent Variable: Cholesterol Screening. This dichotomous variable captured utilization of healthcare services with timely preventive screenings. Cholesterol screenings are a critical prerequisite in the primary prevention of cardiovascular disease. As cardiovascular disease is largely preventable, screenings can determine whether a person should receive pharmacological treatment, or needs to eliminate tobacco, limit salt intake, increase physical exercise, and improve their diet.[229] The MEPS item reads: "About how long has it been since (PERSON) had (PERSON)'s blood cholesterol checked by a doctor or other health professional?" There was help available for respondents who needed a definition of blood cholesterol check. For those who responded with "within the past 5 years" or less was coded as "yes" (coded as 1). For those responding "never" or "more than 5 years", the study coded these respondents as "no" (coded as 0). The outcome was restricted to adults age 35-64, based on the recommendation made by U.S. Preventive Task Force.[230] The MEPS variable for cholesterol screening is CHOLCK53.

Dependent Variable: Dental Visit. This dichotomous variable captured utilization of healthcare services through timely access into the oral healthcare system. Access to dental services offers a more specialized dimension of access to healthcare when compared to preventive services offered in primary care. Although use of dental services is often

underestimated and believed to be less life-threatening than other healthcare services, access to preventive dental services improves overall health status and quality of life.[57] The MEPS item reads: “On average, how often (do/does) (PERSON) receive a dental check-up?” This study coded the variable as “twice a year or more” or “once a year” into “yes” (coded as 1), and those who responded with “less than once a year”, and “never go to the dentist” into “no” (coded as 0). This coding was based on oral health goals outlined in Healthy People 2020.[20] The MEPS variable for dental visit is DENTK53.

Dependent Variable: Cervical Screening. This dichotomous variable captured utilization of reproductive healthcare services with timely preventive cancer screenings for females**.** Cervical cancer screenings (Papanicolaou or Pap) are one of the most reliable and effective cancer screening tests available. By identifying cancer at an early stage, cervical screenings greatly increase the chances for successful treatment, and can reduce the risk of premature death.[231] The MEPS item reads: “When did (PERSON) have (PERSON)’s most recent Pap test? If necessary, say: A Pap smear or Pap test is a routine test for women in which the doctor examines the cervix, takes a cell sample from the cervix with a small stick or brush, and sends it to the lab.” Respondents answering “within the past 3 years” or “less than three years” were coded as “yes” (coded as 1), and respondents who answered “Within the past 5 years” or “never” as “no” (coded as 0). This study excluded respondents who reported having a hysterectomy. This coding was based on recommendations by the United States Preventive Task Force,[32] Healthy People 2020 goals,[20] and the American Cancer Society guidelines.[232] The MEPS variable for cervical cancer screening is PAPCHK53.

4.4.2 Contextual Level Variables

Construct: Rural and urban areas. Rural and urban areas were defined as a person’s immediate residential environment and were classified as either rural or urban, or somewhere in between (semi-urban). Rural and urban areas represent a continuum reflecting differences in

area level characteristics including the local economy, infrastructure, and social context. The measures used to capture rural and urban areas vary by aim. For aim 1, all five measures were used to classify counties and tracts. These five rural-urban measures were selected as they are utilized most often in public health and health services research,[74, 89] were publically available, and could be merged at the county and tract level for each MEPS respondent. The analyses for aim 2 were based on one of these five codes, the Rural Urban Commuting Area Code, which was selected since it captured a more proximal estimate of a rural area at the tract level. The analyses for aim 3 used the Metropolitan Statistical Area, which was selected to correspond to the measure of racial/ethnic residential segregation, which was at the county level. In summary, the five measures used to capture rural and urban areas included the Metropolitan Statistical Area, the Urban to Rural Classification Scheme, Rural-Urban Continuum Code, County Typology Code, and the Rural-Urban Commuting Area Code as described below and in Table 4.3.

Independent Variable: The Metropolitan Statistical Area (MSA).[233] A Metropolitan Statistical Area captured a geographic entity designated by the Office of Management and Budget (OMB). According to the 2000 OMB standards, a Metropolitan Statistical Area was an area that contained a large population nucleus and adjacent communities that had a high degree of economic and social integration with that core. An MSA must have been an urbanized area (as defined by the Bureau of the Census) with a population of at least 50,000 and a total MSA population of at least 100,000 (75,000 in New England). Each MSA must have included the county in which the central city is located and may have included additional contiguous counties (fringe counties). The OMB considered any county not included in an MSA as non-metropolitan, including Micropolitan counties.

The OMB treated Alaska, Hawaii, and six New England states slightly different.[234] Alaska was classified into boroughs, which was considered county-equivalents, and one county (Anchorage). Except for Anchorage all of Alaska were considered non-metropolitan. In Hawaii,

the major islands were county equivalents. In the New England states', metropolitan areas were defined in terms of cities and towns but in general, these followed county boundaries. The OMB was explicit about delineating MSA's for statistical purposes only. The MSA measure was previously included in all MEPS data files. The MSA coding is as follows:

1 = Metropolitan: 50,000 population with high degree of social and economic integration with urban core
2 = Non-Metropolitan: Micropolitan (Population 10,000 – 49,999) & Non-Metropolitan (Population < 10,000)

Independent Variable: Rural-Urban Classification Scheme.[84] This ordinal measure classified all U.S. counties and county-equivalents into six levels, with four categories for metropolitan counties and two categories for nonmetropolitan counties. This study used the 2006 version of the measure. The foundation of the measure used the OMB's delineation of metropolitan and nonmetropolitan counties. The measure also used the cut points of the Rural Urban Continuum Codes to subdivide the metropolitan counties based on the population of their metropolitan statistical area. The largest metropolitan areas (1 million or more population) was subdivided into two subcategories, in order to capture "semi-urban" areas. The rural-urban Classification Scheme is as follows:

1 = Large central metro (MSA of 1 million or more population that: 1) contain the entire population of the largest principal city of the MSA, or 2) are completely contained within the largest principal city of the MSA, or 3) contain at least 250,000 residents of any principal city in the MSA
2 = Large fringe metro (MSA of 1 million or more population that do not qualify as large central)
3 = Medium Metro (MSA of 250,000-999,999)
4 = Small Metro (MSA of 50,000- 249,999)
5 = Micropolitan (Micropolitan statistical area)
6 = Noncore (Not in Micropolitan Statistical Area)

Independent Variable: Rural- Urban Continuum Code (RUCC).[85] This ordinal measure subdivided all counties into one of nine codes. Originally developed in 1974, the Economic Research Services updates the Rural-Urban Continuum Code every ten years. The study used the 2003 version. The codes are widely available and in use by the Bureau of Health

Care Professions and the Department of Agriculture. In the RUCC classification system, urbanized counties fall into three groups based on size of the county's population. Nonmetropolitan defined counties fall into six groups based on total population of the county, degree of urbanization, and whether it is adjacent or nonadjacent to a metropolitan county. The Rural-Urban Continuum Code is as follows:

1 = MSA > 1 million
2 = MSA of 250,000 – 1million
3 = MSA of 50,000-250,000
4 = Urban population of > 20,000, adjacent to MSA
5 = Urban population of > 20,000, not adjacent to MSA
6 = Urban population of 2,500-19,000, adjacent to MSA
7 = Urban population of 2,500-19,000, not adjacent to MSA
8 = <2,500 Urban population, adjacent to MSA
9 = <2,500 Urban population, not adjacent to MSA

Independent Variable: County Typology Code.[235] This categorical variable was originally developed in 1979 by the Economic Research Service, and differentiates counties based on economic characteristics. The 2004 version was used for this study. The code helps distinguish the economic dependency among rural counties, with urban counties also coded to facilitate comparisons. The typology classifies counties according to six non-overlapping categories of economic dependence, including farming-dependent, mining-dependent, manufacturing-dependent, federal/state government dependent, services-dependent, and non-specialized dependent counties. The code does not capture "rural" and "urban" per se, but economic factors that may help explain economic differences across areas. The County Typology Code is as follows:

1 = Farming Dependent: Either 15% or more of average annual labor and proprietors' earnings derived from farming during 1998-2000 or 15% or more of employed residents worked in farm occupations in 2000.
2 = Mining-Dependent: 15% or more of average annual labor and proprietors' earnings derived from mining during 1998-2000.
3 = Manufacturing-dependent: 25% or more of average annual labor and proprietors' earnings derived from manufacturing during 1998-2000.
4 = Federal/State Government-dependent: 15% or more of average annual labor and proprietors' earnings derived from Federal and State government during 1998-2000.

5 = Services-dependent: 45% or more of average annual labor and proprietors' earnings derived from services (SIC categories of retail trade; finance, insurance and real estate; and, services) during 1998-2000.
6 = Nonspecialized-dependent: County did not meet the dependence threshold for any one of the above industries.

Independent Variable: The Rural-Urban Commuting Area Code.[236] This ordinal variable was originally developed in 1990, to differentiate rural and urban areas based on tracts. The 2000 version was used for this study. The creation of these codes was a collaborative project between the Department of Agriculture, HRSA's Office of Rural Health Policy, and the WWAMI.[237] WWAMI is a partnership between the University of Washington - School of Medicine and the states of Wyoming, Alaska, Montana, and Idaho. The RUCA has the same theoretical concepts used by the Office of Management and Budget (OMB) to define MSA's, but provided a tract based classification scheme that utilizes the Census Bureau definitions in combination with work commuting information to characterize all of the tracts regarding their rural and urban status and their relationships. The measure splits rural and urban in approximately the same way as the OMB Metro definition but at the sub county-level. The classification contains 10 primary codes, and 30 secondary codes. Whole numbers of the code delineated metropolitan, micropolitan, small town, and rural commuting areas based on the size and direction of the primary (largest) commuting flows with the codes further subdivided to provide flexibility in combining levels to meet varying definitional needs and preferences. The Rural-Urban Commuting Area is as follows:

1 Metropolitan area core: primary flow within an Urbanized Area (UA)
1.0 No additional code
1.1 Secondary flow 30% through 49% to a larger UA

2 Metropolitan area high commuting: primary flow 30% or more to a UA
2.0 No additional code
2.1 Secondary flow 30% through 49% to a larger UA

3 Metropolitan area low commuting: primary flow 10% to 30% to a UA
3.0 No additional code

4 Micropolitan area core: primary flow within an Urban Cluster (UC) of 10,000 through 49,999 (large UC)
4.0 No additional code
4.1 Secondary flow 30% through 49% to a UA
4.2 Secondary flow 10% through 29% to a UA

5 Micropolitan high commuting: primary flow 30% or more to a large UC
5.0 No additional code
5.1 Secondary flow 30% through 49% to a UA
5.2 Secondary flow 10% through 29% to a UA

6 Micropolitan* low commuting: primary flow 10% to 30% to a large UC
6.0 No additional code
6.1 Secondary flow 10% through 29% to a UA

7 Small town core: primary flow within an Urban Cluster of 2,500 through 9,999 (small UC)
7.0 No additional code
7.1 Secondary flow 30% through 49% to a UA
7.2 Secondary flow 30% through 49% to a large UC
7.3 Secondary flow 10% through 29% to a UA
7.4 Secondary flow 10% through 29% to a large UC

8 Small town high commuting: primary flow 30% or more to a small UC
8.0 No additional code
8.1 Secondary flow 30% through 49% to a UA
8.2 Secondary flow 30% through 49% to a large UC
8.3 Secondary flow 10% through 29% to a UA
8.4 Secondary flow 10% through 29% to a large UC

9 Small town low commuting: primary flow 10% through 29% to a small UC
9.0 No additional code
9.1 Secondary flow 10% through 29% to a UA
9.2 Secondary flow 10% through 29% to a large UC

10 Rural areas: primary flow to a tract outside a UA or UC (including self)
10.0 No additional code
10.1 Secondary flow 30% through 49% to a UA
10.2 Secondary flow 30% through 49% to a large UC
10.3 Secondary flow 30% through 49% to a small UC
10.4 Secondary flow 10% through 29% to a UA
10.5 Secondary flow 10% through 29% to a large UC
10.6 Secondary flow 10% through 29% to a small UC

As an ordinal variable, the designers of the RUCA code specified that that code should not be analyzed continuously, so this study used the Washington States Department of Health categorization,[238] with the coding scheme provided below. While there are a number of ways to collapse the categories,[7, 239, 240] this scheme provided the most fitting categorization to capture

the most isolated rural populations. A sensitivity analysis was conducted to explore other ways to categorize the RUCA code, revealing small differences across the dependent variable.

1 = Urban (Populations of 50,000 persons+, Urbanized Areas by U.S. Census Bureau) (codes 1.0, 1.1)
2 = Semi-Urban (Populations living in small cities/large towns, populations between 10,000 and 49,999 with high commuting levels) (codes 2.0, 2.1, 3.0, 4.0, 4.1, 4.2, 5.0, 5.1, 5.2, 6.0, 6.1, 7.1, 8.1, and 10.1)
3 = Rural (Small Towns with populations below 10,000, lower commuting levels, or in isolated rural areas, more than an hour drive to the nearest city) (codes 7.0, 7.2, 7.3, 7.4, 8.0, 8.2, 8.3, 8.4, 9.0, 9.1, 9.2, 10.0, 10.2, 10.3, 10.4, 10.5, 10.6)

Construct: Racial/Ethnic Residential Segregation. Segregation is an institutional mechanism of racism that isolates racial and ethnic groups in both rural and urban counties. For this study residential segregation captured past and current patterns of racial prejudice and discrimination, across housing and labor markets and residential preferences.[112, 149] There are at least five hypothesized dimensions of segregation; evenness, exposure, concentration, centralization, and clustering.[115] This study focused on one dimension, exposure.

Independent Variable: Isolation Index. This continuous measure captured the exposure dimension of residential segregation and estimated the extent to which blacks or Hispanics live in areas where they are exposed only to other people of their own race/ethnicity.[241] The calculation of the isolation index entails describing the distribution of individuals across micro-units (e.g., block group) within larger macro-areas (e.g., county). Counties were selected as the macro-unit as they are the primary political unit of local government and demonstrate programmatic importance at the federal and state levels.[242] To better reflect the ways in which segregation operates in smaller geographies of both rural and urban areas, the micro-unit of analysis for segregation was the census block group. The block group may serve as a better, more proximal indicator of one's immediate neighborhood.[149] In comparison to tracts which recently have come under scrutiny as proxies for neighborhoods,[135] block groups typically consist of between 600 to 3,000 people, with an average size of 1,500 people.

The isolation index ranges from 0 to 100, with a score near zero indicating that blacks were completely integrated, and a score of 100 meaning that blacks were completely isolated. The isolation index captured the segregation of one racial group at a time and accounted for the relative size of the group. In order to reduce multicollinearity and improve interpretability, residential segregation was standardized for aim 3. The isolation index was calculated separately for Non-Hispanic blacks and Hispanics.

Black Segregation: To calculate the index for Non-Hispanic blacks, the equation is: SUM $(b_i / B_i) \times (b_i / t_i)$, where b_i = the black population of the block group, within the county, B_i = the total black population of the county, and t_i = the total population of the county. This variable was constructed using variables B03002_003E and B03002_001E in the American Community Survey.

Hispanic Segregation: To calculate the index for Hispanics, the equation is: SUM $(h_i / H_i) \times (h_i / t_i)$, where h_i = the Hispanic population of the block group, within the county, H_i = the total Hispanic population of the county, and t_i = the total population of the county. This variable was constructed using variables B03002_012E and B03002_001E in the American Community Survey.

Control Variable: Racial/Ethnic Composition. This continuous measure captured the proportion of racial/ethnic minority residents at the county and tract level. This measure was only used for aim 1 as a descriptive variable.

Percent Non-Hispanic Black. This continuous measure captures the percentage of Non-Hispanic blacks in a county or tract. This variable was constructed using variables B03002_003E and B03002_001E in the American Community Survey.

Percent Hispanic. This continuous measure captures the percentage of Hispanics in a county or tract. This variable was constructed using variables B03002_012E and B03002_001E in the American Community Survey.

Construct: Poverty. Poverty refers to the geographic concentration of low-income households and associated social and structural conditions that may influence health and healthcare within each area.[28, 49] Poverty serves as a control in this study, helping to rule out alternative explanations that are associated other key independent variables in this study including segregation.[16, 28, 49, 243]

Control Variable: Proportion Poor. This continuous measure captured households who are unable to meet basic living standards according to federal guidelines as the proportion of household below the 125% Federal Poverty Level. This variable was included in all aims of this study. For aim 1, poverty is included both at the tract and county level, depending on the geographic level of the rural-urban measure being tested. For aim 2, poverty is at the tract level. For aim 3, poverty is at the county level. In order to reduce multicollinearity and improve interpretability in aim 2 and aim 3, proportion poor was standardized. This study constructed this variable using variables C17002_002E through C17002_008E in the American Community Survey.

Construct: Healthcare System. The healthcare system refers to the proportion of physicians and the availability of healthcare system infrastructure for residents in a county. Healthcare resource distribution remains a determinant of access to healthcare.[244] Estimates of health service providers and facilities are at the county-level, since health systems generally serve geographic areas that are generally larger than a tract. This study used three measures of healthcare supply. Aim 1 included all three measures of healthcare supply, while aim 2 and aim

3 excluded the proportion of specialists due to its high correlation with the proportion of primary care physicians.

Control Variable: Primary Care Physicians per 10,000 residents. This continuous variable provided an assessment of healthcare provider availability in 2010. Primary care physicians included those in General Family Medicine, General Practice, General Internal Medicine and General Pediatrics. Subspecialties within these specialties were excluded for this variable. In the Area Health Resource File this is variable F14676-10.

Control Variable: Specialists per 10,000 residents. This continuous variable provided an assessment of specialty healthcare providers in 2010. Specialists included those in Allergy and Immunology, Cardiovascular Disease, Dermatology, Epidemiology, Gastroenterology, Internal Medicine, General Internal Medicine Subspecialties Pediatrics, General Pediatric Subspecialties, Pediatric Allergy, Pediatric Cardiology, and Pulmonary Disease. In the Area Health Resource File this is variable F04618-10.

Control Variable: Hospital Beds per 10,000 residents. This continuous variable provided a general assessment of healthcare facilities and the availability of inpatient medical care. The measure captured hospital bed availability for a one-year period (2008). In the Area Resource File this variable is F08921-08.

4.4.3 Compositional Level Variables

Predisposing Variable: Race/ethnicity. This categorical variable captured self-reported “race” and “ethnicity” as specified by the Office of Management and Budget. In MEPS, the primary household respondent reported the race/ethnicity for themselves and every other household member. If the interviewer did not obtain race/ethnicity in Round 1, the interviewer asked the respondent in subsequent rounds. MEPS asked two questions of the respondent. The first question, “(Do/Does) (PERSON) consider (yourself/himself/herself) Hispanic or Latino?” “yes” or “no”. Respondents were then asked if each person's main national origin or ancestry

was Puerto Rican, Cuban, Mexican, Mexicano, Mexican American, or Chicano; other Latin American; or other Spanish. Persons claiming a main national origin or ancestry in one of these Hispanic groups, regardless of racial background were classified as Hispanic. Second, the respondent were asked to describe each person's race by specifying any combination of races that applied (i.e., multiracial) and were asked, “Please look at this card and tell me which race or races best describes (PERSON).” Answer categories for race included: (1) white, (2) black/African American, (3) American Indian or Alaska Native, (4) Asian, (5) Native Hawaiian or other Pacific Islander, and/or (6) Other: Specify. Prior to releasing data files, AHRQ edited and imputed both the race and ethnicity variables. For values where race and/or ethnicity were not collected in MEPS, responses were substituted from the National Health Interview Survey by AHRQ. If the respondents race was still not ascertained, the race, and/or ethnicity were assigned based on the relationship to other members in the household using a priority ordering that gave precedence to blood relatives in the immediate family. For this study, race/ethnicity was constructed using the variables RACEX and HISPANX and coded into four categories. The variable was coded: 1 = Non-Hispanic black, 2 = Hispanic, any race, and 3 = Non-Hispanic Other/Multiple Race, and 0 = Non-Hispanic white (reference category).

***Predisposing Variable: Educational Attainment*.** This categorical variable captured one key dimension of socio-economic status, which is correlated with potential job opportunities and resources. In MEPS, respondents provided their highest educational degree when they first entered the sample. MEPS collected educational attainment in three ways: highest grade completed (RE103), high school diploma (RE104), and highest degree (RE105). For this study educational attainment was constructed using the variable HIDEG. The MEPS item reads: “What is the highest grade or year of regular school (PERSON) ever completed?” If highest grade completed was "Refused" or "Don’t Know" for those with a "No Degree" response for the highest degree question, the variable HIDEG was coded as 1 "No Degree". For this study,

educational attainment was coded as: 1 = Less than high school, 2 = High School or GED, 3 = Highest Degree Inapplicable/under 25, and 0 = Bachelor's Degree or more (reference category).

Predisposing Variable: Poverty Status. This categorical variable captured households who are unable to meet basic living standards according to federal guidelines for the year in which the survey was administered (2005-2010). In MEPS poverty status is a household-level variable. Possible sources of income included annual earnings from wages, salaries, bonuses, tips, and commissions; business and farm gains and losses; unemployment and Worker's Compensation; interest and dividends; alimony, child support, and other private cash transfers; private pensions, individual retirement account (IRA) withdrawals, Social Security, and Department of Veterans Affairs payments; Supplemental Security Income and cash welfare payments from public assistance, Aid to Families with Dependent Children and Aid to Dependent Children; gains or losses from estates, trusts, partnerships, S corporations, rent, and royalties; and a small amount of "other" income. The MEPS calculated a total income value by summing all sources of income across all earners in the household according to the total yearly income. Within a household, all individuals related by blood, marriage, or adoptions are family. The total income value was divided by the appropriate poverty line income value adjusted for family size and composition and is based on poverty statistics developed by the Current Population Survey. The definitions of income, family, and poverty categories used to construct the poverty indicator correspond to the year that the respondent participated in MEPS. For this study, the variable POVCAT coded into four categories. The variables was coded: 1 = < 125% FPL, 2 = 125% – 200% FPL, 3 = 200% - 400% FPL, and 0 = >400% FPL (reference category).

Predisposing Variable: Employment Status. This categorical variable indicated whether the respondent worked full or part time or was unemployed at the time of the interview. The MEPS item reads: "(Do/Does)/As of MM/DD/(YEAR), did) (PERSON) (currently) have a job for pay or own a business? PROBE: Do not count work around the house. Include work in a family farm or business, even if unpaid". The MEPS variable that corresponds to this question

was EMPST42. This study used responses from round 4 and 2 that had an affirmative response to being employed at round 4/2 interview date, had a job to return to at round 4/2 interview date, or had a job in past reference period. Missing values were imputed for this study using previous panel rounds of the same variables, including EMPST31 and EMPST53. For this study, employment status was coded: 1 = unemployed and 0 = employed (reference category).

Predisposing Variable: Family Size. This continuous variable indicated the number of persons in a household and may serve as another indicator of household socioeconomic status. For this study, family size was the MEPS reporting unit, which was a person or a group of persons in the sampled dwelling unit. A reporting unit included those related by blood, marriage, adoption, foster care, or other family association. Unmarried college students (less than 24 years of age) who usually live in the sampled household but were living away from home and going to schools were treated as reporting units separate from that of their parents. This variable provided a broader estimate of household size. The MEPS variable is RUSIZE.

Enabling Variable: Health Insurance. This categorical variable captured an important enabling factor of access to healthcare, according to the Andersen Model. Underinsurance and insurance type have been associated with reduced access to quality healthcare.[36, 245, 246] The MEPS variables INSCOV and EVRUNIS were used for this study. The variable was coded: 1 = Public Only (covered by Medicaid, State and local medical assistance programs, and TRICARE for the entire year), 2 = Uninsured (anytime in past 12 months did not have insurance), and 0 = Private (insurance all year that provided coverage for hospital and physician care from a nonpublic source, provided by a private single-service plan as private health insurance) (reference category).

Enabling Variable: Limited English Proficiency. This categorical variable assessed perceived competence with which an individual can communicate in English and possible linguistic barriers respondents may face in healthcare settings. A previous study constructed English proficiency in this manner.[247] The MEPS variables INTVLANG, ENGPSK42, and

LANGHM42 were used to construct this variable. This study coded the variable as: 1 = English Proficient (took the MEPS interview in English, but spoke a language other than English at home), 2 = Limited English Proficient (took the MEPS interview in Spanish or another language and were not comfortable speaking English), and 0 = (took the MEPS interview in English) (reference category).

Enabling Variable: Out-of-Pocket Medical Expense. This binary variable determined total past year payments made by the respondent for services. Having health insurance does not necessarily prevent people from having high health care spending, particularly those who are financially constrained.[248] In MEPS, out-of-pocket expenses included the portion of payments by individuals and families for services received during a complete year. This included the direct payment for medical services, but excluded payments for health insurance premiums or contributions made to group health plans. The MEPS variable that corresponds to total out-of-pocket medical expenses is TOTSLFX. This study coded the variable as: 1 = had any out of pocket medical expenses and 0 = no out of pocket expenses (reference category).

Need Variable: Self-rated health. The categorical variable captured a subjective measure of overall health that may differ from objective measures given by physicians. This variable came from the MEPS adult self-administered questionnaire. The MEPS item reads: “In general, would you say your health is: Excellent, Very good, Good, Fair, Poor?” The MEPS variable is RTHLTH42. For this study, missing values were imputed using previous panel rounds, including RTHLTH31 and RTHLTH53. The variable was coded as: 1 = good, 2 = fair/poor, and 0 = excellent/very good (reference category).

Need Variable: Chronic Conditions. This categorical variable captured the number of self-reported serious chronic conditions based on the MEPS priority conditions. Access to healthcare may differ for respondents with chronic conditions, as those respondents are likely to maintain close contact with the healthcare systems out of necessity. While MEPS asks about many conditions, for this study chronic conditions included angina, asthma, coronary heart

disease, diabetes, emphysema, hypertension, heart attack, and stroke. The MEPS item reads: "(Have/Has) (PERSON) ever been told by a doctor or other health professional that (PERSON) had coronary heart disease?" The MEPS variables that captured chronic conditions are DIABDX, ASTHDC, CHDDX, EMPHDX, HIBPDX, MIDX, ANGIDX, and STRKDX. This study coded the variable as: 1 = one condition, 2 = two or more conditions, and 0 = no chronic conditions (reference category).

4.4.4 Other Control Variables

Control Variable: Age. This continuous variable indicated the age of the respondent in years at the time of the interview. The MEPS item reads: "What is (READ NAME)'s date of birth? (Entered as MM/DD/YYYY). The respondent's age was based on the date of the survey, with interviewers verifying the current age when administering the survey. If the interviewer entered an age that contradicted the date of birth, the CAPI still calculated the age based on date of birth when the interviewer left the screen. The MEPS variable is AGEX. Age was rescaled to correspond to a 10-year change.

Control Variable: Gender. This dichotomous variable provided the gender of the respondent. As an in person interview, gender is only asked to MEPS respondents if not obvious, "Is (READ NAME) male or female?" This study coded gender as 0 = Males and 1= Females (reference category). Gender was carried over originally came from the National Health Interview Survey, but during each MEPS interview, gender is verified by the interviewer, and if necessary was corrected. AHRQ assigned gender in a number of ways when the gender of a reporting unit (RU) member was not available from the NHIS interviews and was not ascertained during one of the subsequent MEPS interviews. First, the person's first name assigned gender if obvious (0 cases). Second, if the person's first name provided no indication of gender, then AHRQ reviewed the relationships of family members (1 case in 2009, 1 case in 2008). If neither of these approaches made it possible to determine the individual's gender,

MEPS randomly assigned gender (1 case in 2009, 3 cases in 2008 1 case in 2006). The MEPS variable name is SEX.

Control Variable: Marital Status. As a categorical variable, MEPS asked respondents two questions about their marital status. First, "My records show that (as of December 31, (YEAR) (PERSON) (have/has/had) never been married. Is that correct?" "yes" or "no". If respondent states no, they are asked "(Are/Is)/On December 31, (YEAR), (were/was)(PERSON) (now) married, widowed, divorced, or separated?" The MEPS variable is MARRYX. For this study marital status was coded as: 1 = Divorced/Widowed, 2 = Never Married/Single, and 0 = Married (reference category).

Control Variable: Survey Year. As a continuous variable, survey year ranged from 2005-2010 and captured the administration year of MEPS. Survey year helped control for any differences across the six-year period. Table 4.4 shows each of the five dependent variables over the years from 2005-2010. The MEPS variable name is YEAR.

Control Variable: U.S. Region. This categorical variable provided information about U.S. regional variation, and corresponding social and political conditions that may influence access to healthcare.[12] Census region was included the MEPS file and corresponded to the respondents' state of residence at the time of the interview. The variable classified respondents as belonging to one of four categories: 1 = Midwest, 2 = South, 3 = West, and 0 = Northeast (reference category). Respondents were categorized based on four regions:

0 = Northeast: Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, and Pennsylvania
1 = Midwest: Ohio, Indiana, Illinois, Michigan, Wisconsin, Minnesota, Iowa, Missouri, North Dakota, South Dakota, Nebraska, and Kansas
2 = South: Delaware, Maryland, District of Columbia, Virginia, West Virginia, North Carolina, South Carolina, Georgia, Florida, Kentucky, Tennessee, Alabama, Mississippi, Arkansas, Louisiana, Oklahoma, and Texas
3 = West: Montana, Idaho, Wyoming, Colorado, New Mexico, Arizona, Utah, Nevada, Washington, Oregon, California, Alaska, and Hawaii

4.5 Analytic Samples

4.5.1 Missing Data

The pooled 2005-2010 MEPS sample for adults age 18-64 was 113,814 respondents. As MEPS used the sample from the NHIS, Figure 4.1 outlines how MEPS was derived from NHIS. For this study, respondents must have linked to tract and county level data from the other four sources (American Community Survey, Area Health Resource File, National Center for Health Statistics, and U.S. Department of Agriculture). This section describes how I created a total of five samples for each aim (total of fifteen samples), based on age restrictions, missing data for independent and dependent variables, and recommendations put forth by the U.S. Preventive Task Force, American Cancer Society, and Healthy People 2020.

As explained in the description of compositional variables (Section 4.4.3), I imputed missing values for MEPS variables using substitution. Beyond substitution, I did not conduct multiple imputation. The rationale for complete-case analysis was based on three reasons. First, a significant portion of the missing data, particularly for aims 1 and aims 2 resulted from the inability to match MEPS respondents to valid data about the tracts in which the respondents reside. After merging MEPS with area-level data, information on 107,593 individuals was available (94.5% of the sample). Due to the restricted nature of the data, there was no way to impute and re-assign tract and county information appropriately. The second reason was that it is computationally intensive for Stata to impute missing values. Some statisticians recommend 50 (or more) imputations when using complex survey data.[249] Lastly, imputation of MEPS variables would only increase the sample size by approximately 1% and model building to appropriately perform imputation could take a significant amount of time. Item-missing rates of 5 to 10% are not likely to produce major biases for survey estimates based on only the complete cases.[250] A similar study of access to healthcare of the 2000 MEPS was unable to match 9% of respondents to U.S. Census information at the block group level. In that study, imputation of the

missing block groups revealed that substantive findings did not change when cases were removed.[49] While loss of precision and the potential for bias are obvious threats to any analysis of survey data, complete case analysis was deemed appropriate. To inform these decisions about imputation, the next sections provide a description of the sensitivity analyses preformed and the deprivation of the samples.

4.5.2 Aim 1 Analytic Samples

Figure 4.2 shows how this study arrived at the five analytic samples for aim 1. Only 31 respondents were missing information on the type of area they lived in. From this, 107,562 of MEPS respondents age 18-64 had complete tract and county level data. Respondents were excluded if they were missing on the dependent variable or were ineligible based on the federal recommendations as outlined in Table 4.2. By dependent variable, 2,100 respondents were excluded from the usual source of health, 951 respondents for unmet need, 44,324 for cholesterol screening, 2,178 for dental screening, and 57,468 for cervical screening.

Excluded respondents were compared to the analytic sample, using a bivariate design-based Wald test (Table 4.5). Respondents were excluded if they were missing data on independent and dependent variables. This analysis was weighted to account for the complex study design using the survey estimation commands available in Stata. There were five analytic (one per dependent variable), each sample of a differing size. The table presents the sensitivity analysis for the largest analytic sample, used to examine unmet need, and the most restricted sample, used to examine cervical cancer screening. Overall, those excluded from these two analytic samples did not differ by age; however, those excluded were significantly more likely than sample members to reside in urban areas. The final five samples by each dependent variable were: usual source of healthcare (n = 105,462), unmet need (n = 106,611), cholesterol screening (n = 63,256), cervical screening (n = 50,122), and dental visit (n = 105,384). A full description of the aim 1 samples is provided in Chapter 5.

4.5.3 Aim 2 Analytic Samples

Figure 4.3 shows how the study arrived at the five analytic samples for aim 2. Compared to aim 1, aim 2 incorporated more individual level variables from MEPS, which had more missing values. As MEPS is a panel survey, the study was careful to substitute missing values using previous panel rounds of the same variable whenever possible. The study intended to include citizenship status and home ownership as variables in this study, both variables fielded by the National Health Interview Survey. Too many missing values in the MEPS sampling frame prohibited these variables from being included in this study.

Among respondents matched with county and tract level data, five were missing values on marital status, 642 on educational attainment, 91 on employment status, 606 on family size, 80 on self-reported health, 811 on chronic conditions, and 31 on area of residence (urban, semi-urban, or rural). In total 1,799 unique respondents were missing on one of more the independent variables and were excluded from this study. Respondents who were missing on the dependent variables or were ineligible based on the federal recommendations as outlined in Table 4.2 were also excluded. By dependent variables, 1,460 respondents were excluded from the usual source of health, 488 respondents for unmet need, 43,051 for cholesterol screening, 1,266 for dental screening, and 55,955 for cervical screening.

For aim 2, excluded respondents were compared to the analytic sample, using a bivariate design-based, Wald test (Table 4.6). Respondents were excluded if they were missing data on independent and dependent variables. This analysis was weighted to account for the complex study design using the survey estimation commands available in Stata. There were five analytic samples (one per dependent variable), each sample of a differing size. The table presents the sensitivity analysis for largest analytic sample size in which unmet need was examined, and the most restricted sample size, cervical cancer screening were examined.

Differences emerged between the analytic and excluded samples. For those in the largest sample, a larger proportion of excluded respondents were male, non-white, and reported

limited English proficiency. For the smallest sample, those excluded were more likely to be non-white, single, and to be uninsured in the last year. The final sample sizes for aim 2 by dependent variables were: usual source of healthcare (n = 104,334), unmet need (n = 105,306), cholesterol screening (n = 62,743), cervical screening (n = 49,839), and dental visit (n = 104,528). A full description of the aim 2 samples is provided in Chapter 6.

4.5.4 Aim 3 Analytic Samples

Figure 4.4 shows how this study arrived at the five analytic samples for aim 3. Aim 3 samples are larger than the corresponding aim 2 samples, because the aim 3 analysis did not incorporate tract-level characteristics, in which more MEPS respondents were missing information. Aim 3 samples are also larger due to the exclusion of five individual level variables (employment status, family size, out of pocket medical expenses, chronic conditions, and limited English proficiency), since these variables substantially delayed the analysis by increasing the computational time. For aim 3, 27 respondents were missing on the segregation measure, 688 respondents were missing on educational attainment, and 81 on self-reported health. In total 789 unique respondents had missing data on one of more the independent variables and were excluded from this study. Respondents who were missing on the dependent variables or were ineligible based on the federal recommendations as outlined in Table 4.2. By dependent variables, 2,029 respondents were excluded from the usual source of health, 900 respondents for unmet need, 46,596 for cholesterol screening, 2,136 for dental visit, and 60,216 for cervical screening.

Excluded respondents were compared to the analytic sample, using a bivariate design-based, Wald test (Table 4.7). Respondents were excluded if they were missing data on independent and dependent variables. This analysis was to account for the complex study design using the survey estimation commands available in Stata. There were five analytic samples (one per dependent variable), each sample of a differing size. The table presents the

sensitivity analysis for largest analytic sample size in which unmet need was examined, and the most restricted sample size in which cervical screening was examined.

For both the largest and smallest sample, those excluded were significantly more likely to be non-white, to be at or below the poverty line, and to be uninsured. By dependent variable, the final sample sizes for aim 3 were: usual source of healthcare (n = 110,996), unmet need (n = 112,125), cholesterol screening (n = 66,429), cervical screening (n = 52,809), and dental visit (n = 110,889). A full description of the aim 3 samples is provided in Chapter 7.

4.6 Sample Weights & Variance Structure

In order to provide correct point estimates and accurate standard errors, MEPS data requires accounting for the estimation weights (MEPS variable PERWTF), primary sampling units (MEPS variable VARPSU), and strata (MEPS variable VARSTR). Accounting for these design elements adjusts for nonresponse among those households subsampled from NHIS for the MEPS, non-response at the person level to account for survey attrition across the multiple rounds of data collection.

To facilitate analysis of subpopulations this study needed to pool together more than one year of MEPS – Household Component (MEPS-HC) data to yield sample sizes large enough to generate reliable estimates. In most years, the MEPS-HC samples are not completely independent because households are drawn from the same sample geographic areas and many persons are in the sample for two consecutive years. This proves to be limitation for this study. Each year of the MEPS-HC, however, is designed to be nationally representative. As such, AHRQ is explicit in its MEPS-HC documentation that keeping all observations in the analysis for pooled analysis is appropriate.[251] This documentation states that to obtain appropriate standard errors when pooling years of MEPS-HC data, it is necessary to specify a common variance structure that properly reflects this complex sample design of the MEPS.

In this study, duplicate respondents could be particularly problematic for two of the five of the dependent variables (i.e. cholesterol screening in past 5 years & cervical screening in past 3 years), since they questions ask about screening adherence more than 12 months prior. Approximately 30% to 40% of these samples were duplicate respondents. To determine if this study needed to account for clustering at the person-level the size of the design effect was calculated for all dependent variables. A design effect of two or above would indicate that the clustering of the data at the person-level needs to be taken into account during estimation.[252] The design effect for usual source of healthcare, unmet need, cervical screening, dental visit, and cholesterol screening all fell below two (ranging from 0.58 to 1.11). Thus, although there are duplicate respondents in my samples, each observation represents a 1-year observation period. Additional analyses removed all duplicates and multivariate models were run, with no drastic differences emerging. Using the non-duplicate samples appears to make the estimates of access to healthcare slightly more extreme, suggesting that the findings from the current study bias the results towards the null.

Additionally, since the study pooled six years of MEPS data (2005-2010) the person weight needed to be divided by six. Dividing the person weight by six provided correct weighted counts of the population and represents the average person over the years 2005 through 2010.[251]

As MEPS sampling strategy oversamples low income households, and respondents who are black, Hispanic, and Asian, it was important to use the weights when conducting the multi-level analysis. The current recommendation for analyzing multi-level models in complex survey data is to either scale the weights or leave the data unweighted.[253] Including the weights but failing to scale them (i.e. including them as “raw” weights) would result in biased parameters and standard errors, especially with small cluster sizes.[254]

I scaled the Level 1 weights of MEPS based on recommendations from previous simulation work and recent public health research.[253-255] For this study, the scaled weights

summed to the county cluster sample size, which accounted for unequal selection probabilities of people within counties. The county provided the closest approximation of the Primary Sampling Unit (PSU), as PSU's in MEPS consist of a county, a small group of contiguous counties, or a metropolitan statistical area. A previous sensitivity analysis identified that using this scaling method provided a feasible approach to analyzing complex survey data, and provides the least biased estimates.[253] To determine whether this method was the most appropriate for my analyses, I also ran the models with scaled weights that summed to the effective cluster size, as well as running the models unweighted.[253] Scaled weighted findings agreed for the most part, but were slightly different from unweighted analyses, with estimates and standard errors remaining for relatively comparable. As level-2 and level-3 weights (accounting for selection probabilities of the tracts and counties, respectively) were unavailable in this study, Level-2 and Level-3 weights were set to one.[253]

4.7 Analytic Plan

This section presents the statistical strategies used to address the three aims and corresponding hypotheses of this study. The data analysis for this study was conducted in the California Census Research Data Center located in the UCLA Luskin Public Affairs Building. All data management, descriptive statistics, and regression modeling were conducted with Stata version 13.0. The complex sample design was taken into consideration using the SVY commands, or survey procedures, offered in this statistical package. Additionally, for aim 2 and aim 3 this study used Gllamm,[256] a user written program in Stata to estimate the multi-level logistic regression models.

As a review, the primary research question of this study was to test how rural and urban areas (independent variable) were associated with access to healthcare (dependent variable). There were five dependent variables, each an indicator of access to healthcare: having a usual

source of healthcare, unmet healthcare need, cholesterol screening, cervical screening, and dental visit.

4.7.1 Analysis of Aim 1

This aim compared the following five measures of rural and urban areas (rural-urban measures): the (1) Metropolitan Statistical Area, (2) County Typology Code, (3) Rural-Urban Continuum Code, (4) Rural-Urban Classification Scheme, and (5) Rural-Urban Commuting Code. All objectives for this aim were restricted to adults age 18-64. First, a Spearman's correlation matrix was run which included each of the five rural-urban measures and the socio-demographic and health supply variables from the ACS and AHRF. Bivariate analyses were run for the five rural-urban measures by each of the county and tract-level socio-demographic characteristics. Bivariate analyses were also run for the rural-urban measures by each of the healthcare supply characteristics.

Separate logistic regression models estimated the odds of having a usual source of healthcare, any unmet need, cholesterol screening, cervical screening, and dental visit, controlling for age. Age was the only variable controlled for since on average, rural residents are older than urban residents and since the need for medical care typically increases with age. Multivariate logistic regression models were run for each of the five rural-urban measures along with the post-estimation command to obtain predicted probabilities for each of the outcomes. Lastly, these same logistic regression models were rerun with corresponding predictive probabilities, with an interaction term included for each of the rural-urban measure and U.S. region.

4.7.2 Analysis of Aim 2

The second aim of this study tested whether racial and ethnic disparities in access to healthcare differed for those residing in rural and urban areas. To better understand the

characteristics of the population specific to this aim, frequencies were calculated for all study variables by the Rural Urban Commuting Area Code (urban, semi-urban or rural tract). Candidate variables were evaluated for inclusion in the multivariate models using bivariate analysis of each study variable by the five dependent variables, using the analysis of variance to compare continuous variables, and the chi-squared statistic to compared categorical variables. A correlation matrix identified any issues of overfitting among the study variables, with no correlation coefficients exceeding 0.6 included in the final multivariate models.

Three-level, random intercept logistic regression models estimated the odds of reporting a usual source of healthcare, unmet need, cholesterol screening, cervical cancer screening, and dental visit. Each model included county, tract, and individual level variables. For this study, a multi-level statistical approach provided the distribution of each outcome across all tracts (level 2) and counties (level 3) and determined the proportion of between-group (between tract and between county) variance in access to healthcare. The decision to run a 3-level model was based on the main independent variable of this aim, rural and urban areas, being a tract level variable, and the healthcare supply variables that were only available at the county level.

There is no gold-standard technique for multilevel modeling with complex survey data.[253, 257] Sampling plans for survey data result in non-independent data, as the survey design organizes populations into clusters (e.g. counties), then samples the clusters (i.e. select some but not all of the counties), and then selects units within the clusters (e.g. people within the county). Although it is correct for analysts to respond to clustered survey data by adjusting the standard errors and accounting for non-independence, this method does not allow for the study of between-cluster variance unaccounted for by predictors included in the model.[258, 259] As people in one cluster tend to be more similar to each other than they are to people in other clusters, this can result in biased standard errors and parameters. Failing to account for the multi-level design ultimately leads to increased Type I errors and the possibility of incorrectly rejecting the null hypotheses.

Conceptually, multi-level models are understood as a hierarchical system of regression equations. Below is a simplified, representative equation for this aim is presented, as indicated by random intercept model for the probability of reporting access to healthcare for *i* th individual, living in tract *j*, in county *k*. Levels and corresponding variables (in bold) are also listed.

Level - 1: $\text{logit}(\Pr(y_{ijk}(\text{ACCESS}) = 1 | x_{ijk})) = \beta_{0jk} + \beta_1(\text{RACE}_{ijk}) + \beta_2(\text{EDUCATION}_{ijk})\ldots$

Level - 2: $\beta_{0jk} = \gamma_{0k} + \gamma_0(\text{URBANRURAL}_{jk}) + \upsilon_{0j}$

Level - 3: $\gamma_{0k} = \tau_{00} + \tau_1(\text{HOSPITALBEDS}_k) + \eta_{ok}$

Level - 1: Individual Characteristics (Race/Ethnicity, Education, Poverty, Employed, Self-Reported Health, Family Size, Chronic Conditions, Insurance Status, Any Out-of-pocket Medical Expenses, Limited English Proficiency)

y_{ij} = Log odds of having access for individual *i* in tract *j* in county *k*

β_{0jk} = intercept or average of access for tract *j* when all covariates are held equal

RACE_{ijk} = represents the race of the individual *i* in tract *j* in county *k*

β_1 = the effect of being non-white on access in tract *j*

EDUCATION_{ijk} = represents the educational attainment of the individual *i* in tract *j* in county *k*

β_1 = the effect of having less than a high school degree on USC in tract *j*

Level – 2: Tract Level Characteristics (Rural and Urban Area, Proportion Poor)

β_{0jk} = the tract specific intercept for tract *j* in county *k*

γ_{0k} = the common intercept across tracts (i.e., average access across tracts when all other covariates are equal to zero)

URBANRURAL_{jk} = represents the rural-urban continuum of the tract *j* in county *k*

γ_0 = partial effect of rural-urban continuum on access for tract *j*

υ_{0jk} = the error term that is associated with tract *j*.

Level – 3: County Level Characteristics (Proportion Primary Care Physicians, Proportion Hospital Beds)

γ_{0k} = the county specific intercept or average access for county *k*

τ_{00} = the common intercept across counties (i.e., average access across counties when all other covariates are equal to zero)

$HOSPITALBEDS_k$ = represents the proportion of hospital beds per 10,000 in a county *k*

τ_1 = partial effect of hospital beds on access for county *k*

η_{ok} = the error term that is associated with county *k*

Controls: Age, Gender, Marital Status, Survey Year, Region

This study used the Generalized Linear Latent and Mixed Model (Gllamm) procedure in Stata to fit random intercept models and allowed both tract and county intercepts to vary.[256] Gllamm is a user-written program for the maximum likelihood estimation of multilevel and latent variable modeling.[260] Because the dependent variables were dichotomous, the study used the logit link to model the response variable and the adaptive quadrature integration option in Stata which may provide better estimates than those obtained from ordinary quadrature.[261] Compared to other software packages such as Mplus or MLwiN; Gllamm is an appropriate fit for this analysis as it allows the user to simultaneously specify three-level models and allows for the incorporation of weights. Gllamm also allows for cross-level interactions and does best with categorical outcomes when compared to continuous outcomes.[260]

Gllamm models took a substantial amount of time to run, ranging from a few hours, to days. Multiple methods were used to speed up the models. The study used estimates obtained from a simpler model as starting values for the target model using the from() option, which saved iterations and consequently reduced the computation time of gllamm. Using the trace option was useful because it displayed the details of the model being fitted and those of the maximum-likelihood iterations as the models were running. This study also used the Stata command xtmelogit for model building, which accounted for the nested structure of the data, but did not allow for the incorporation of weights. BIC (Bayesian information criterion) and AIC

(Akaike information criterion) were used to assess model fit, covariate selection, and determination of final models.

To analyze the hypotheses specific to this aim, the study utilized comprehensive models, which included all individual level variables, along with tract and county-level variables. Stratified models are not an appropriate method for binary outcomes as the scale of logistic regression coefficients is not fixed; the equation is identified relative to an equation specific scale, a scale that changes as variables are added to the model.[262] Comprehensive models help rule out alternative explanations, since they control for competing hypotheses.[263]

First, three-level models with no variables were estimated. Table 4.8 indicates that accounting for the nested structure of the data was necessary. Based on the five samples, the number of respondents, tracts, and counties differed. For the dependent variable usual source of healthcare, the model was fitted using 104,334 respondents, nested within 16,248 tracts, nested within 1,517 counties. For the dependent variable unmet need, the model was fitted using 105,306 respondents, nested within 16,259 tracts, nested within 1,518 counties. For the dependent variable cholesterol screening, the model was fitted using 62,743 respondents, nested within 10,366 tracts, nested within 1,217 counties. For the dependent variable dental visit, the model was fitted using 104,528 respondents, nested within 16,268 tracts, nested within 1,520 counties. For the dependent variable cervical screening, the model was fitted using 49,839 respondents, nested within 12,266 tracts, nested within 1,332 counties.

This study estimated the full models to determine the main effects of rural and urban area and race/ethnicity separately. Comprehensive models were then run for each of the five outcomes by including 11 dummy variables (Urban black, Semi-Urban black, Rural black, Urban Hispanic, etc.) and an omitted reference category (Urban whites) since this group is the largest in terms of sample size. The parameterization of the model with dummy variables is mathematically equivalent to the model with the interaction term, but allows for easier interpretation.[263] Tract-level poverty was standardized for a more meaningful interpretation of

the results. The post estimation command, lincom allowed the study to test the overall significance of the interaction term. The study then tested the linear combination of the interaction term, which determined any significant differences in the coefficients within and between racial/ethnic groups by rural and urban residence. Since six independent statistical tests were performed, the Bonferroni correction adjusted the p-value to 0.008.

4.7.3 Analysis of Aim 3

The third aim of this study examined the association between racial/ethnic residential segregation and access to healthcare in rural and urban areas. To better understand the distribution and characteristics of the population specific to this aim, the study calculated weighted frequencies for all study variables by whether adults lived in a Metropolitan Statistical Area (urban or rural area). As a review, in aim 3, *urban* refers to metropolitan counties, while *rural* refers to non-metropolitan counties. All study variables were then examined for respondents residing in counties in which blacks were highly segregated and then for respondents residing in counties in which Hispanics were highly segregated. These estimates were further stratified for respondents who lived in rural and urban areas. The study then considered the bivariate associations of the black segregation and Hispanic segregation for each of the five dependent variables. For all of the descriptive analysis continuous variables were compared using the analysis of variance, and categorical variables were compared using the chi-squared statistic. A correlation matrix identified any issues of overfitting among the study variables. In evaluating collinearity, no correlations between the categorical variables exceeding 0.6 were observed.

Two-level (i.e. individual and county level) random intercept logistic regression models were run for aim 3 to estimate the odds of reporting a usual source of healthcare, unmet need, cholesterol screening, cervical screening, and dental visit, controlling for county and individual level covariates. Two-level models, instead of 3-level models, were run since the main

independent variable of this aim, residential segregation was a county-level variable. For the dependent variable usual source of healthcare, the model was fitted using 110,996 respondents nested within 1,526 counties. For the dependent variable unmet need, the model was fitted using 112,125 respondents nested within 1,527 counties. For the dependent variable cholesterol, the model was fitted using 66,426 respondents nested within 1,221 counties. For the dependent variable dental visit, the model was fitted using 110,889 respondents nested within 1,528 counties. For the dependent variable cervical screening, the model was fitted using 52,809 respondents nested within 1,335 counties.

Similar to the description provided for aim 2, a simplified, representative multi-level equation for aim 3 is presented below. Illustrated below is the random intercept model for the probability of reporting access to healthcare for *i*th individual, living in county *j*. Levels and corresponding variables (in bold) are also listed below as well.

Level - 1: $\text{logit}(\Pr(y_{ijk}(\text{ACCESS}) = 1 | x_{ijk})) = \beta_{0jk} + \beta_1(\text{RACE}_{ijk}) + \beta_2(\text{EDUCATION}_{ijk}) \ldots$

Level - 2: $\beta_{0jk} = \gamma_{0k} + \gamma_0(\text{SEGREGATION}_{jk}) + \upsilon_{0j}$

Level - 1: **Individual MEPS Respondents (Race, Education, Poverty, Employed, Self-Reported Health, Family Size, Chronic Conditions, Insurance status, Out-of-pocket Expense, Limited English Proficiency)**

Level – 2: County Level Characteristics (Rural and Urban Area, Isolation Index, Poverty, Proportion Primary Care, Proportion Hospital Beds)

Controls: Age, Gender, Marital Status, Survey Year, Region

This study first estimated the two-level models without including any variables and learned that accounting for the nested structure of the data was necessary (Table 4.9). Then five multi-level models with the black isolation index and five models for the Hispanic isolation index were run, controlling for all other county and individual level covariates. For a more meaningful interpretation of the results and to reduce collinearity, estimates for county-level

segregation and county-level proportion poor correspond to a difference equivalent to a 1-standard deviation increase. BIC (Bayesian information criterion) and AIC (Akaike information criterion) were used to assess model fit, covariate selection, and determined final models.

In order to assess whether black segregation or Hispanic segregation had a curvilinear relationship with any of the dependent variables, both the black and Hispanic isolation index were squared. The squared terms were non-significant in the models so were not included. Next, the study tested for a multiplicative effect (i.e. interaction) between the standardized Black isolation Index and rural and urban counties (black isolation index x Rural, Hispanic isolation index x Rural) in each of the models. Stratified models were run for urban counties and rural counties, with additional models that included an interaction term for segregation and individual race/ethnicity (black isolation index x black, Hispanic isolation index x Hispanic).

CHAPTER 5

RESULTS: AIM 1

5.1 Introduction

In this chapter, the results for aim 1 of the study are presented, which compared and contrasted five measures commonly used to characterize an area as rural or urban, and learn if the relationship between rurality and the dissertation study's access to healthcare variables varied across the five measures. There were three objectives: (1) to determine how five rural-urban measures capture socio-demographic and healthcare supply characteristics and, (2) how the association between each rural-urban measures and access to healthcare variables vary, and (3) to assess how the association between each rural-urban measure and access to healthcare variables differ when considering four regions in the United States.

To review, this aim compared and contrasted five rural-urban measures: (1) Rural Urban Commuting Area Code, (2) Metropolitan Statistical Area, (3) Urban Rural Classification Scheme, (4) Rural Urban Continuum Code, and the (5) Economic Typology Code. *Socio-demographic and healthcare characteristics* estimated county and tract level income, educational attainment, Non-Hispanic black, Hispanic, and the proportion of primary care physicians, specialists, and hospital beds. *Region* was captured as one of four areas in the United States: (1) Northeast, (2) Midwest, (3) South, and (4) West.

This chapter has five sections. First, the distribution of the five rural-urban measures is described. Next, to test the hypotheses the chapter describes how each of the five rural-urban measures captured socio-demographic and healthcare supply characteristics as well as each of the access to healthcare variables. The chapter ends with a description of the association between each of the five rural-urban measures, access to healthcare, and region.

5.2 Descriptive Analyses

Table 5.1 characterizes the weighted sample for adults age 18-64 by the five rural-urban measures. The Rural-Urban Commuting Area Code was the only measure that used the census tract as its geographic unit; the other four measures used the county. No conclusions can be drawn about the distance between two categories, as four of the measures were ordinal and one rural-urban measure was categorical (Economic Typology Code).

Despite some overlap, each rural-urban measure categorized the adult population differently. Of all the measures, the Metropolitan Statistical Area (MSA) categorized the most adults as urban (83.7%). The Rural Urban Continuum Code had the most categories (nine); accordingly it disaggregated respondents the greatest of all the rural-urban measures, however this resulted in relatively small sample sizes for codes five through nine. Of all the rural-urban measures, the Urban Rural Classification Scheme distributed the population most evenly, with 29.5% of adults residing in the most urban counties. According to the Economic Typology Code, 42.0% of adults resided in counties identified as service dependent.[1] A small percentage of adults resided within farming dependent counties[2] (1.4%) or mining dependent counties[3] (0.7%). Table 5.2 elaborates on the characteristics, strengths and weaknesses of each rural-urban measure.

5.3 Objective 1

Hypothesis 1.1: The greater number of categories an rural-urban measure has, the stronger its association will be with socio-demographic and healthcare supply characteristics at the census tract and county levels.

[1] > 45% of average annual labor and proprietors' earnings derived from services such as retail trade; finance, insurance and real estate.
[2] Either > 15% of average annual labor derived from farming or >15% of employed residents worked in farm occupations.
[3] >15% of average annual labor and proprietors' earnings derived from mining

Overall, the rural-urban measures captured socio-demographic and healthcare supply indicators similarly. This finding did not support my hypothesis.

In order to measure the general strength and direction of relationships among measures, Table 5.3 presents a correlation matrix of county and tract-level variables. Except for the Economic Typology Code, all rural-urban measures were highly correlated with each other, with correlation coefficients greater than 0.61. The rural-urban measures most highly correlated with each other were the Urban Rural Classification Scheme (NCHS) and Rural Urban Commuting Area Code (RUCA) (0.91). Each rural-urban measure was moderately correlated with the socio-demographic and healthcare supply variables. The Urban Rural Classification Scheme had the strongest negative correlation with the proportion of specialists in the county (-0.60), however for each measure the proportion of specialist decreased as rurality increased.

Bivariate analysis of each rural-urban measure by the four measures of socio-demographic characteristics and three measures of healthcare supply characteristics are reported in Table 5.4. For each rural-urban measure, Table 5.4 indicates an ordered association for estimates of poverty and educational attainment. For instance, counties and tracts that are characterized by greater rurality have higher levels of poverty and lower levels of educational attainment. The Urban Rural Classification Scheme is an exception to this trend. Based on this measure, residents in category 2 (“Large Fringe Metro”) were characterized as having the lowest poverty and highest educational attainment compared to any other category. Across all of the measures, the percentage of Non-Hispanic blacks and Hispanics as well as the proportion of primary care physicians and specialists decreased steadily as rurality increased in counties and tracts. No rural-urban measure showed a consistent trend in the proportion of hospital beds.

The MSA measure captured a similar trend in socio-demographic and healthcare supply characteristics as the other rural-urban measures, however it concealed some heterogeneity. This was especially true for the counties classified as non-MSA, for which the MSA measure

underestimated poverty and educational attainment. For instance, 14.6% of MSA counties, and 18.9% of Non-MSA counties were characterized by having residents with less than a high school degree. Compared to the Rural Urban Continuum Code, in which 14.8% of the "Most Urban", and 22.7% of the "Most Rural" counties were characterized by having residents with less than a high school degree.

5.4 Objective 2

Hypothesis 1.2: Regardless of the rural-urban measure utilized, adults in the most rural areas will have significantly poorer access to healthcare after adjusting for age, when compared to other categories.

Provided in Table 5.5 are weighted predicted probabilities of five indicators of access to healthcare for adults age 18-64, adjusted for age. Findings partially supported my hypothesis. When comparing the frequencies obtained from each of the rural-urban measures, findings on four measures of access to healthcare were consistent. Unmet healthcare need was the only outcome that was an exception to this finding.

Across all rural-urban measures, a greater proportion of adults in the most rural areas had a usual source of healthcare. The Rural Urban Continuum Code captured the greatest difference between rural and urban adults, with 71.7% of adults in the most urban counties having a usual source of healthcare, compared to 81.2% of adults in the most rural counties.

Across all rural-urban measures, fewer adults in rural areas had a cholesterol screening in the past five years, a dental visit in the past year, and cervical screening in the past three years. Although this finding was similar across the rural-urban measures, there was some variation in the estimated frequencies. Compared to the other rural-urban measures, the Economic Typology Code captured the most variation in access to healthcare, such that 46% of adults in mining dependent counties had a dental visit, compared to 65% of adults in a services dependent county.

By contrast, the adjusted percentage of adults with unmet healthcare need varied depending on the rural-urban measure used. Specifically, the Urban Rural Commuting Area Code, the MSA and Economic Typology Code did not support any statistically significant difference in unmet need across the rural-urban categories. The Rural Urban Continuum and Urban Rural Classification Scheme indicated a statistically significant difference in unmet healthcare need. Based on these measures, unmet healthcare need was lower in the "most urban" and "most rural" counties, and estimates were higher in semi-urban counties.

5.5 Objective 3

Hypothesis 1.3: When stratified by region, the association between each of the rural-urban measures and access to healthcare will not differ after adjusting for age, with adults residing in the rural South experiencing the worst access and those in the rural Northeast experiencing the best.

Weighted predictive probabilities determined whether access to healthcare varied across the four mutually exclusive regions of the United States, which included the Northeast, Midwest, South, and West. Figure 5.1 and Figure 5.2 provide predicted probabilities for two of the five dependent variables, unmet healthcare need and dental visit by region, adjusting for age. These two outcomes emphasized key variations in access to healthcare when stratified by region.

My hypothesis was confirmed. In analysis stratified by region, the association between each of the rural-urban measures and access to healthcare did not differ after adjusting for age. For each measure, adults in the rural South experienced the lowest levels of access to the types of care and those in the rural Northeast experienced the highest.

As hypothesized, levels of unmet healthcare need were lowest in counties and tracts of the Northeast region, and this pattern held across all measures. In urban counties, the Midwest, South, and West regions had similar levels of unmet healthcare need. Depending on the rural-urban measure selected, the estimated percentage of adults who had unmet healthcare fluctuated. While, the Urban Rural Continuum Code indicated no clear difference between

regions and unmet healthcare need, the Economic Typology Code evidenced the greatest amount of regional variation in unmet healthcare need for farming and mining counties.

The estimates from every rural-urban measure indicated fewer dental visits among adults living in more rural tracts or counties. The percentage of adults with a dental visit was lower in the rural South than elsewhere. According to the Rural Urban Commuting Area Code, 46% of adults in the rural South had a dental visit, compared to 68% of adults in the rural Northeast.

Some rural-urban measures indicated that among counties and tracts characterized by greater rurality, the percentage of adults with a usual source of healthcare increased (data not shown). Findings based on the Rural Urban Commuting Area Code indicated a greater percentage of adults had a usual source of healthcare in semi-urban tracts in the Northeast (86.3%), when compared to urban tracts (81%) or rural tracts (83%) in the Northeast. The estimates from the Economic Typology Code indicated that in the West, only 64% of adults in farming and 60% of adults in mining dependent counties had a usual source of healthcare compared to the Midwest where 92% of adults in farming dependent counties and 74% of adults in mining dependent counties had a usual source of healthcare. The other rural-urban measures were unable to capture these large differences in a usual source of healthcare.

The greatest proportion of adults in category 2 (“Large Fringe Metro”) of the Urban Rural Classification Scheme had a cervical screening and cholesterol screening (data not shown), with those in the Northeast having the highest adherence of all regions. Compared to the other measures of access to healthcare, cervical screening adherence did not show as much variation by each of the rural-urban measure and region. Most rural-urban categories identified that 80.0% to 85.0% of women had a cervical screening (range = 76.0% to 90.0%).

Small sample sizes prohibited some analysis for this objective. For all dependent variables, after stratifying by each of the rural-urban measure and by region, some rural-urban measures had unstable estimates. For instance, when looking at the largest sample unmet

healthcare need, the Rural Urban Continuum Code had no respondents in category nine (the most rural counties, n = 0). The Economic Typology Codes also had no respondents in the Northeast for Farming (n = 0) and unstable estimates for Mining (n = 8) counties.

5.6 Summary of Key Findings

Analyses from this chapter revealed that all five rural-urban measures similarly captured socio-demographic and healthcare supply characteristics at the county and census tract levels. In counties or tracts characterized by greater rurality, the percentage of the population in poverty and with lower educational attainment was higher, while the percentage of racial/ethnic minority groups and physician supply was lower. Compared to the other four rural-urban measures, the Urban Rural Classification Scheme provided the most even distribution of the U.S. population, allowing for the disaggregation of urban areas ("semi-urban"), which are counties characterized by higher educational attainment and lower estimates of poverty. With two categories, descriptive results suggested that the MSA measure hid some variation in socio-demographic and healthcare supply characteristics at the county level.

Based on a sensitivity analysis of five rural-urban measures, the choice of measure influenced the estimates obtained regarding access to the various types of healthcare. The rural-urban measures concurred in estimating that a greater proportions of adults in rural than non-rural areas had a usual source of healthcare, while fewer had undergone screenings. Three of the five measures however, produced percentages of unmet healthcare need that varied for rural vs. urban adults, while the other two measures produced no statistically significant differences. Lastly, the analysis in support of this aim revealed that the association between each of the rural-urban measures and access to healthcare was generally consistent when stratified by region. Across all five measures of access to healthcare, access to healthcare was highest among more urban counties and tracts in the Northeast. It was lowest among more rural counties and tracts in the South and in the West.

CHAPTER 6

RESULTS: AIM 2

6.1 Introduction

This chapter presents the results for aim 2 of the study, which determined whether racial and ethnic disparities in access to healthcare differed by rural vs. urban area. As review, areas are defined as a person's immediate residential environment which are classified as either rural or urban, or somewhere in between (semi-urban). Rural and urban areas represent a continuum reflecting differences in area level characteristics including the local economy (economic dependency of the land, adjacency to metropolitan areas, and commuting patterns), infrastructure (built environment and population density), and social context (self and outsiders perceptions). For this aim, respondents lived in an "urban"[4], "semi-urban"[5], or "rural"[6] area captured at the census tract level.

The chapter has six sections. It begins by describing the population's demographic characteristics and the bivariate associations among the study variables. The chapter then describes the three-level random intercept logistic regression models that tested whether rural and urban areas and race/ethnicity were independently associated with access to healthcare. The chapter ends with an investigation of the specific objectives of this aim, and an explanation of the whether the differences in access to healthcare varied within and between racial/ethnic groups.

6.2 Descriptive Analysis

[4] Populations of 50,000 persons+
[5] Small cities/large towns with populations of 10,000 to 49,999 or high work commuting levels
[6] Small towns with populations below 10,000, lower work commuting levels, or in isolated rural areas with more than an hour drive to the nearest city

6.2.1 Distribution of Study Variables. Table 6.1 provides the weighted distribution of the sample (n = 105,306), which ranged in age from 18 to 64 years, for each of the study variables overall and by urban, semi-urban, and rural area. The proportion of males and females in each area did not significantly differ. On average, adults in rural areas were older (mean = 42.5) than adults in urban areas (mean = 39.9). As expected, urban areas were more racially/ethnically diverse, with 40.4% of adults self-reporting as black, Hispanic, or other race, compared to 18.3% in rural areas. A greater percentage of adults in rural areas were married, when compared to adults in urban areas.

Rural populations had significantly lower educational attainment, with 13.2% having less than a high school education compared to 9.8% urban populations ($p < 0.000$). In urban areas, a greater percentage of adults reported higher incomes, were currently employed, and had private health insurance when compared to adults in rural areas. Those in rural areas were less healthy, with poorer self-reported health and more chronic conditions. In the past year, 79.3% of adults in rural areas had some type of out of pocket medical expense, compared to 76.6% of adults in urban areas. Among adults in urban areas, 9.9% had limited English proficiency, compared to 3.7% of adults in rural areas.

At the tract level, 69.0% of adults age 18-64 lived in an urban area, 22.4% in a semi-urban area, and 9.0% in a rural area. On average, 17.7% of adults lived in a high poverty census tract (< 125% Federal Poverty Level). The proportion of primary care physicians decreased in rural areas, while the proportion of hospitals beds did not significantly differ by area of residence.

6.2.2 Rural and Urban Areas and Race/Ethnicity by Outcome. Table 6.2 presents the unadjusted percentage of adults who reported access to healthcare. Among adults age 18-64, 73.0% had a usual source of healthcare, 13.2% had unmet healthcare need in the past 12 months, and 62.3% had a dental visit in the past year. Among adults age 35-64, 85.8% had a

cholesterol screening in the past 5 years. Among females age 21-64, 86.0% had a cervical screening in the past three years.

On average, when compared to adults in urban areas, a significantly larger percentage of adults in rural areas had a usual source of health, while a significantly smaller percentage had a cholesterol screening, dental visit, or cervical screening (not shown in table). Hispanics had the lowest access to healthcare with 57.0% having a usual source of healthcare, when compared to 70.0% of blacks, and 78.0% of whites (not shown in table). A greater percentage of blacks, than whites or Hispanics, had a cholesterol screening or cervical screening.

Table 6.2 shows frequencies for the five outcome variables stratified by urban, semi-urban, and rural areas and further stratified by race/ethnicity, with 95% confidence intervals included to make comparisons across groups. Significant differences in access to healthcare emerged across racial/ethnic groups, and when making comparisons within racial/ethnic groups who live in different residential areas. A greater proportion of whites and blacks in rural areas had a usual source of healthcare (80.6% and 75.1% respectively), when compared their urban counterparts (77.2% and 69.6% respectively). There was a 20.9% point difference in having a usual source of healthcare between whites and Hispanics in urban areas, which was similar in rural areas, with a 20.6% point white-Hispanic difference observed in rural areas.

Unmet healthcare need did not vary drastically by subgroup; the exception was for blacks in rural areas who had the lowest unmet healthcare need of all groups (9.2%). While the percentage of whites and blacks with a cholesterol screening was similar in urban areas, the percentage of blacks in a rural area with a cholesterol screening (74.0%) was significantly lower than for whites in a rural area (81.3%). Particularly for Hispanics, those with a dental visit varied by area of residence, with a 12.5% point difference in having a dental visit when comparing those in urban to rural areas. The percentage of women with a cervical screening did not vary drastically, except for blacks in urban areas who had the highest percentage (90.7%) and Hispanics in rural areas who had the lowest percentage of all groups (81.1%).

6.2.3 Summary of Descriptive Analysis. On average, a greater proportion of adults in rural areas were older, white, in poverty, with less educational attainment, and poorer health compared to adults in urban areas. Descriptive analyses revealed that compared to adults in urban areas, a greater percentage of adults in rural areas had a usual source of healthcare, but a lower percentage had a cholesterol screening, dental visit, and cervical screening. Additionally, a lower percentage of blacks and Hispanics had a usual source of healthcare and dental visit when compared to whites. Unadjusted percentages indicated large between and within group differences for each racial/ethnic group depending on whether the respondent lived in a rural or urban residential area. While all rural adults, no matter their race/ethnicity, report lower screenings and dental visits than urban adults, blacks and Hispanics disproportionately have lower adherence than whites.

6.3 Main Effects of Rural and Urban Area and Race/Ethnicity on Access to Healthcare

Three-level random intercept logistic regression models tested the main associations of race/ethnicity and area for each of the five measures of access to healthcare. The findings from these multi-level analyses are presented in Tables 6.3 through Tables 6.7. Model 1 shows the bivariate association between area of residence and the outcome, model 2 adds race/ethnicity, and model 3 are the final models which accounted for all individual, tract, and county-level variables. The tables indicate that a greater proportion of the variance for all five outcomes was explained at the tract level (Level 2), when compared to the county level (Level 3).

According to Table 6.3, both unadjusted and adjusted estimates suggest that more adults in rural areas can identify a usual source of healthcare relative to adults in urban areas. Model 2 shows that significantly fewer racial/ethnic minorities groups report a usual source of healthcare relative to whites. After adjusting for other covariates, adults in rural areas had 1.52

times higher odds of a usual source of healthcare compared with adults in urban areas (95% Confidence Interval (CI): 1.29, 1.78). Race/ethnicity is no longer significant in the model.

Table 6.4 shows that in unadjusted estimates adults in rural areas report higher odds of unmet healthcare need (OR = 1.13, CI: 1.05, 1.22), however after adjusting for the other covariates, there area of residence was no longer significant. Model 2 and model 3 both show that racial/ethnic minority groups have significantly lower odds of reporting any unmet need when compared to whites.

In Table 6.5 through 6.7, model 1 shows that relative to adults in urban areas, those in rural areas had significantly lower odds of reporting all screenings and visits. Even after controlling for all covariates (model 3), adults in rural areas had 0.62 times lower odds of a cholesterol screening (CI: 0.51, 0.74), 0.79 times lower odds of cervical screening (CI: 0.65, 0.96), and 0.78 times lower odds of a dental visit (CI: 0.69, 0.89) (Table 6.5, Table 6.6, and Table 6.7 respectively). There were mixed findings for screening and dental visits when considering race/ethnicity. In unadjusted models, some racial/ethnic minorities reported lower adherence relative to whites. However, after controlling for covariates, blacks and Hispanics had higher odds of a cholesterol screening, dental visit, and cervical screening when compared to whites. For instance, black women had 2.53 times higher odds (CI: 2.18, 2.95) of a cervical screening when compared to white women.

6.4 Objective 1

Hypothesis 2.1: The difference in access to healthcare between Non-Hispanic blacks and Hispanics compared to Non-Hispanic whites will be larger in rural areas compared to urban areas.

Based on Section 6.3, the multi-level analysis revealed that after controlling for other individual, tract, and county-level characteristics, area of residence and race/ethnicity each had an independent association with all five outcomes. After adjusting for all covariates, there was a

statistically significant interaction between area of residence and race/ethnicity for all five dependent variables varied by race/ethnicity ($p_{interaction} = 0.0000$). A significant interaction indicated that for whites, blacks, and Hispanics the association between residing in a particular area and access to healthcare differed.

Hypothesis 2.1 was partially supported by this analysis, as the "difference in differences" approach compared the coefficients between racial/ethnic minority and majority groups by rural and urban area. Overall in rural areas, the differences in levels of access to healthcare between blacks and whites, as well as the differences between Hispanics and whites varied when compared to the racial/ethnic differences observed in urban areas.

Figure 6.1 shows that after controlling for other individual, tract and county-level characteristics, the difference in unmet healthcare need between blacks relative to whites in rural areas was greater than the difference observed between blacks relative to whites in urban areas ($p < 0.000$). In all areas, blacks had lower odds of unmet healthcare need relative to whites. This similarly aligns with the unadjusted estimates, that found 14.9% of whites in rural areas, compared to 9.2% of blacks in rural areas had unmet healthcare need. Additionally, the difference in dental visits between blacks and whites was greater in the rural areas compared to the difference observed in rural areas ($p < 0.05$).

Alternatively, Figure 6.1 shows that the difference in cholesterol screening between blacks relative to whites in rural areas was smaller than the corresponding black and white difference in urban areas ($p < 0.000$). When compared to whites, a greater proportion of blacks had a cholesterol screening, no matter if the adult lived in a rural or urban area. The same figure shows that the difference in cervical screening between blacks relative to whites in rural areas was smaller than the corresponding racial differences in urban areas ($p < 0.000$). A greater percentage of black women, no matter whether they lived in a rural or urban area, had a cervical screening.

After controlling for other individual-, tract- and county-level, the Hispanic and white difference in cholesterol screening was smaller in rural areas than in urban areas (Figure 6.2). Meanwhile the same figure shows that the difference in cervical screening between Hispanics relative to whites in rural areas was significantly greater than the difference observed in urban areas. While Hispanics overall had higher odds of a cervical screening relative to whites, the difference with whites was greater in rural areas. Hispanic women in rural areas had the highest reports of cervical screenings of all groups.

The overall findings partially supported Hypothesis 2.1; the disparities between blacks and whites varied in rural vs. urban areas. The difference in unmet healthcare need among blacks relative whites in rural areas was greater than the racial difference observed in urban areas. For cholesterol and cervical screenings, the difference between blacks and whites was greater in urban areas than the racial difference observed in rural areas.

6.5 Objective 2

Hypothesis 2.2: Within each racial/ethnic group (whites, blacks, and Hispanics), adults in rural areas will have poorer access to healthcare, compared to their counterparts in urban areas.

The analysis confirmed Hypothesis 2.2 for white and black adults. Only one outcome, cholesterol screening, was confirmed for Hispanics. Figure 6.3 shows that after controlling for other individual, tract, and county-level characteristics whites in rural areas had significantly higher odds of a usual source of healthcare when compared to whites in urban areas. Alternatively, whites in rural areas had 0.66 lower odds of a cholesterol screening (CI: 0.53, 0.81) and 0.76 lower odds of a dental visit (CI: 0.66, 0.88) when compared to their urban counterparts. There was no significant difference in unmet healthcare need and cervical screenings for whites by area of residence.

As shown in Figure 6.4, the coefficients corresponding to blacks residing in rural vs. urban areas indicate large, negative differences in cholesterol and cervical screenings. Blacks in

rural areas had 0.38 times lower odds of a cholesterol screening (CI: 0.28, 0.48) and 0.48 times lower odds of a cervical screening (CI: 0.34, 0.67) when compared to blacks in urban areas. There was no statistically significant difference in usual source of healthcare, unmet need, and dental visits when comparing blacks in rural vs. urban areas.

While descriptive frequencies in Table 6.2 indicated large variation in the proportion of Hispanics reporting access to healthcare by area of residence, a majority of this variation did not remain after accounting for other individual, tract, and county-level characteristics. As seen in Figure 6.5, only cholesterol screening remained significant. Hispanics in rural areas had lower odds of cholesterol screening when compared to Hispanics in urban areas. There was no difference in having a usual source of healthcare, unmet need, dental visit, or cervical screening when comparing Hispanics in rural vs. urban areas.

In summary, compared to whites in urban areas, only whites in rural areas had higher odds of a usual source of healthcare, but lower odds of a cholesterol screening and dental visit. Relative to blacks in urban areas, those in rural areas had lower odds of a cholesterol screening and cervical screening. Hispanics in rural areas had lower odds of cholesterol screenings relative to Hispanics in urban areas.

6.6 Objective 3

Hypothesis 2.3: The difference in access to healthcare between blacks and Hispanics will be larger in rural areas, compared to urban areas.

The results of the “difference in differences” test provided no support for Hypothesis 2.3. Shown in Figure 6.6, although non-significant, the general relationship of cholesterol screening and cervical screening flipped in rural and urban areas. For instance, in urban areas, less screening was reported among Hispanics relative to blacks. While in rural areas, more screening was reported among Hispanics relative to blacks. Due to these non-significant

findings, the black-Hispanic difference in access to healthcare was relatively similar in rural and urban areas as evidenced by the non-significant findings.

6.7 Summary of Key Findings

Unadjusted analysis revealed sizable disparities in access to healthcare. Relative to urban areas, adults in rural areas had higher unmet healthcare need and lower adherence of preventive screenings and dental visits. While fewer Blacks and Hispanics could identify a usual source of healthcare compared to whites, these groups reported lower perceived need for services. The association between area of residence and access to healthcare differed by race/ethnicity.

Further examination revealed differences between subgroups after controlling for individual, tract, and county-level characteristics. When compared to urban areas, the difference between black and white adults in rural areas was greater for unmet healthcare need, but smaller for cholesterol and cervical screening. Relative to urban areas, the Hispanic and white difference in cervical screening was greater in rural areas. While blacks and Hispanics overall might have better access to healthcare when compared to whites, blacks in urban areas had the highest access to healthcare.

Within each racial/ethnic group differences in access to healthcare were identified by area of residence. Among whites, those in rural areas had higher odds of a usual source of healthcare and lower odds of cholesterol screenings and dental visits than whites in urban areas. Among blacks, those in rural areas had lower odds of cholesterol and cervical screenings, when compared to blacks in urban areas. Among Hispanics, those in rural areas had lower odds of cholesterol screenings vs. Hispanics in urban areas. The difference between Hispanics and blacks was similar in rural and urban areas for all measures of access to healthcare.

CHAPTER 7

RESULTS: AIM 3

7.1 Introduction

This chapter presents the results for aim 3 of the study, which examined the association between the black segregation and Hispanic segregation, respectively, and access to healthcare in rural and urban areas. As review, for this aim adults lived in either an *urban*[7] or *rural* [8] area, captured at the county level. *Residential segregation* was captured using the isolation index for blacks and Hispanics separately based on block groups nested within counties.

There are five sections to the chapter. The first section describes the population's demographic characteristics and bivariate associations among the study variables. The next section presents the results from the two-level random intercept logistic regression models, which tested the main associations of residential segregation and area of residence on access to healthcare. This is followed by an explanation of the interaction, which tested whether the association between segregation and access to healthcare varied in urban compared to rural areas. Next, the association between segregation and access to healthcare, stratified for rural and urban areas is described. The chapter concludes by explaining the interaction between segregation and individual level race/ethnicity in the stratified models.

7.2 Descriptive Analyses

7.2.1 Distribution of Study Variables. Table 7.1 provides the weighted distribution for each of the study variables overall and for adults in rural and urban areas. Descriptively, the

[7] Metropolitan (Populations of 50,000 persons+ with high degree or social and economic integration with urban core)
[8] Micropolitan (Population 10,000 – 49,999) & Non-Metropolitan (Population < 10,000)

rural and urban differences were not drastically different from those described in aim 2. This aim, however, differs from aim 2 in that it captures rural and urban areas at the county-level rather than at the tract level, and does not distinguish semi-urban areas. For this aim, among adults age 18-64, 83.6% lived in an urban area, and 16.4% lived in a rural area.

At the county level, for the average adult who was black, 11.9% of their neighbors were black. For the average adult who is Hispanic, 10.6% of their neighbors were Hispanic. Estimates of segregation were higher among adults who lived in urban areas, compared to estimates of segregation among adults who lived in rural areas. Overall, 13.4% of adults lived in areas where poverty was at or below 125% the Federal Poverty Level; in rural areas the proportion was higher at 16.8%. The proportion of primary care physicians was lower in rural areas, while the proportion of hospitals beds did not significantly differ by area.

At the individual-level, adults in rural areas were slightly older than adults in urban areas. Similar to aim 2, adults in rural areas were less racially/ethnically diverse, with 81.9% being white, 7.9% black, and 6.4% Hispanic. Among adults in rural areas 25.6% had a Bachelor's degree or higher, compared to 36.2% of adults in urban areas. On average a greater proportion of adults of urban relative to rural areas had higher incomes and private health insurance. Among adults in rural areas, 31.8% were uninsured at some point in the last year. Adults in rural areas were less healthy with 13.9% reporting fair or poor health, relative to 10.5% urban counterparts. The largest proportion of adults in rural areas lived in the South (42.4%).

7.2.2 Distribution of Study Variables by Segregation. Table 7.2 provides the weighted distribution for each of the study variables by racial/ethnic residential segregation. The table is stratified separately for adults who lived in counties where blacks were highly

segregated, and also for adults who live in counties where Hispanics were highly segregated.[9] The table is further stratified by urban and rural area.

In this sample, estimates of residential segregation were lower in rural areas than estimates observed in urban areas. On average, for a typical black person who lived in an urban area that was highly segregated, 26% of their neighbors were black. For the typical Hispanic person who lived in an urban area that was highly segregated, 24% of their neighbors were Hispanic. For the typical black person who lived in a rural area that was highly segregated, 17% of their neighbors were black. For the typical Hispanic who lived in a rural area that was highly segregated, 13% of their neighbors were Hispanic.

The proportion of the county population living in poverty (< 125% FPL) was greater in areas characterized by higher levels of segregation. For instance, in rural areas with higher levels of Black segregation, 20.0% of the population was living in poverty. The proportion of primary care physicians also differed by level of segregation and residential area. Rural areas where Hispanics were highly segregated had five primary care physicians per 10,000, as compared to seven primary care physicians per 10,000 in similarly segregated urban areas. The proportion of hospitals beds did not differ by levels of segregation.

In rural areas, areas with higher levels of segregation had higher proportions of adults who were older, identified as White, had lower incomes, and had lower educational attainment. The percentage of adults in poverty who were uninsured at any time in the last year was also higher in rural areas when compared to all adults nationally. The levels of Black segregation were greatest in the South; Hispanic segregation was greatest in the South and West.

7.2.3 Distribution of Segregation by Outcome.

Table 7.3 provides the unadjusted odds ratio of the five outcomes for adults in segregated rural and urban residential areas. Report of a usual source of healthcare was lowest

[9] Counties in which the black Isolation Index and Hispanic Isolation Index was ≥ 75th percentile

for adults who lived in urban areas with high black and high Hispanic segregation. For adults in rural areas with high black segregation, 80.6% had a cholesterol screening and 53.2% had a dental visit. Compared to adults in urban areas with high black segregation, where 88.6% had a cholesterol screening and 64.0% had a dental visit. A similar trend was observed for adults who resided in rural areas with high Hispanic segregation. Only 79.1% of adults in rural areas with high Hispanic segregation had a cholesterol screening and 51.1% had a dental visit, compared to 86.9% and 62.5% of adults in urban areas with high Hispanic segregation respectively.

7.2.4 Summary of Descriptive Analysis. In this sample, estimates of black and Hispanic residential segregation were lower in rural compared to urban areas. Areas with higher estimates of black and Hispanic segregation had a greater proportion of the residents in poverty. Higher estimates of segregation appear to be concentrated in the South and West. Bivariate analyses indicated that higher levels of both black segregation and Hispanic segregation were associated with lower odds of a usual source of healthcare. For both rural and urban areas, higher levels of black segregation were positively associated with cholesterol screening and cervical screenings. While higher levels of Hispanic segregation were negatively associated with unmet need and dental visits. Fewer adults who lived in highly segregated urban areas had a usual source of healthcare, but a greater percentage reported screenings and dental visits. Alternatively, fewer adults who lived in highly segregated rural areas had screenings and dental visits, but a greater percentage had a usual source of healthcare.

7.3 Main Effects of Segregation and Rural and Urban Areas on Access to Healthcare

Two-level random intercept logistic regression models tested the main associations of segregation and area of residence for each of the five measures of access to healthcare. The findings from these multi-level analyses are presented in Tables 7.4 through Tables 7.8. Model 1 shows the bivariate association between segregation and the outcome, and model 2 accounts

for all other individual, tract, and county-level variables. Each table examines black segregation on the left and the association of Hispanic segregation on the right. Across all models, variation in access to healthcare at the county level explained a sizable portion of the variation in access to healthcare.

According to Table 7.4, for the entire sample, each standard deviation increase in black segregation was associated with 0.92 times lower odds of a usual source of healthcare (95% Confidence Interval (CI): 0.88, 0.95) and each standard deviation increase in the Hispanic segregation was associated with 0.81 times lower odds in a usual source of healthcare (CI: 0.75, 0.88) (model 1). After adjusting for individual and county-level characteristics (model 2), Black segregation no longer shared a significant association with a usual source of healthcare. A one standardized increased in Hispanic segregation, however, remained associated with 0.92 lower odds of a usual source of healthcare (CI: 0.86, 0.97). Black segregation and Hispanic segregation, according to Table 7.5, were not associated with unmet healthcare need in both unadjusted and adjusted models.

In model 1 of Table 7.6, an increase in black segregation was positively associated with cholesterol screening (OR = 1.16, CI: 0.1.11, 1.21). This relationship remains in adjusted analysis (model 2), as a one standardized increase in black segregation was associated with 1.09 times higher odds of a cholesterol screening (CI: 1.04, 1.19). Similarly in Table 7.7, black segregation was positively associated with cervical screenings (OR = 1.12, CI: 1.08, 1.20) (model 1). This positive relationship remains in the adjusted model (model 2). Table 7.8 shows that an increase in Hispanic segregation was negatively associated a dental visit (OR = 0.93, CI: 0.90, 0.96) in unadjusted analysis (model 1), however, this relationship did not remain in adjusted analysis (model 2).

In adjusted analysis, similar to findings in aim 2, adults in rural areas had 1.21 higher odds of a usual source of healthcare (CI: 1.07, 1.38) in both the black and Hispanic segregation

models. The Hispanic segregation model indicated that residing in a rural area was associated with 0.85 times lower odds a cholesterol screening (CI: 0.74, 0.97).

7.4 Objective 1

Hypothesis 3.1: The association between racial/ethnic residential segregation and access to healthcare is similar in rural and urban areas.

Adjusting for all county and individual level characteristics, Hypothesis 3.1 was partially confirmed. The interaction term (segregation x rural area) was non-significant in all multi-level models, which included all adults who lived in both rural and urban areas.

Model 1 in all five tables (Tables 7.9 through Tables 7.13), examined the association of segregation on access to healthcare in stratified rural and urban area models. According to Model 1, controlling on other individual- and county-level characteristics, a one standardized increase in Hispanic segregation in urban areas was associated with 0.90 lower odds (CI: 0.85, 0.96) of a usual source of healthcare (Table 7.9). By contrast, a one standardized increase in black segregation in urban areas was associated with 1.13 higher odds of cholesterol screenings (CI: 1.05, 1.21) and 1.08 higher odds of a dental visit (CI: 1.04, 1.12) (Table 7.11 and Table 7.13 respectively).

7.5 Objective 2

Hypothesis 3.2: In both rural and urban areas, differences in access to healthcare will be explained by both racial/ethnic residential segregation and individual level race/ethnicity.

Model 2 in Tables 7.9 through Tables 7.13 presents the results from the examination of the interaction between segregation and race/ethnicity relative to access to healthcare in stratified urban and rural areas. Adjusting for other individual-level and county-level characteristics, the analyses partially confirmed Hypothesis 3.2. The interaction term (segregation x race/ethnicity) was significant in several models.

In both rural and urban models, numerous statistically significant interactions indicated that the association between segregation and access to healthcare differed by individual level race/ethnicity. Specifically, the association between the segregation of blacks and access to healthcare differed for blacks when compared to all other racial/ethnic groups. In the same manner, the association between the segregation of Hispanics and access to healthcare differed for Hispanics when compared to all other racial/ethnic groups.

For blacks in rural areas, a one standardized increase in Black segregation was associated with 0.66 lower odds of unmet healthcare need (CI: 0.47, 0.91) (Table 7.10). A similar association was observed in urban areas. For Hispanics in rural areas, a one standardized increase in Hispanic segregation was associated with 0.79 lower odds of unmet healthcare need (CI: 0.65, 0.96).

For blacks in urban areas a one standardized increase in Black segregation was associated with higher odds of cervical screening (OR = 1.21, CI: 1.09, 1.36) and dental visits (OR = 1.07, CI: 1.00, 1.15) (Table 7.12 and Table 7.13 respectively). For Hispanics in urban areas a one standardized increase in Hispanic segregation was associated with 1.11 higher odds of a usual source of healthcare (CI: 1.02, 1.22) (Table 7.9).

7.6 Summary of Key Findings

In unadjusted analysis a one standard deviation increase in segregation was negatively associated with a usual source of healthcare, yet positively associated with screenings. And Hispanic segregation was negatively associated having a dental visit. Holding all individual and county level covariates constant, some of these associations remained. For all respondents, the segregation of Hispanics had a negative association with a usual source of healthcare. The segregation of blacks was positively associated with cholesterol screenings, dental visits, and cervical screenings for all adult respondents. The interaction between the continuous measure of segregation and residential area was not significant.

In stratified models, the segregation of blacks in urban areas was positively associated with cholesterol screenings and dental visits, while the segregation of Hispanics in urban areas had a negative association with a usual source of healthcare. For blacks in rural areas, the segregation of blacks was negatively associated with unmet healthcare need. Similarly, for Hispanics in rural areas, the segregation of Hispanics also was negatively associated with unmet healthcare need. Hispanics who lived in urban areas with increasing estimates of Hispanic segregation had higher odds of a usual source of healthcare.

CHAPTER 8

DISCUSSION

8.1 Introduction

The goal of this study was to improve understandings of the relationship between residing in rural vs. urban residential areas and disparities in accessing selected healthcare services among vulnerable populations in the United States. The study had three aims, which were to: (1) compare and contrast common measures used to define areas as rural vs. urban; (2) determine if racial/ethnic disparities in accessing healthcare vary for rural vs. urban areas; and, (3) identify relationships between racial/ethnic residential segregation and access to healthcare in urban vs. rural areas. The study's conceptual model integrated Andersen's Model and the theory of fundamental causes. A secondary analysis was conducted using the Medical Expenditure Panel Survey merged with the American Community Survey, Area Health Resource File, and assessments of rural and urban areas from the United States Department of Agriculture and National Center for Health Statistics.

This final chapter discusses the findings relative to the existing literature. It comprises both aim-specific and overall discussions of the findings. Each aim-specific discussion describes how the major findings from the analysis relate to the existing literature, explains the strengths and limitations of the analysis and identifies key implications. The chapter then provides a discussion of considerations that are common across all of the study aims and, therefore, relevant for understanding how the overall study can inform the field. The chapter then addresses strengths and limitations of the overall project, and the study's implications for theory, research, and policy. The chapter ends with a conclusion with respect to the overall dissertation.

8.2 Aim-Specific Discussions of Findings

8.2.1 Aim 1: Measurement of Rural and Urban Areas

8.2.1.a Key Findings. The first aim of this study had two parts, which were to (1) compare and contrast five measures commonly used in public health and health policy research to characterize the degree to which an area is rural vs. urban, and (2) learn if the relationship between rurality and the dissertation study's access to healthcare variables varied across the five measures. Overall, in counties or tracts characterized by greater rurality, the percentage of the population in poverty and with lower educational attainment was higher, while the percentage of racial/ethnic minority residents and proportion of physician supply was lower. The MSA measure masked some of these area-level characteristics. Only one access to healthcare outcome, unmet healthcare need, was affected by the choice of measure. Adults in the urban Northeast had the highest access to healthcare; adults in the rural South and rural West had the least access to healthcare.

Applying the five rural-urban measures, the distribution of the U.S. population captured by each measure inherently varied due to differences in how areas were quantified as rural or urban, population thresholds and the geographic unit of choice. As discussed in the next section (8.2.1.b), disaggregated rural-urban measures should capture differences in area level variation better than aggregated measures do; however, the estimates produced by each rural-urban measure indicated that greater rurality was associated with lower educational attainment and income levels at the county or tract level relative to the U.S. population. The MSA measure, which had two categories, yielded similar patterns as the other measures, though it masked some area-level heterogeneity. The Urban Rural Classification Scheme measure was best at capturing "semi-urban" areas, which could be characterized by higher educational attainment and income levels.

Across all of the rural-urban measures, adults living in areas characterized by greater rurality had fewer preventive screenings compared to those living in urban areas, but greater proportions had a usual source of healthcare than did their urban counterparts. The selection of

a rural-urban measure was associated with a change in one outcome only, unmet healthcare need. For unmet healthcare need, three of the rural-urban measures did not produce statistically significant differences across the rural-urban categories; however, two measures identified a significant difference. Of all the rural-urban measures, the Economic Typology Code detected the most variation in access to healthcare, however many of the sample sizes were too small to support reliable estimates.

Across all rural-urban measures, similar trends in access to healthcare emerged by region. Access to healthcare varied for adults living in the Northeast, South, Midwest, and West. By region, the measures all indicated that access to the five types of healthcare was highest among adults in the Northeast who lived in areas characterized by higher urbanicity. While those residing in areas characterized by higher rurality in the South and West had the lowest access to healthcare.

8.2.1.b Implications. This comparison revealed several implications for research. Except for the MSA measure, all measures similarly captured area-level socio-demographic characteristics and were highly correlated with each other. This finding highlights that most quantitative measures use population density as the foundation on which categories are constructed, enabling the measures to similarly capture area-level characteristics. Mixed findings however, for one of the outcomes suggest that the unit of analysis may be particularly important in health research. For instance while the Urban Rural Classification Scheme may be best at evenly disaggregating the U.S. population, the Rural Urban Commuting Area Code and its use of census tracts may be better at differentiating smaller population groups. Explained in further detail below are how the findings underscore the need to justify the conceptualization, measurement, and application of any instruments used to capture area level assessments of rural and urban areas.

Conceptualization

Rural and urban areas are difficult to define well, as prior research evidences the struggle in explicitly conceptualizing the constructs of rural and urban.[89, 264] Needed are area-level, continuum-based measures that capture important characteristics of local economies, infrastructure, and social contexts. In contrast to categorical or binary measures, continua may provide richer understandings about the relationship between specific dimensions of rurality and healthcare. Without solid conceptualization there is limited justification of what rural-urban measures capture in research beyond serving as proxies for population density or the geographic density of health care providers and facilities.[49, 62] Since rural-urban measures serve as practical analytic and policy tools, developing conceptually and methodologically sound measures of rurality (and urbanicity) should be a priority for any project that examines health related outcomes. For this study, even selection of the term “rural and urban areas” from other possibilities, such as the “rural to urban continuum” and “rural and urban environments” speaks to the complexity surrounding this geographical and social construct.

Measurement

Findings from this aim highlighted key area level characteristics that rural-urban measures capture. As both “rural” and “urban” are multifaceted concepts about which there is little agreement,[74] disaggregated rural-urban measures should inherently be better at capturing nuances of the external environment and healthcare system.[83, 264] Surprisingly, all rural-urban measures similarly captured area level trends including socio-demographic and healthcare characteristics when using the same sample. Although the foundation of each of the five rural-urban measures used population density, these rural-urban measures may also be decent ways to assess other key area level socio-demographic and healthcare supply characteristics.

To define areas using government measures, researchers might consider administrative boundaries, economic influence, or land use patterns. In this study three of the rural-urban measures relied on administrative definitions. Designed by rural development programs, administrative definitions determined rural and urban areas based on municipal or other

jurisdictional boundaries. The other two rural-urban measures relied on economic definitions, which recognize the influence of cities on labor, trade, and commuting patterns.[265] Much of the research surrounding these measures suggests defining urban first, with rural being defined as the territory not included.[265] Thus, choosing an appropriate rural definition requires an understanding of the key characteristics of urban entities and how they, in turn, determine the characteristics of rural definitions derived from them.

In order to better capture area level variations, using smaller units in a rural-urban measure may provide a better approximation of the variability and diversity of areas. As rural areas across the United States are diverse, operationalizing rural communities at smaller units, such as census tracts or zip codes, may significantly strengthen conclusions public health researchers can make.[89] When compared however to county level measures, the use of smaller units forces researchers to consider how tracts may differ in rural and urban areas. For instance, urban tracts may be organized by city blocks, which may or may not be the same size or shape. Alternatively rural tracts may or may not have this same organization, can be diverse and also hard to define. Moreover, rural populations may live in areas or regions of the country where the nearest neighbors are miles away or scattered across the countryside. Testing and distinguishing between rural-urban measures may help to identify important features of the contextual environment and clarify why geographical disparities in access to healthcare may persist.

Application

The selection and application of a rural-urban measure has implications for public health research findings. Despite the five rural-urban measures similarly identifying area-level socio-demographic and healthcare supply characteristics, the rural-urban measures did not uniformly agree on whether access to healthcare was worse in rural areas. This was as expected, since the literature remains mixed on whether rural populations are uniformly disadvantaged. While

access barriers or underutilization have been found to be greater in rural than urban areas,[5-7, 9, 266] for other indicators no difference has been observed between rural vs. urban areas.[8, 59]

Mixed findings might suggest differences in outcomes or specific study populations, but could also indicate that the selection of instruments to capture rural and urban may be driving results. Findings from this study were consistent with previous research that fewer adults in rural counties had timely access to preventive screenings and visits while more had a usual source of healthcare.[5, 6, 8, 51, 56] Mixed findings, however, for differences in unmet healthcare need, emphasize the importance of researchers to familiarize themselves with various rural definitions and geographic methodologies and then to carefully weigh the pros and cons of available measures and their definitions.

All rural-urban measures captured similar trends for each of the five outcomes by region, with the Northwest having the best access to healthcare. This corresponds with other research, suggesting that access to healthcare differs in the Northeast, South, Midwest, and West regions.[1, 82] The historical and economic realities of diverse regions may contribute to issues with access to healthcare and utilization.[65, 160] This finding also indicated that when studying rural-urban disparities, no matter the rural-urban measure used, failing to control for region may obscure findings and the ability to tease out meaningful characteristics pertinent to rural and urban areas.

The availability of data at different geographic scales often dictates the geographic unit that researchers must use. Two categories (rural vs. urban) may be more beneficial for federal and state policies, which tend to treat rural areas as a single entity.[74] Policymakers and legislators often do not understand that rural areas may differ from one another in a myriad of ways and that a number of methods are used to define an area as rural or urban. One consideration is the unit of analysis. For instance, identifying a county as “urban,” does not necessarily mean that the county does not contain rural territory. It simply means that at the level of the county, the area’s characteristics are consistent with those of an urban area,

whether or not it also is consistent with all the constituent sub-county units. Additionally, as a unit of analysis, counties may be less useful in national studies due to large differences in size and population. For instance, counties typically are geographically small in New England, whereas counties west of the Rockies are substantially larger. Awareness of such limitations from the start of research projects can inform decisions about which rural-urban measures are most useful for a particular study. Being upfront about the selection of the rural-urban measure and which dimensions are hypothesized to influence health and healthcare help to more accurately specify and ultimately target vulnerable groups.

8.2.1.c Aim 1 Strengths and Limitations. Using the same data set, this aim compared five common measures used to assess the rurality or urbanicity of an area and examined how the measures influenced findings on access to healthcare among working age adults. The incorporation of outside data files enabled the study to consider how various socio-demographic and healthcare supply characteristics may be captured by various rural-urban measures. And use of five outcome variables provided a more comprehensive measurement of access to healthcare, than one measure alone. Additionally, the aim validated that each rural-urban measure similarly captured regional variation in access to healthcare, which is useful for future work interested in exploring similar healthcare indicators. At the same time, applying each rural-urban measure on a national sample assumes that rural areas are homogenous places.[74] As MEPS is a national study by design, the aggregation of rural areas of differing sizes and levels of remoteness may obscure characteristics at the local level.

8.2.2 Aim 2: Racial/Ethnic Disparities in Access to Healthcare

8.2.2.a Key Findings. The second aim of this study *was to determine whether racial and ethnic disparities in access to healthcare differed by rural vs. urban area.* Disparities in access to healthcare we most apparent in unadjusted analysis. Compared to urban areas, more adults in rural areas delayed or were unable to get the healthcare, prescription medication, and dental

care when they or a doctor believed care was necessary. Timely adherence of preventive screenings and dental visits was also worse in rural compared to urban areas. Blacks and Hispanics, in unadjusted analysis, had more difficultly in identifying a usual source of healthcare when compared to whites. Access to healthcare differed when considering the combined effect of area of residence and race/ethnicity. While unadjusted analysis indicated large disparities for blacks and Hispanics, particularly for those residing in rural areas; many of these disparities were narrowed after controlling for key predictors of access, including income, education, and insurance status.

In fully adjusted models, when comparing minority to majority groups, gaps in access to healthcare were most drastic between blacks and whites. When making comparisons within each racial/ethnic group, only for whites, was living in a rural area, relative to living in an urban area positively associated with a usual source of healthcare. For blacks, living in a rural area was negatively associated with unmet healthcare need and screenings. For Hispanics, living in a rural area was negatively associated with cholesterol screenings.

Differences in access to healthcare between racial and ethnic groups depended on where adults lived. Across all areas, blacks had less unmet healthcare need and better adherence of screenings than whites. The racial difference in unmet healthcare need, however, was greater in rural areas compared to the racial difference observed in urban areas. Alternatively, the racial difference in screenings was smaller in rural areas compared to the racial difference in urban areas. For cholesterol screening, the Hispanic and white difference was smaller in rural areas.

Only for one outcome, did the difference in access to healthcare flip when the minority group changed. The difference in cervical screenings between Hispanics and whites was larger in rural areas relative to the difference observed in urban areas, with Hispanic women reporting more screenings. No significant differences in access to healthcare were observed when

comparing minority groups, as the difference on all measures of access to healthcare between blacks and Hispanics were similar in both rural and urban areas.

For certain racial and ethnic groups, access to healthcare was influenced by where the adults lived. Blacks in rural areas had lower levels of healthcare utilization; fewer adults had preventive screenings when compared to their urban Black counterparts. For whites, living in a rural area was positively associated with having a usual source of healthcare, though screenings were lower relative to whites in urban areas. For Hispanics, access to healthcare was similar in both rural and urban areas, except for cholesterol screening; fewer Hispanics in rural areas reported having had these.

8.2.2.b Implications. Racial/ethnic disparities in access to healthcare depended on whether adults live in rural or urban areas. Specifically, while large disparities exist for both racial/ethnic minority groups and rural populations, disparities were less apparent when other individual, tract, and county level characteristics are controlled for. The literature remains sparse with respect to rural racial/ethnic population differences in access to healthcare. The few studies that consider race/ethnicity use county level measurements of rural and urban areas. Few incorporate community level factors, such as healthcare supply and area-level poverty, or examine racial/ethnic differences in access to healthcare in different social and geographical contexts.[13, 14, 137]

Between Group Disparities in Access to Healthcare

Across all areas, relative to whites, fewer blacks and Hispanics had a usual source of healthcare and unmet healthcare need, but a greater proportion had access to the three preventive screenings. These findings align with a study that found blacks had 0.76 (CI: 0.65, 0.88) and Hispanics 0.45 (CI: 0.37 to 0.55) lower odds of needing medical care, after controlling for personal and community level characteristics.[26] Other work suggests that when compared to whites, fewer Hispanics reported a cholesterol screening and a greater proportion of blacks had a cervical screening.[21]

While these general trends by race/ethnicity remained, the difference between minority and majority groups varied in rural and urban areas. These differences are somewhat supported in the literature, though the between and within racial/ethnic group differences have not been fully tested previously. Differences in access to healthcare were most drastic for black compared to white adults, and less drastic for Hispanics compared to whites in this study. The differences, however, in access to healthcare between Hispanics relative blacks were not clearly supported in this study.

Blacks reported the lowest perceptions of healthcare need of all groups. The difference in unmet healthcare need between blacks and whites was greater in rural areas compared to the racial difference observed in urban areas. Low reports of unmet healthcare need, particularly among blacks relative to whites in rural areas, may indicate poorer clinical experiences, lower expectations, or trust in the healthcare system.[34, 102-104, 207] Findings from a mixed methods paper of blacks in the rural South, suggest that low perceived need for medical care may reflect lack of information about baseline standards and the lack of discomfort and urgency associated with some acute and chronic conditions.[65] Compared to the racial/ethnic majority, minority groups may experience poor patient-provider communication, high levels of implicit bias, stereotyping, and perceived discrimination, all factors influencing perceptions of healthcare need.[34, 102-104, 207] Additionally, social norms within rural areas could influence perceptions of need. Perceptions of medical need have been found to differ for rural populations, such that when sick, the population is more self-reliant, believing they are “healthy”, and do not need to seek medical care.[40, 70, 71] These social norms could directly influence responses to the unmet healthcare need questions, as MEPS only asked respondents who “needed” care about any issues they faced in obtaining medical care, prescription medications, and dental care.

Alternatively, the difference between blacks and whites in adherence to preventive screenings was smaller in rural areas compared to the racial difference in urban areas. Relative

to whites in urban areas, one study found that blacks in urban and large rural areas were more likely to receive all screenings (cervical screening, mammogram, colorectal cancer screening), yet the odds of these screenings decreased with rurality.[13] Another estimate suggests that blacks in urban areas have higher adherence of colorectal cancer screening than Non-Hispanic whites in urban areas (51.8% vs. 49.5%).[137] Only for cholesterol screening, was the Hispanic and white difference smaller in rural areas, than the difference observed in urban areas. This is surprising because relative to rural whites, rural working-age Hispanics have lower odds of having health insurance and visiting a healthcare professional in the past year.[267] In contrast, another study found that having a usual source of healthcare was similar among Mexicans in Metropolitan counties compared to Non-Hispanic whites in Metropolitan counties.[9]

Relative to whites, substantially higher rates of preventive screenings among blacks and Hispanics in urban areas, could be attributed to increased public awareness of timely cardiovascular and cancer screenings and national initiatives such as Healthy People 2020,[20] Racial and Ethnic Approaches to Community Health (REACH),[268] and the National Breast and Cervical Cancer Early Detection Program.[269] This finding may suggest that blacks and Hispanics in urban areas have been differentially targeted by public awareness campaigns and national initiatives, while racial/ethnic minorities in rural areas have received less direct targeting.

This explanation, however, is not clearly supported when considering that the difference between Hispanic and whites in cervical screenings was greater in rural areas, compared to urban areas. These findings may indicate that women share a different relationship to the healthcare system compared to men, particularly in regards to reproductive healthcare services. In rural areas, Hispanic women may have strong social networks and open lines of communication that are critical in providing information about how to access healthcare services. For instance, a qualitative study highlighted that despite having low rates of insurance, literacy barriers and experiences of discrimination, the social networks of Hispanic women may

encourage resourcefulness in helping women to comply with recommended treatments. While another study suggests no difference exist for adherence to cervical screenings for Hispanic women living in small rural counties, the reference group was white women living in urban counties, which makes the comparisons to the current study difficult.[13]

Within Racial/Ethnic Group Disparities in Access to Healthcare

Among blacks, proportionately fewer of those in rural areas as compared to those in urban areas had timely preventive screenings. This finding is partially supported by prior evidence of rural/urban disparities and the probability of colorectal cancer screening among blacks (44.8% among rural blacks vs. 51.8% among urban blacks).[137] Another study in contrast, found only slight but statistically significant within group differences, with 89.0% of Metropolitan blacks reporting a cervical screening, compared to 90.3% of Non-Metropolitan blacks.[9]

One explanation for lower cholesterol screenings among blacks in rural areas may be that screenings are increasingly available and administered in retail settings, which are rarely located in rural areas. While cervical screenings must be performed in a doctor's office, this study's analysis was unable to capture retail settings as a measure of healthcare supply. Clinics located within retail stores, such as grocery stores, drugstores, and "big box" stores such as Wal-mart may help explain why more blacks in urban areas reported a cholesterol screening. A systematic review of the retail clinic industry found that while one-third of the urban population lives within a ten-minute drive of a retail clinic, far fewer clinics appear to be located outside of these areas.[270] Retail clinics appear to serve a different patient population underserved by primary care physicians, with nearly all clinics offering evening and weekend hours.[271]

Higher levels of cholesterol screening among blacks in urban areas could also reflect the higher prevalence of cardiovascular risk. Although this study controls for self-rated health and chronic conditions, such as coronary heart disease and hypertension, measures of cardiovascular risk such as overweight, obesity or tobacco use were not included. Since clinicians evaluate a patient's cardiovascular risk and other conditions, black patients in urban

areas who have seen their clinician may get screened because they are aware of their high-risk status.

Among Hispanics, the hypothesis that those in rural areas would have poorer access to healthcare than those in urban areas was not clearly supported. After controlling for key determinants of access to healthcare among Hispanics, including insurance coverage and limited English proficiency, relatively few within group differences emerged. The exception was for cholesterol screening, in which fewer Hispanics in rural areas reported adherence relative to Hispanics in urban areas. Prior work suggests small but significant within group differences exist with respect to cervical screening: while 88% of Hispanics in urban counties obtained cervical screenings, 87.6% of those in non-urban counties had a screening.[9] Hispanics may experience difficulties in receiving preventive care, as ethnographic evidence among rural adults with Mexican ancestry suggest many of them rely heavily on safety net providers.[145] Across both rural and urban areas, social and economic inequalities remain strong predictors of access to healthcare that restrict access to diverse forms of healthcare among Hispanics.[144]

The findings among whites partially mirror those of other studies. More whites in rural areas had a usual source of healthcare than did those in urban areas, but fewer had accessed screenings.[6] These findings generally corroborate with the broader rural-urban health literature, which finds that non-urban populations report significantly higher odds of a usual source of healthcare (OR = 1.69), when compared to urban populations.[6] Practitioners in close-knit communities are often more integrated and better able to offer services to a community.[272] Evidence suggests that the ability to locate healthcare services may result from positive care-giving experiences or “positive gossip” that circulates in closely knit rural communities.[273] Although more adults may report a usual source of healthcare, this study did not examine whether these locations are easily accessible in regards to distance and transportation.

While whites in rural areas were able to identify a provider, their access to screenings as assessed by dental visits and cholesterol screenings remained low. One study found that

women in rural non-adjacent counties had 0.88 times lower odds of a cervical screening, relative to women in urban counties.[8] After controlling for population characteristics and provider availability, there was no difference in rates of cervical screening and mammograms for white women in rural areas compared to white women in urban areas.[13] This same study, however, found that rural white women were less likely to have physical examination.[13]

Overall, the association between area of residence and access to healthcare varied depending on the race or ethnicity of the adult (Figure 3.4). As access to healthcare is a multidimensional construct, findings on the ability or capacity to access to healthcare differed from findings related to preventive screenings. This suggests that characteristics of rural and urban areas may operate and influence each dimension of access to healthcare differently.

For instance, within and between racial/ethnic differences in perceived healthcare need may provide insight into diverse clinical experiences and expectations of healthcare systems in rural areas. These experiences may highlight differences in “social context”, one proposed area level characteristic that is pertinent to understanding rural and urban areas. Rural populations, particularly racial/ethnic minority groups in rural areas may have different personal values and attitudes, and self-perceived identities as hardworking individuals. For instance, particularly when considering blacks who reside in the rural South, historical oppression and the deeply embedded push for self-sufficiency, could influence perceptions of the role and need for healthcare, prescription medications, and dental care.

Findings related to majority and minority differences in preventive screenings suggest that information about preventive health standards and services may not be disseminated by local organizations as effectively in rural areas as in urban areas. This reality may highlight differences in “infrastructure”, another area-level characteristic that may be pertinent when understanding urban versus rural areas. Access to basic services may depend on the built environment and how the distribution of resources may be focused on areas with higher population densities. By including five outcomes that considered both the ability to access care

and actual use of the healthcare system, the complexities that contribute to racial/ethnic disparities in healthcare may be better revealed. A logical next step was to examine whether racial/ethnic residential segregation, an area level characteristic, may help to explain some of these findings.

8.2.2.c Aim 2 Strengths and Limitations. This aim's multi-level analysis highlighted the importance of considering racial/ethnic disparities in access to healthcare in urban vs. rural areas. By comparing majority and minority group differences, and by switching the reference group away from whites in urban areas this aim exposed compelling differences between disadvantaged populations that may have been lost in previous research. By pooling the MEPS household data files, sample sizes were large enough to examine blacks and Hispanics within isolated rural areas. While some research has focused on racial/ethnic differences in preventive cancer screenings for women in rural and urban areas, no research to date specifically has examined unmet healthcare need and having a usual source of healthcare in this manner.

A majority of the previous literature derived findings from the public use files of the Behavioral Risk Factor Surveillance System.[8, 13, 137] The BRFSS public use file excludes counties with fewer than 10,000 residents, leading to an underrepresentation of the residents in the smallest rural counties. Using restricted MEPS data and applying the tract-level Rural Urban Commuting Area Code enabled the current study to better capture the most isolated rural populations in the United States and a proxy for their life space, including respondents living in areas with populations below 10,000, with lower commuting levels, and with more than an hour drive to the nearest city. The Rural Urban Commuting Area Code is widely used for policy and research purposes, such as by the Centers for Medicare and Medicaid Services. Tracts however, are not standardized, which could be problematic in areas where populations are sparser, such as in the West. In the future, measures of rurality at the block group level or ZIP code level may work better to capture rural areas. Additionally, past research that uses the Behavioral Risk Factor Surveillance System recognizes that as a telephone survey, participation

is low for young, poor, and minority populations.[274] While survey weights typically adjust for this issue, as an in person interview, MEPS may be better at capturing these vulnerable respondents.

Three-level multi-level models were the analytic method of choice as the healthcare supply variables were available only at the county level. Use of county level healthcare supply could potentially mask sub-county health departments and the ability to deliver more localized healthcare delivery. Yet use of multi-level statistical approaches provided the distribution of each outcome across all tracts and counties and determined the proportion of between-group variance in access to healthcare. A greater proportion of the variance was explained at the tract level, than at the county level. This suggests that a respondent's access to healthcare may be more similar to their immediate neighbors, than to those that share the same county. MEPS, however, is a complex sample, its utility in performing multi-level analysis is limited. For this aim in particular, the variance at the Level 2 should be interpreted with caution. Specifically, for the outcome usual source of healthcare, a substantial portion of the variation is explained at the tract level. Future analysis would benefit by accounting for the clustering particularly at the household-level.

8.2.3 Aim 3: Racial/Ethnic Residential Segregation and Access to Healthcare

8.2.3.a Key Findings. Aim 3 *examined the association between racial/ethnic residential segregation and access to healthcare in rural vs. urban areas.* Residential segregation, assessed using the isolation index, was associated with many indicators of access to healthcare across residential areas. The association between segregation and access to healthcare was present in both rural and urban areas; however, in urban areas, segregation was associated with all five of the outcomes.

Unadjusted analysis indicated that an increase in the segregation of blacks and an increase in the segregation of Hispanics were negatively associated with having a usual source

of healthcare. After controlling for county and individual characteristics, this relationship only remained for Hispanic segregation. An inverse association was observed when an individual's race/ethnicity was considered. The combination of being Hispanic and living in an urban area in which Hispanics were more segregated was positively associated with having a usual source of healthcare.

There was no observed association between segregation and unmet healthcare need. The combination, however, of being black and living in a rural area in which blacks were more segregated was negatively associated with unmet healthcare need. A similar association was identified for being Hispanic and living in a rural area in which Hispanics were more segregated.

Adherence to cholesterol and cervical screenings, along with dental visits were positively associated with Black segregation, a relationship that remained after controlling for other individual and county characteristics. Only in unadjusted models was Hispanic segregation negatively associated with a dental visit.

8.2.3.b Implications. Using a nationally representative sample, racial/ethnic residential segregation accounted for disparities in the ability and actual utilization of the healthcare system in both rural and urban areas. While the connection between residential segregation and healthcare is documented in urban cities and metropolitan areas,[10, 11, 113] segregation was a significant contextual level characteristic in rural areas as well. The relationship between segregation and access to healthcare, however, was inconsistent across outcomes and differed for black segregation and Hispanic segregation.

Residential Segregation of Blacks

Higher levels of black segregation were consistently and positively associated with screenings and dental visits after adjusting for covariates. This finding aligns with two studies; residents of counties with higher percentages of blacks had less difficulty obtaining care, had fewer perceived financial barriers, and more regular mammograms.[129, 275] A recent study, however, using MEPS found that person's living in predominantly black zip codes had fewer

office-based physician visits compared to persons living in predominately white zip codes.[15] In that study, the racial/ethnic composition of the respondents' zip code was dichotomized, which may have masked unique area-level heterogeneity. Additionally, having an office based physician visit in the past year, which included primary care and specialist visits, may not be necessary for all adults and could capture another dimension of access than the outcomes assessed in this study. Using a standardized and continuous measure of segregation, the current study suggests that higher levels of black segregation, particularly in urban areas, are positively associated with screenings for working age adults.

These positive findings parallels those of aim 2, and supports explanations that public awareness campaigns and national initiatives may be differentially targeted at urban areas that have higher concentrations of racial minority groups, as has been done with other outcomes.[276] Particularly the CDC's REACH campaign and the National Breast and Cervical Cancer Early Detection Program may be strong contributors to helping equalize rates of screenings. Over the past 20 years, the expansion of Community Health Centers may also have ensured better access to primary care in low income and minority communities.[277]

Simple racial composition estimates (i.e., % black) in a county, however, do not account for discrimination, which may drive residential patterns and potentially influence access to healthcare. Discrimination and prejudice in housing and mortgage markets have been important factors in shaping the residential patterns of blacks;[278] segregated areas have fewer economic opportunities, worse physical environments, fewer public resources, inadequate housing, and higher levels of health hazards such as pollution and violence.[114, 278] These historical and economic realities may vary across diverse regions, particularly when considering the concentration of blacks in the South, and Hispanics in the Southwest, which could contribute to disparities in healthcare.[65, 160]

As a fundamental determining factor, segregation persistently reconstitutes the conditions necessary for the perpetuation of racial and ethnic inequality in health.[48, 113]

Increasing segregation was associated with better access to healthcare, suggesting that over time, black communities may have cultivated ways to counteract the influence of segregation and possible helping to facilitate better access to healthcare.[129] Although strides towards racial intolerance have generally declined over time, particularly in regions such as the South, the legacy of slavery and racial discrimination remain.[150, 158] In areas in which blacks are residentially segregated, timely uptake of screenings may suggest that areas have worked to create autonomous institutions, with "formal organizations, informal networks, ideologies, and cultural frameworks … in order to mitigate, resist, and undo the structural constraints communities face." [220]

Within segregated communities, social norms may also create different expectations for healthcare among residents.[279] Social norms can be shaped by social networks, which may facilitate better access to healthcare by providing channels to supply information about the availability of care and how to navigate that healthcare system. Impoverished "rural ghettos"[160] of long-standing segregated black communities may encourage better compliance of preventive screenings through established personal ties to their physicians. Segregated areas may also be fueled by experiences of disconnection, inspiring community organizing, activism, and the election of black leaders,[221] characteristics shown to benefit black health.[222]

Residential Segregation of Hispanics

For all adults, higher levels of Hispanic segregation were positively associated with cholesterol screenings, a finding that similarly supports public health campaign and social network explanations provided for the influence of black segregation. In particular, living in areas with individuals of a similar ethnic background or of a common language may aid in the formation of social networks and the sharing of information on how to navigate the health care system. Previous work has indicated individuals in counties with a high proportion of Hispanics were 30% more likely to have a cholesterol screening, compared to individuals in counties with a low proportion of Hispanics.[275] Additionally, for Mexican American immigrants, living in an area

populated by relatively more Spanish speakers or more Hispanic immigrants was associated with having any healthcare expenditure and a usual source of healthcare, with the association being stronger for more recent immigrants compared to immigrants who are better established.[279]

Despite these positive findings for cholesterol screenings, unadjusted estimates showed, that living in areas with increasing Hispanic segregation was negatively associated with a usual source of healthcare and having a dental visit. And that Hispanic segregation, in adjusted models, continued to be negatively associated with having a usual source of healthcare for all adults. A comparable study using L.A. FANS data found no significant association of living in a neighborhood with a dominant ethnic group (either white or Hispanic) and having a regular source of healthcare or a preventive checkup in the last two years.[280] Another study using MEPS that restricted their analysis to urban areas, found that for U.S. born Mexican Americans the association with local demographic characteristics and access to various indicators differed by insurance status.[279] Specifically, higher percentages of Hispanic populations were negatively associated with having a medical office visit and medical expenditure for uninsured U.S. born Mexican Americans, yet no association was observed among insured U.S. born Mexican Americans.[279] Community level nativity status may play a large role in determining access to healthcare, as another study found that among Asian Americans in California, adults who live in high racially concordant neighborhoods had lower odds of having a usual source of healthcare when compared to Asian Americans living in low concordance neighborhoods.[281]

Fewer adults being able to identify a usual source of healthcare in highly segregated Hispanic communities may support this aims theoretical hypotheses. Although less pronounced than blacks, there is evidence of housing and mortgage discrimination against Hispanics.[282] As a fundamental cause, segregation was expected to contribute to a diminishing local tax base leading to unequal access to healthcare.[113, 211, 212] The diminishing tax base may have resulted from the economic impact of migration. The changing distribution of the Hispanic population in

the U.S. may highlight the more recent impact of migration into non-traditional destinations and its influence on the economic or material prospects of the county,[162] which could restrict a person's ability to access services. In this study, a large proportion of urban counties with high levels of Hispanic segregation were in the West and South. The Southeast in particular has been characterized by significant population gains of Hispanics in the last decade.[162] These demographic shifts may have implications for healthcare within communities.

Racial/Ethnic Differences and Residential Segregation

The influence of residential segregation, however, was not uniform across racial and ethnic groups. Racial and ethnic differences in access to healthcare increased with higher levels of segregation. Blacks and Hispanics who lived in more highly segregated rural areas had lower unmet healthcare need. This finding aligns with research that observed Hispanics who lived in areas with more Hispanics had less perceived difficulty obtaining healthcare.[129] Additionally, the findings from this aim suggest that for Hispanics in urban areas, higher levels of segregation had a positive association with a usual source of healthcare. This is a surprising finding, given that in aim 2 of this study, no differences in usual source of healthcare were observed for Hispanics.

These findings may also suggest that adults who are non-black or non-Hispanic and who live in more segregated counties may face greater difficulty in accessing healthcare.[129] One study found that whites living in predominantly Hispanic zip codes had 55% lower odds of an office-based physician visit compared to whites residing in predominantly white zip codes.[15] Similarly, whites who lived in areas with a high proportion of Hispanics were more likely to have difficulty obtaining healthcare compared with whites who lived in a county with a low proportion of Hispanics (17.7% vs. 9.4%).[129]

The observed racial/ethnic differences may result from minority physicians being more likely to work in areas with more individuals of similar race or ethnicity,[283] and the possibility that individuals can communicate more effectively with a healthcare provider of a similar

race/ethnicity.[284] Also, while fewer providers may locate in minority communities,[15] a greater proportion of racially/ethnically concordant physicians in counties with a greater proportion of blacks and Hispanics may facilitate better access to healthcare. The availability of physicians who are Hispanic, or perhaps, those that are Spanish speaking [279] may help explain the positive findings for Hispanics with a usual source of healthcare. Also too a greater degree than their urban counterparts, health workers in rural areas may occupy positions of status and respect within their communities,[272] which may encourage better communication and actions to address health needs. These realities may explain the lower rates of unmet healthcare need observed among blacks and Hispanics who live in highly segregated rural areas.

Overall findings from this aim confirmed that racial/ethnic residential segregation was associated with access to healthcare in both rural and urban areas as visually conveyed in Figure 3.5. The influence of residential segregation was not uniform, with some indicators showing a negative association, while others a positive. Most interesting, was that blacks and Hispanics had less perceived need as segregation increased in both rural and urban areas. These findings support a key dimension of the study's conceptual model that suggests the tight interrelatedness of contextual and compositional factors. By acknowledging the processes and interactions that occur between people and their social and physical environments,[193] this study was better able to capture how residential segregation and individual level race/ethnicity might influence access to healthcare. As both deliberate and unintended public policy outcomes and forms of explicit and implicit discrimination arguably problematize trends in residential segregation, broadening the spatial scale of segregation beyond its traditional urban focus may help in determining the fundamental underlying and causes of healthcare disparities across different areas.

Due to small sample sizes, this study was unable to focus on American Indians. Like the spatial segregation of blacks in rural areas, settlement patterns of American Indians have evolved in ways that reflect their unique historical experiences but in different regions of the

United States. More than half of American Indians live in the five states of California, Oklahoma, Arizona, Texas, and New York. A majority of rural American Indians/Alaska Natives remain on reservations,[162] with segregation rates for rural American Indians remaining static over the past few decades.[149] Given the health disparities that affect American Indians and the role that access to healthcare can play in reducing or ameliorating them, this is an important area for future research.

8.2.3.c. Aim 3 Strengths and Limitations. In both rural and urban areas, racial/ethnic residential segregation was a key contextual level characteristic in understanding differences in access to healthcare. While a large body of research has examined racial residential segregation and healthcare outcomes of blacks,[222, 241, 285] far fewer studies have focused on the association of segregation on health service use or the influence of Hispanic segregation.[15, 16, 132] Past studies that use racial/ethnic composition often create a binary variable for this county level characteristic.[121, 129] Acknowledging these limitations, this study used a continuous and standardized measure to capture residential segregation, considered both rural and urban areas, and used five outcome measures to examine differences in access to healthcare.

The use of the isolation index captured the exposure dimension of residential segregation,[278] and estimated the extent to which blacks or Hispanics live in areas in which they are exposed only to other people of their own race or ethnicity. While the isolation index does not compare the distribution of two groups, its main strength is that it accounts for the relative size of the groups, as compared to other segregation measures (i.e. Dissimilarity Index), which does not. The Dissimilarity Index is commonly used as a measure of segregation as the Census makes the index publically available. Accounting for the relative size of racial/ethnic groups, as the isolation index does, may be particularly important in rural areas. For instance, in a national study of rural residential segregation using the Dissimilarity Index, counties with a low percentage and absolute count of blacks or Hispanics were excluded to prevent small racial/ethnic minority groups from skewing their estimates of segregation.[149] An additional

strength of using a formal measure of segregation is that relative to measures of racial/ethnic composition of areas, the isolation index may be better at capturing the social processes and dynamics of racial inequality in education, housing, and labor markets.[130]

This study was strengthened by its ability to capture segregation using the isolation index for both rural and urban counties, as block groups nested within counties. While there is considerable variation in the macro-unit of segregation selected in research, such as the Metropolitan Statistical Area, State, City, and County,[133] counties correspond broadly to the primary political units of local government and have programmatic importance at the federal and state levels. Use of the county may also help to capture rural and poor minority residents who may choose to live immediately outside of the city limits to obtain cheaper housing.[286] Selection of the county however, does not overcome the reality that nationally, counties vary in both population and geographic size.

Block groups, which served as the micro-unit, may have been better proxies for neighborhoods than tracts were, because rural areas have smaller population sizes and dispersed settlement patterns. Utilization of block groups however, may actually underestimate segregation making findings from the analyses lean towards the null. A study of metropolitan areas, using the National Health and Nutrition Examination Survey, reported the average black isolation index among blacks in metropolitan areas was 0.50, while the black isolation index among whites was 0.36.[255] That study calculated the isolation index for tracts nested in metropolitan areas. For this dissertation, in early sensitivity analysis, the isolation index was similarly calculated for tracts nested in counties, the estimate for the black isolation index among all adults was 0.26. Using block groups nested in counties, the estimate was lower at 0.12 (Table 7.2).

These differences should emphasize the limitation of using survey data in multi-level analysis as examined in Section 4.6. While MEPS is a nationally representative survey, with estimates aggregated across multiple counties being sufficiently large, the counties represented

in this study do not represent all counties in the U.S. With no county level weights to adjust for this issue (set to 1 for analysis), the study is better equipped to describe the general associations between segregation with access to healthcare (Level 1), but lacks in its ability to make conclusions about estimates for segregation alone (Level 2).

In the analysis of segregation and access to healthcare, computational concerns arose when running Gllamm for the multi-level modeling particularly for this aim. Plausible explanations for models not converging relate to the number of covariates in the models and that outcomes were binary. Ultimately reducing the number of individual level covariates, to exclude employment status, family size, out of pocket medical expenses, chronic conditions, and limited English proficiency, allowed the models to successfully run. Attempts to investigate segregation as a categorical variable using percentiles was also made, but cutoffs and interpretation appeared to vary for rural vs. urban counties. In order to better understand the relationships within rural and urban areas, stratified rural and urban models with continuous measures of segregation served the best purpose in addressing the hypothesis of this aim.

8.3 Discussion of Overall Study

8.3.1 Additional Findings

In summary, the general patterns described below existed for key contextual factors and compositional factors. The external environment, specifically the proportion poor at the county- and tract-levels, remained a strong negative predictor of access to healthcare. In aim 1, area level poverty was a key dimension detected by all rural-urban measure counties and tracts characterized by greater rurality. In aim 2 and aim 3, higher levels of poverty in an area were negatively associated with all access to healthcare outcomes. Some research suggests that the spatial concentration of rural poverty is the primary explanation for disparities in access to healthcare.[28, 47, 175] While findings from this study identified that concentrated poverty was

significantly associated with all five outcomes of access to healthcare, whether a resident lived in an urban or rural area remained as a significant predictor in the models. This suggests there is something unique about the rurality or urbanicity of areas that influence access to healthcare beyond the proportion living in poverty.[28]

Although the findings were not consistent across all types of access to healthcare, an increase in the proportion of healthcare facilities and supply had a positive, yet small association with access to healthcare. This confirms research that suggests that those living in areas with greater healthcare supply and more primary care providers have greater access to screenings and with more residents having a usual source of healthcare.[46, 49, 147, 177] The proportion of primary care physicians was more strongly correlated with the five outcomes in this study, compared to the proportion of hospital beds in a county, a finding which suggests that all of the outcomes are primary care related. Hospital availability and size has been found to have a direct association with access to healthcare, as living in a county with a greater proportion of hospital beds is positively associated with a usual source of healthcare.[49, 88] Although urban areas may have a large proportion of physicians and a greater amount of healthcare facilities, health services are often not equally distributed in inner city areas and many poor urban populations may lack the resources to access them.[182]

Several individual level compositional factors were consistently associated with access to healthcare. As specified by the Andersen Model, need factors including self-reported health and report of a chronic condition remained important in understanding the five outcomes or proxies used to assess access to healthcare. Adults with chronic conditions were the heaviest users of healthcare, with most of the utilization by people with two or more conditions.[287] While having a chronic condition was positively associated with a usual source of healthcare, having a chronic condition had a negative association with preventive screening outcomes, including dental visits and cervical screenings. As rural adults have significantly poorer health and

multiple chronic conditions, the influence of residing in a rural area may compound issues with accessing healthcare services, specifically preventive care.

8.3.2 Limitations: Overall Study

This study has several limitations. First, the data are cross-sectional, which restricts the study from making conclusions that residing in a particular area causes poor access to healthcare. As cross-sectional studies are carried out at one time point, the sequence of events of events cannot be determined. Use of repeated measures, longitudinal and fixed-effects models based on the nesting of panel data would better determine the ordering of the constructs and establishing causality. In this study, the statistical models are simply tools to capture data and measure associations. Another key problem in area level health research is that individuals do, to some extent, choose where they live. Individual attributes may be related to health and healthcare access and, therefore, could confound the study's findings (endogeneity).[288]

While the Medical Expenditure Panel Survey is representative of the civilian non-institutionalized population in the United States, some important groups of people are excluded from the sample. For instance patients in long-term care facilities, persons on active duty with the Armed Forces, and persons incarcerated in the prison system are not in the sample. These groups may have different access to healthcare, with some groups being more likely to reside in rural areas.[289] Additionally, a majority of respondents lived in the South (approx. 42%) and a much smaller percentage in the Northeast (approx. 11%) and West (approx. 14%). Yet use of MEPS, as a national sample, may better emphasize the historical and regional demographic patterns and where rural populations are concentrated in the U.S.

The independent and dependent measures may be less than ideal in capturing key constructs in this study. In particular, the measures of rurality and urbanicity are government defined, rather than local-actor mapped regions, non-geographical self-definitions, or measures of distance from home, all of which have been used in previous work.[89] While the rural-urban

measures used in this study are policy relevant, quantitative measures of rural and urban areas restrict the ability to capture heterogeneity of rural areas, which are likely more different than the same.

As MEPS is a self-reported household survey, respondents are subject to recall bias as they were asked to remember their own and their families use of healthcare services. For instance, respondents were asked to remember whether they received cholesterol screenings in the past five years. Additionally, respondents may also not have a clear understanding of which blood tests were ordered.[290] The measure of unmet healthcare need also may have produced lower estimates than those obtained from other surveys due the unique skip patterns and screeners MEPS used. Findings may be biased as unmet need and delayed access to healthcare were only asked of respondents who report a "need" for healthcare for themselves or anyone in their family. Self-reported outcomes however, may serve as better indicators of one's access to healthcare, as compared to estimates inferred based on utilization patterns in healthcare claims data. This study did not include other key indicators of access to healthcare such as the amount of time it takes to get to one's provider and the type of transportation used to arrive there. These enabling variables were only asked of respondents with a usual source of healthcare, and as such they miss out on the most vulnerable respondents.

Although the analytic approaches taken in this study are the most appropriate to date, the approach does present some limitations. As explained in earlier sections, particularly related to estimates of county-level segregation, while MEPS is a nationally representative survey, respondents represent approximately 16,259 tracts nested within 1,518 counties in the United States. While all 50 states are represented, the sample does not have representative data for all counties in the United States.

8.3.3 Strengths: Overall Study

Despite the stated limitations, there are several notable conceptual and methodological strengths to this study. The multi-level approach to examining racial/ethnic disparities in access to healthcare in rural vs. urban areas address two important gaps in the existing literature. First, the analytic approach accounts for both individual and contextual determinants of access to care, and second the study works to recognize that the relationships in rural areas may differ from those in urban areas, on which most existing research is based.

The study highlights how geographical inequalities and racial/ethnic residential segregation may be key contextual level determinants of access to healthcare. With a focus on working age adults, improving the health of adults means advantages for all ages, as adults play essential social roles as economic providers and caretakers. Particularly in rural areas, ensuring a healthy and productive workforce is critical to the vitality of local communities and the nation, with global challenges of future food supply, poverty, and climate change.[77] The study directly addresses federal initiatives set by Healthy People 2020, United States Preventive Task Force, and American Cancer Society. The study provides estimates of two important dimensions of access to healthcare, the ability to access healthcare and utilization of preventive screenings, assessed with five self-reported proxies.

This study relied on a theoretical framework that incorporated two models on healthcare disparities. From the Andersen Model came guidance on key predisposing, enabling, and need factors; and from the theory of fundamental causes came guidance on how social conditions continue to reconstitute and perpetuate inequalities in access to healthcare. Additionally, the literature on contextual and compositional factors guided the development of the conceptual model and the interrelatedness of individual and area level characteristics. In addition to establishing a solid foundation for conceptualizing and implementing the research, the integration of these models provided a more complete description than any single model alone in helping to explain how area level characteristics influenced access to healthcare. A strong foundation is key for interpreting the findings and identifying the public health implications of this

research. Most importantly, however, it can inform the design of future studies to test hypotheses about the relationships between these constructs.

From a methodological perspective, merging diverse data sources, including MEPS, the Area Health Resource File, the American Community Survey, and five rural-urban measures significantly strengthens this study. The study is better able to capture both the external and healthcare environment which may predispose individuals to poor health.[291] Also, as MEPS is a large, nationally representative sample of the United States, the scaled MEPS population weights yielded findings that are generalizable to the larger population.

8.3.4 Public Health Implications

A defining characteristics of the field of public health is its concern with avoidable and systematic differences in population health.[192] This study speaks directly to this issue by examining the relationship between residing in a rural vs. urban residential area and access to healthcare. How the findings from this study can inform the development and implementation of public health theory, research, and policy are outlined below.

Theoretical Implications

The application of Andersen's Behavioral Model of Health Services Use and the theory of fundamental causes helpfully structured how place, and the social conditions within these contexts, may be associated with access to healthcare. In this study, the application of these two models revealed conceptual challenges that future studies can work to address.

First the Andersen model, which at its most basic level helps outline the factors that predispose, enable or impede, and foster ones' need for healthcare. A large body of research benefits from the flexibility of the Andersen model, as these three factors help researchers organize complex realities and concepts for various types of research questions. Scholars have built on the flexibility of the Andersen model by creating various versions, such as a model for

vulnerable populations [292] or by adding new determinants to the model, such as psychosocial factors.[293] Missing, however, from much of the research that applies the Andersen model are comprehensive descriptions of key constructs, how the selected variables work to capture these constructs, and ultimately how the Andersen model guided them in the research process. While this lack of conceptualization may have resulted from increasing word restrictions of the peer-reviewed literature, a majority of this research may actually be empirically driven.

In this study, application of the Andersen model confirms the importance of purposeful conceptualization and how pertinent factors are selected for inclusion in a study. For instance, race/ethnicity conceptualized as a predisposing factor, did not have the same implications for access to healthcare in rural compared to urban areas. This is as expected, as race/ethnicity is a socially constructed classification, with its effect varying across different geographical and social contexts. In order to more fully identify equitable access in healthcare services, a primary intention of the Andersen model, researchers must be cautious about assuming there is a "one size fits all" approach and throwing arbitrary variables into a model. Future work should consider deeper examinations and descriptions of constructs and why these constructs are hypothesized to be associated with each other. Additionally, more advanced methods, such as path analyses, would better examine the hypothesized predisposing, enabling, and need characteristics and the feedback loops that connect access to healthcare to other individual and contextual level characteristics. Together, these efforts will help to further refine the Andersen model for future studies and help in pushing the field forward.

The second model used in this study was the theory of fundamental causes. Application of this model helped to conceptualize how places themselves and the social factors within urban and rural areas may create and recreate inequalities in access to healthcare. Specifically, restricting explanations to three main dimensions relevant in distinguishing rural and urban places; the local economy, infrastructure, and social context, helped to provide possible clues to why disparities in healthcare remain. Commonly, the rurality of an area is defined simply by the

supply of healthcare resources. Defining rurality in such a way, however, may be problematic given its close proximity to individual access to healthcare.

Utilization of this model helped to push a new public health conceptualization of rurality as a complex social and geographical construct, that works above and beyond individual level factors. Thus, the application of the theory of fundamental causes may be particularly relevant to further refining how places and characteristics of places may contribute to disparities in access to healthcare.

Research Implications

This study explicitly examined the intersection of place and race/ethnicity. Doing so revealed the complexity of co-occurring phenomena and the realities of social stratification, which indicates the continued gradation of opportunity and position within the United States. Findings from this study revealed implications both for the future of public health research as well as helping to guide my own future research agenda.

Rural populations and racial/ethnic minority groups generally have poor access to healthcare according to unadjusted estimates from this study. For particular outcomes, racial/ethnic disparities may also be greater in rural vs. urban residential areas, and residential segregation negatively influences one's ability to have a usual source of healthcare. Many of these disparities, however, became less apparent after controlling for covariates in multivariate models, potentially highlighting a limitation of this quantitative research. As socio-economic gaps are larger than racial/ethnic differences,[114] it is reasonable to expect that controlling for indicators such as poverty and educational attainment, equalized the wide racial/ethnic income differences that contribute to disparities in healthcare. The inclusion of region as a covariate may have also masked regional concentrations of disadvantage, as could be argued is the case in the rural South. In order to better understand the association between rurality and disparities in access to healthcare, future research would benefit by stratifying by socio-economic status and race/ethnicity.

Next, it is crucial for research to position these social conditions within a geographical context. Specifically, as national health disparities persist, focusing on the implications of the social realities of rural areas will reveal new and compelling ways to connect place to health. In the United States, rural areas are distinctive as they share a complex relationship with populations and the surrounding physical environment, including land use, population density, and labor practices. While all areas are influenced by these factors, in rural areas these factors may be intensified due to historical reasons. As such, future research should consider the historical specificities of local areas, such as agricultural policy, immigration patterns, sharecropping, and Native American treaty policy, which may better demonstrate how rural areas shape current day social inequalities.

Furthermore, to clarify the mechanisms by which rural areas influence health, public health should recognize that quantitative research only goes so far. By researching and listening to local residents, qualitative research may better discern the complex historical specificities that shape rural inequalities. More specifically, grounded theory, open interviews, and observations may better orient and acknowledge the complex processes that have occurred over time in different rural areas across the United States.

Additionally, as a large proportion of residents in rural areas are white, public health research continues to know little about other rural population groups, particularly racial/ethnic minorities. Research should consider incorporating respondents of American Indian/Alaska Native and Asian background, as the residential and settlement patterns of these groups evolved along different historical and demographic lines than those of blacks and Hispanics. Whether these residential patterns have implications for access to healthcare are unknown. Continued research in this area would also benefit from implementing a decomposition analysis in order to better examine racial and ethnic disparities in access to healthcare measures.

The outcomes used in the study examined access to the primary healthcare system. In order to gain a more comprehensive understanding of healthcare disparities, for my own

research I would like to focus on inequities related to processes that occur within the healthcare system. Processes of care may be major contributors to racial/ethnic minority groups and rural populations continuing to have later stage diagnosis of cervical cancer and cardiovascular disease when compared to Non-Hispanic whites and urban populations respectively.[294-296] Disparities in follow-up compliance, referrals to specialists, and quality of care, may be strong contributors to disparities. Delayed diagnoses may have implications for successful treatment and longevity. For instance, the median number of days to diagnostic follow-up after an abnormal mammogram has been found to be greater for blacks and Hispanics when compared to non-Hispanic whites.[297] As such, I would like to conduct research that examines timely follow-up to positive screenings to diagnosis as a result of perceptions of risk and fear, lack of information about symptoms, logistical barriers to access of diagnostic services, or dissatisfaction with the communication of results.[298] Examination of these process indicators will provide a more comprehensive understanding of why morbidity and mortality rates remain higher for both rural populations and racial/ethnic minority groups.

As a majority of area level research has been conducted in urban neighborhoods, little information clarifies how neighborhoods or contextual level characteristics operate in rural areas.[89] Due to this reality, public health research should continue to think innovatively about data sources that incorporate both individual and contextual level indicators used to answer research questions. This can be achieved through better surveillance, improved sampling and routine reporting of both rural populations and racial and ethnic minority populations. Consideration of other area level characteristics, such as other dimensions of segregation, may uncover new and different trends in racial/ethnic health disparities.

Policy Implications

Timely access to healthcare corresponds to greater satisfaction, reduced costs, less emergency department use, and decreased mortality and disability, all of which are salient indicators for health insurers and policymakers.[20, 30] In order to successfully remedy health

disparities, policy makers must not only address inadequacies in healthcare, but target the social conditions that predispose vulnerable populations (racial/ethnic minorities and rural residents) to have poor health.

Research can play a viable role in highlighting how healthcare supply is only one characteristic of rural areas that determines access to resources for residents. While policies that work to increase uptake of Health Information Technologies and reconfiguration of Medicare reimbursement may remedy some disparities in the short term,[41, 82, 179, 291] an overemphasis on "fixing" the healthcare system fails to address pertinent structural inequities, such as residential segregation and concentrated poverty, that predispose individuals to poor health in the first place. Progressive social policies that address educational and labor practices will be the solution to not only to addressing differences in healthcare, but disparities in health outcomes. As many parts of rural America witness new and unique demographic shifts and an influx of racial/ethnic minority groups, local policies should be aware of housing availability and settlement patterns and the implications this has on access to healthcare services. As such, immediate research is needed to show policy makers that healthcare supply policies will only be part of the solution to eliminating inequalities in health.

Inequalities in health are multi-level, with immediate, short-term initiatives still being necessary. Specifically, a relevant policy goal for public health is to continue increasing baseline screening adherence. As disparities in access to healthcare for minority groups varied across rural and urban areas, public health practice may face differing challenges across the many regions and areas of the United States. Tailored policies in rural areas can ensure healthcare systems and health professionals' meet attainable goals for national awareness initiatives to increase adherence of preventive screenings. To address poor clinical experiences, differing expectations of the healthcare system, and baseline knowledge of screenings, trusted local community leaders and public health education must reach out to community members with culturally and regionally appropriate messages. Retail clinics may also offer a unique

opportunity for screening within isolated rural areas. While some physician societies have their concern about the growth of retail clinics, policymakers cite their potential to improve access to healthcare.[299, 300] Immediate efforts can also be dedicated to helping individuals, particularly blacks and Hispanics, to identify a usual source of healthcare, as this has been associated with preventive screenings.[21]

Finally, public health funding mechanisms can help communities develop and express their collective voice to make their health concerns known. Particularly in rural areas where national level initiatives may do little to address local community needs, community-based organizations and coalitions serve an important role in mobilizing and fighting for local issues. Resources should be allocated to addressing both racial/ethnic disparities and geographic disparities. To remedy and ensure disparities in healthcare do not remain, a comprehensive multilevel approach that encompasses individuals, communities, institutions, and larger ideologies would reflect the recommendations of the WHO's Commission on the Social Determinants of Health.[220, 301]

8.4 Conclusion

The overall goal of this study was to identify and explain systematic differences in access to healthcare by race/ethnicity and across rural and urban areas in the United States. The study highlights how racial and ethnic disparities in access to healthcare varied across different residential areas, with residential segregation providing one explanation for the continued disparities in access. The study adds to the evidence by highlighting that characteristics of rural and urban areas are key dimensions of inequality.

Seeking to improve the health of all Americans, federal and state policymakers should advocate for policies that diminish the social characteristics that underlie poor health in both rural and urban areas. A better understanding of area level determinants may help point to

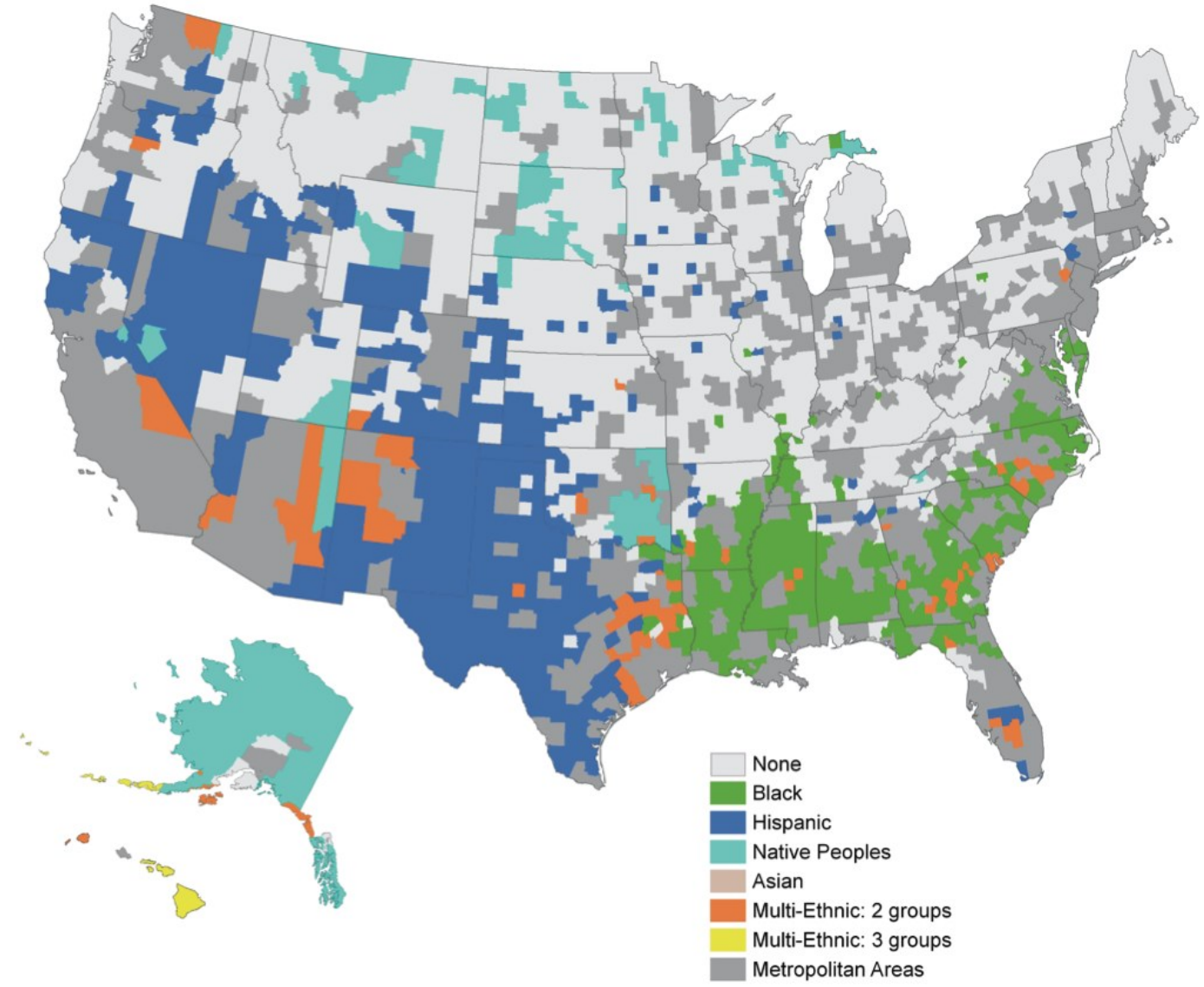
effective policies and strategies for reducing disparities in accessing healthcare. Researchers must continue to examine and expose contextual and area level characteristics so that policymakers can address the health of the most vulnerable groups in the United States.

APPENDIX (TABLES & FIGURES)

Table 2.1: Common Rural-Urban Measures Used in Public Health Research

Classification System	Developer	# of Categories	Geographic Unit
Metropolitan, Micropolitan Statistical Area	U.S. Office of Management and Budget	3	County
Urbanized Areas, Urban Clusters, and Rural Areas	U.S. Bureau of the Census	3	Census Block Group
Rural-Urban Continuum Codes	U.S. Department of Agriculture-Economic Research Service	9	County
Urban Influence Codes	U.S. Department of Agriculture-Economic Research Service	12	County
Rural Urban Commuting Area Codes	U.S. Department of Agriculture-Economic Research Service	10	Census tract or ZIP Code
Economic Typology Code	U.S. Department of Agriculture-Economic Research Service	6	County
Urban Rural Classification Scheme	National Center for Health Statistics	6	County

Figure 2.1. Nonmetropolitan Minority Population Distribution, 2010



Source: U.S. Census Bureau, Census 2010

Figure 3.1. Andersen's Behavioral Model of Health Services Use

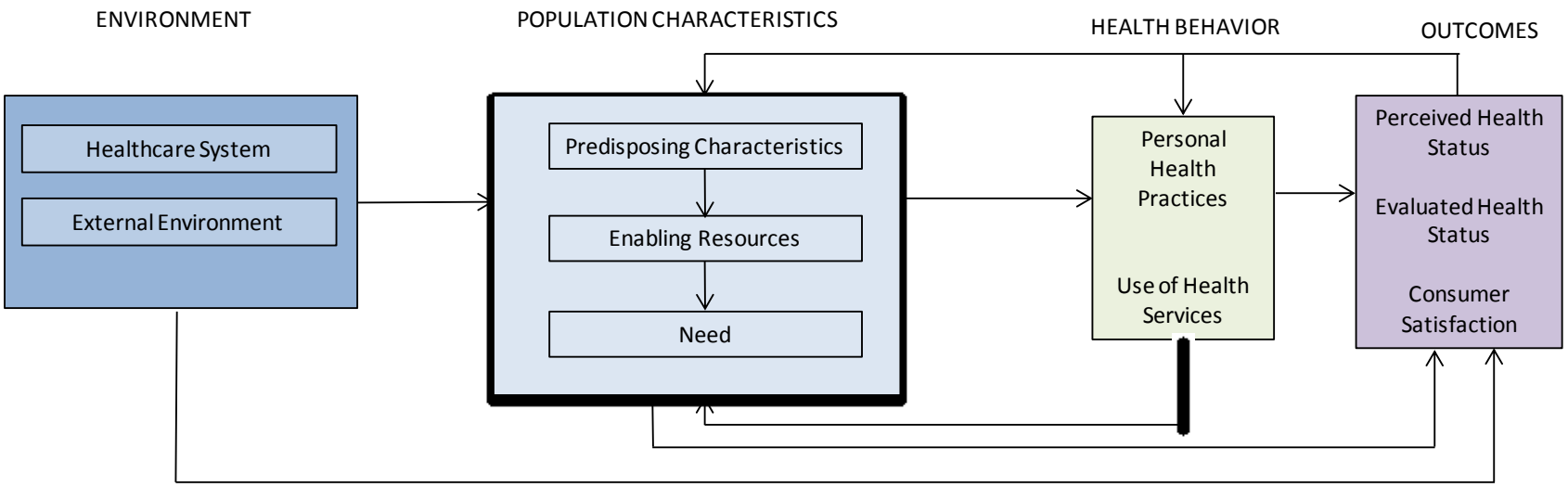


Figure 3.2. Conceptual Model

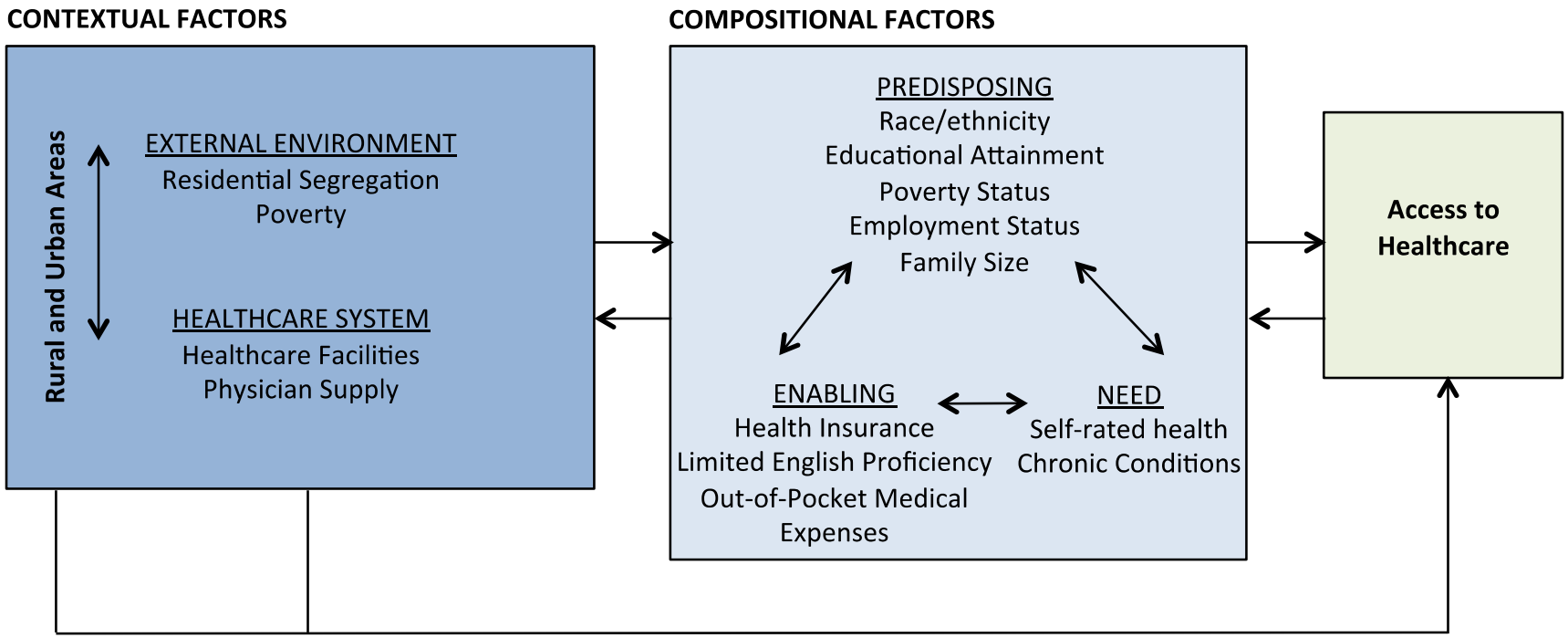


Figure 3.3. Aim 1 Conceptual Model

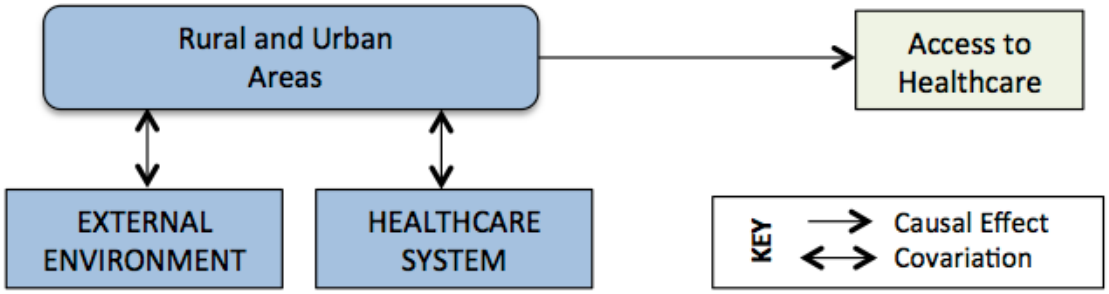


Figure 3.4. Aim 2 Conceptual Model

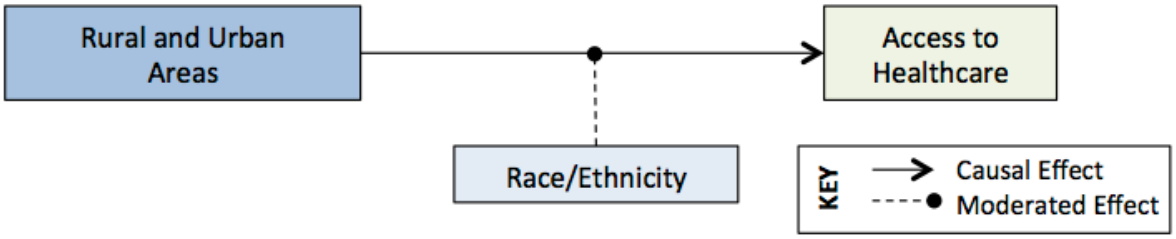


Figure 3.5. Aim 3 Conceptual Model

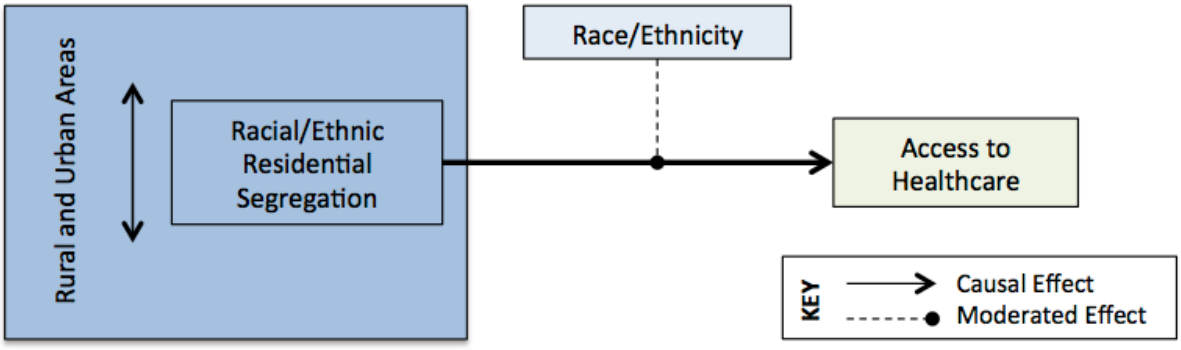


Table 4.1. National Health Interview Survey (NHIS) and Medical Expenditure Panel Survey (MEPS) Sampling Frame and Response Rates for 2005-2010

Year	Households completing NHIS	Sampling Frame from NHIS	# of MEPS Households (Response Rate)	# of MEPS Persons	MEPS Sample[1] (Age 18-64)
2005	42,089	20,897	12,810 (61.3)	33,959	18,929
2006	44,540	21,974	12,811 (58.3)	34,146	19,033
2007	33,468	20,413	11,615 (56.9)	30,964	17,327
2008	33,615	20,769	12,316 (59.3)	33,066	18,730
2009	33,911	24,257	13,875 (57.2)	36,855	20,933
2010	41,177	23,262	12,445 (53.5)	32,847	18,802
Total	**228,800**	**131,380**	**75,872 (57.8)**	**201,837**	**113,814**

[1] Final analytic samples are more restricted, based on study aim and dependent variable

Table 4.2. National Recommendations and Guidelines for Preventive Services

Preventive Services	USPSTF guidelines	Healthy People 2020 goals	ACS guidelines	Universe for this Study
Usual Source of Healthcare	N/A	AH3 – S Increase the proportion of persons with a usual primary care provider.	N/A	All adults age 18-64
Unmet Healthcare Need	N/A	AHS-6 Reduce the proportion of persons who are unable to obtain or delay in obtaining necessary medical care, dental care, or prescription medicines	N/A	All adults age 18-64 reporting in the last 12 months
Cervical Cancer Screening	Ages 21 to 65 years with cytology (Pap smear) every 3 years or, for women ages 30 to 65 years who want to lengthen the screening interval, screening with a combination of cytology and human papillomavirus (HPV) testing every 5 years.	Increase the proportion of women who receive a cervical cancer screening based on the most recent guidelines (21-65 years of age)	Cervical cancer screening (testing) should begin at age 21. Women under age 21 should *not* be tested.	Women age 21-64 reporting in the past year
Blood Cholesterol Screening	Men: All men ages > 35, men ages 20-25 if they are at increased risk for coronary heart disease Women: All women > 45, women ages 20-45 if they are at increased risk for coronary heart disease.	Increase the proportion of adults who have had their blood cholesterol checked within the preceding 5 years (18+).	N/A	Adults age 35-64 reporting in past 5 years
Oral Health		Increase the proportion of adults who used the oral health care system in the past year		All adults age 18-64 reporting a visit in the past 12 months

USPSTF (U.S. Preventive Services Task Force), ACS (American Cancer Society)

Table 4.3. Five Rural-Urban Measures, Population Thresholds, and Categories

Metropolitan Statistical Area	
Metropolitan 50,000 population with high degree of social and economic integration with urban core	1
Micropolitan 10,000 – 49,999 & Non-Metropolitan (< 10,000)	2
Urban Rural Continuum Code	
MSA > 1 million	1
MSA of 250,000 – 1million	2
MSA of 50,000-250,000	3
Urban pop of > 20,000, adjacent to MSA	4
Urban pop of > 20,000, not adjacent to MSA	5
Urban pop of 2,500-19,000, adjacent to MSA	6
Urban pop of 2,500-19,000, not adjacent to MSA	7
<2,500 urban pop, adjacent to MSA	8
<2,500 urban pop, not adjacent to MSA	9
Urban Rural Classification Scheme	
Large central metro (MSA of 1 million or more population that: 1) contain the entire population of the largest principal city of the MSA, or 2) are completely contained within the largest principal city of the MSA, or 3) contain at least 250,000 residents of any principal city in the MSA	1
Large fringe metro (MSA of 1 million or more population that do not qualify as large central)	2
Medium Metro (MSA of 250,000-999,999)	3
Small Metro (MSA of 50,000- 249,999)	4
Micropolitan (Micropolitan statistical area)	5
Noncore (Not in Micropolitan Statistical Area)	6
Economic Typology Code	
Farming Dependent: Either 15% or more of average annual labor and proprietors' earnings derived from farming during 1998-2000 or 15% or more of employed residents worked in farm occupations in 2000.	1
Mining Dependent: Either 15% or more of average annual labor and proprietors' earnings derived from farming during 1998-2000 or 15% or more of employed residents worked in farm occupations in 2000.	2
Manufacturing Dependent: 25% or more of average annual labor and proprietors' earnings derived from manufacturing during 1998-2000.	3
Federal/State Government Dependent: 15% or more of average annual labor and proprietors' earnings derived from Federal and State government during 1998-2000.	4
Services Dependent: 45% or more of average annual labor and proprietors' earnings derived from services (SIC categories of retail trade; finance, insurance and real estate; and, services) during 1998-2000.	5
Nonspecialized dependent: County did not meet the dependence threshold for any one of the above industries.	6
Rural Urban Commuting Area Code	
Urban: Populations of 50,000 persons+	1.0, 1.1
Semi-Urban: all cities/large towns with populations of 10,000 to 49,999 and high commuting levels	2.0, 2.1, 3.0, 4.0, 4.1, 4.2, 5.0, 5.1, 5.2, 6.0, 6.1, 7.1, 8.1, and 10.1
Rural: Small towns with populations below 10,000, lower commuting levels, or in isolated rural areas with more than an hour drive to the nearest city	7.0, 7.2, 7.3, 7.4, 8.0, 8.2, 8.3, 8.4, 9.0, 9.1, 9.2, 10.0, 10.2, 10.3, 10.4, 10.5, and 10.6

Table 4.4. Weighted Dependent Variables by Year, Medical Expenditure Panel Survey, 2005-2010

Year	Usual Source of Care	Unmet Need	Cholesterol Screening	Cervical Screening	Dental Visit
	% Yes	% Yes	% Yes	% Yes	% Yes
2005	74.09	13.61	83.74	87.27	62.92
2006	74.25	14.06	85.66	86.56	62.35
2007	72.75	12.12	85.27	85.97	63.18
2008	72.08	12.72	85.96	85.40	61.23
2009	72.06	13.80	86.04	85.27	61.25
2010	73.62	13.04	88.14	85.60	63.01

Figure 4.1. National Health Interview Survey (NHIS) and Medical Expenditure Panel Survey (MEPS) Sample

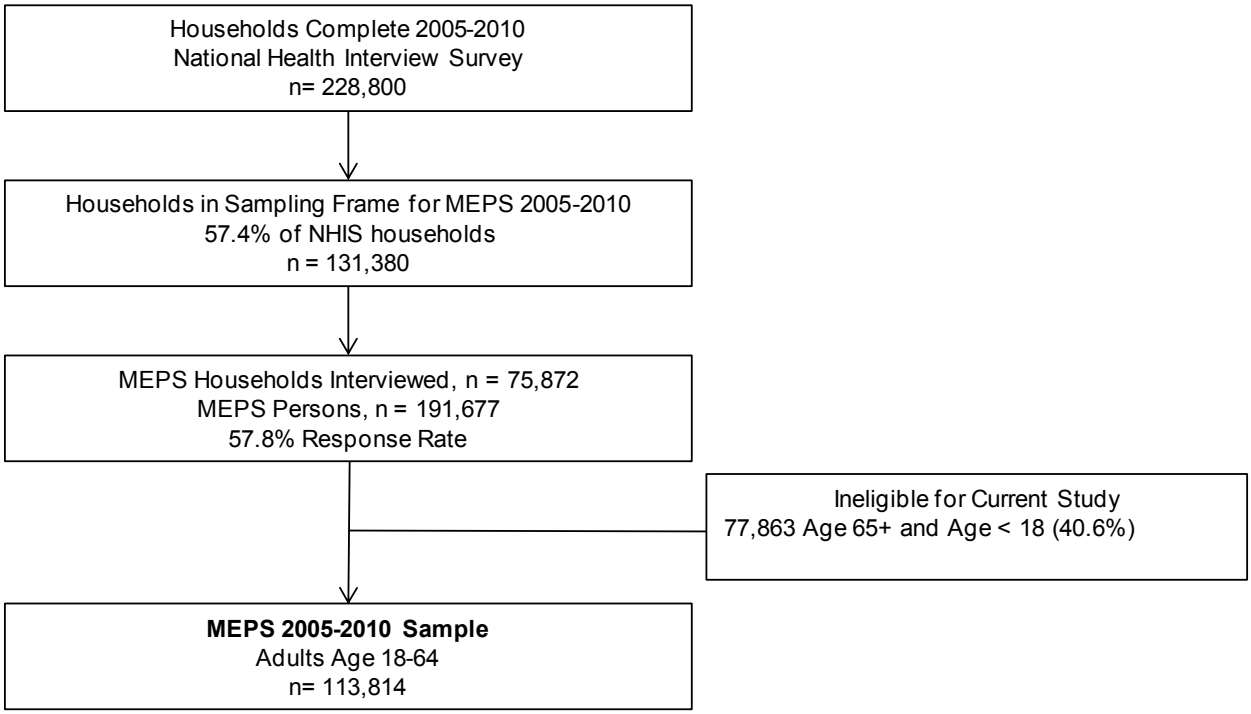


Figure 4.2. Aim 1 Analytic Samples

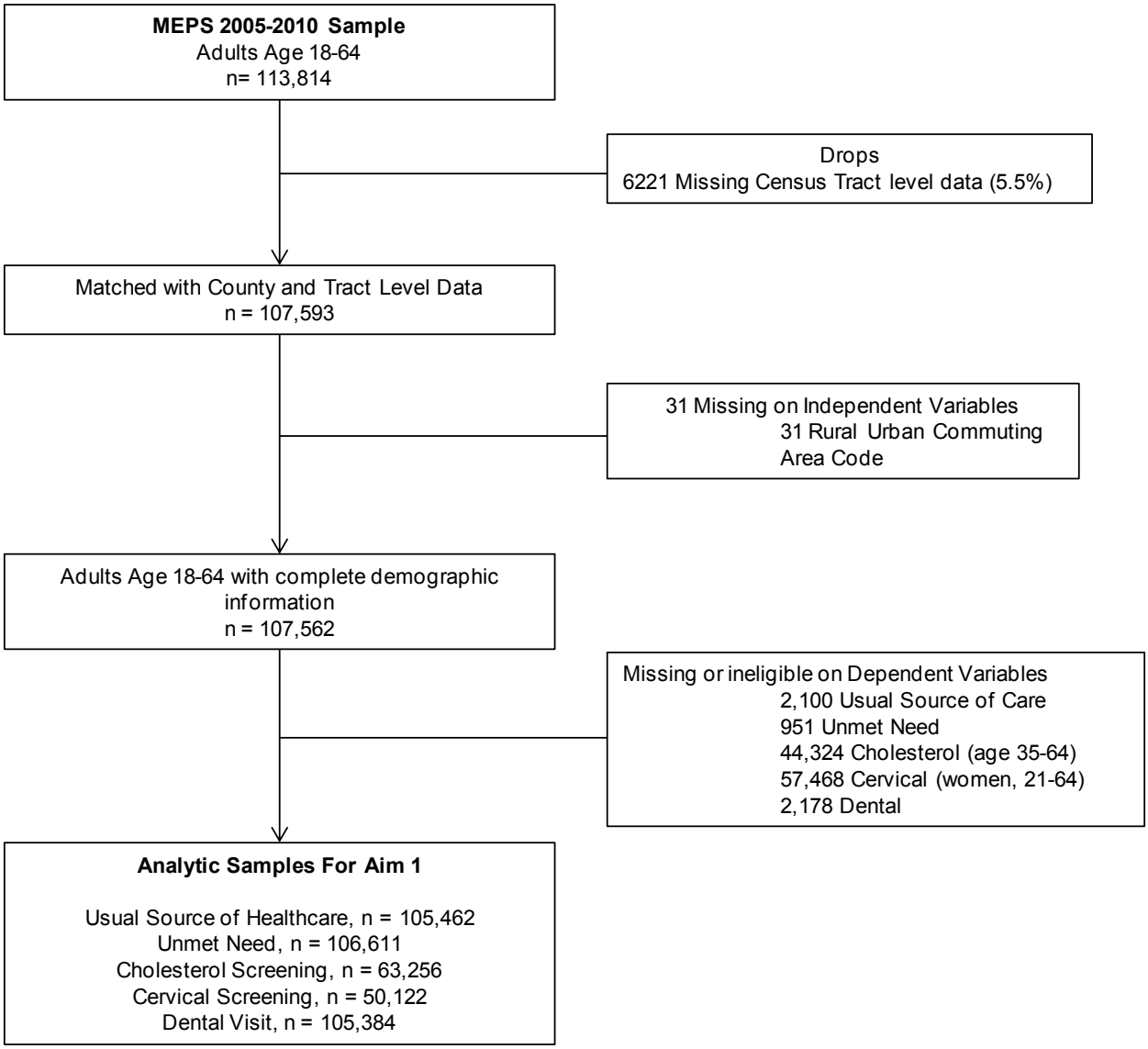


Table 4.5. Aim 1 Sensitivity Analyses: Weighted Analytic Samples compared to Excluded Samples

	Largest Analytic Sample (Unmet Need, Adults 18-64)	Excluded Sample[2]	*p*	Smallest Analytic Sample (Cervical, Women 21-64)	Excluded Sample[3]	*p*
n	106,611	7,203		50,122	6,132	
Age	40.46 (.10)	39.87 (.29)		42.16 (.11)	41.97 (.29)	
Rural-Urban Commuting Area Code						
Urban	69.09	85.08	***	61.01	82.29	***
Semi-Urban	22.30	12.82		22.30	14.35	
Rural	8.60	2.10		8.69	3.36	
Metropolitan Statistical Area						
MSA	83.71	97.22	***	83.58	94.06	***
Non-MSA	16.34	2.78		16.42	5.94	
Continuum						
1 (most urban)	53.99	67.86	***	53.68	67.28	***
2	19.59	22.82		19.79	20.56	
3	9.93	5.54		9.89	5.76	
4	6.04	1.13		6.07	2.30	
5	1.87	0.70		1.85	0.82	
6	4.90	1.12		4.95	2.01	
7	2.46	0.53		2.51	0.78	
8	0.47	0.14		0.50	0.12	
9 (most rural)	0.76	0.16		0.77	0.31	
Typology						
1 (Farming)	1.38	0.58	***	1.34	0.80	***
2 (Mining)	0.73	0.74		0.71	0.47	
3 (Manufacturing)	21.49	13.07		21.63	15.10	
4 (Federal/State Government)	11.50	8.45		11.67	8.90	
5 (Services)	42.31	52.21		42.27	52.48	
6 (nonspecialized)	22.59	24.95		22.41	22.28	
NCHS						
1 (most urban)	29.46	43.95	***	28.82	42.33	***
2	24.89	24.46		25.20	25.42	
3	19.83	22.79		20.01	20.53	
4	9.34	0.53		9.36	5.56	
5	11.18	2.07		11.19	4.10	
6 (most rural)	5.31	1.32		5.43	2.08	

* $p < 0.05$, ** $p<.01$, *** $p <.001$

(2) Individual, tract, and/or county-level data missing among adults age 18-64

(3) Individual, tract, and/or county-level data missing among women age 21-64

Figure 4.3. Aim 2 Analytic Samples

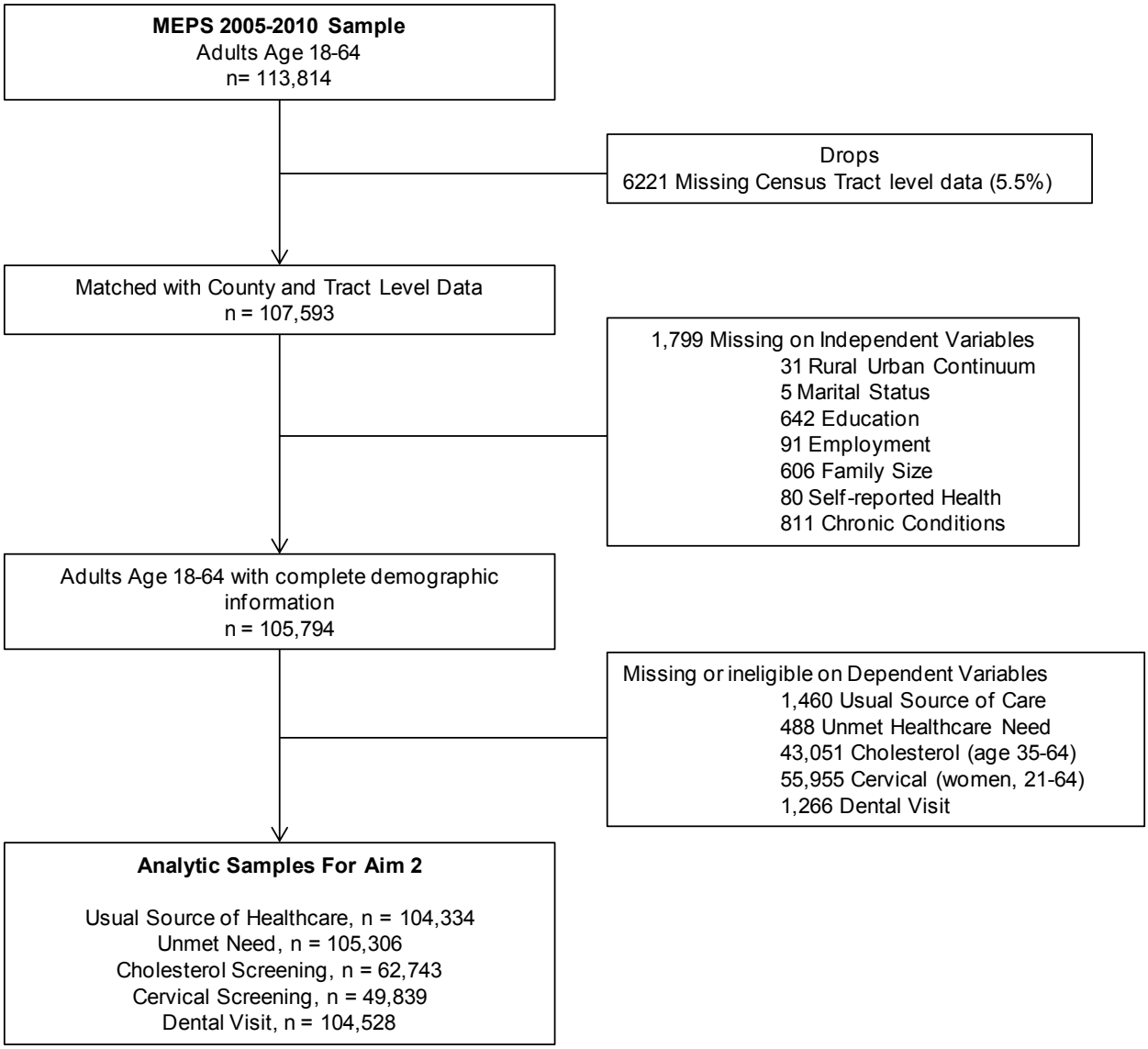


Table 4.6. Aim 2 Sensitivity Analyses: Weighted Analytic Samples compared to Excluded Samples

	Largest Analytic Sample (Unmet need)	Excluded Sample[2]	*p*	Smallest Analytic Sample (Cervical Screen)	Excluded Sample[3]	*p*
n	105,306	8,508		49,839	6,405	
Unmet Need						
Yes	13.22	11.75	*	--	--	
No	86.78	88.25		--	--	
Cervical Screening						
Yes	--	--		86.01	85.02	
No	--	--		13.99	13.02	
Gender			***			
Male	49.36	51.94		NA	NA	
Female	50.64	48.06		NA	NA	
Mean Age	40.44	40.19		42.15	42.06	
Race/Ethnicity			***			***
White, NH	66.61	59.43		67.19	59.03	
Black, NH	11.97	12.79		12.55	14.38	
Hispanic	14.68	18.18		13.56	15.76	
Other, NH	6.75	9.60		6.71	10.83	
Marital Status						***
Married	54.18	52.64		58.56	55.72	
Divorced/Widowed	15.53	16.13		19.46	18.84	
Single	30.29	31.21		21.98	25.44	
Educational Attainment			**			*
Less than High School	9.91	10.06		9.49	11.11	
High School/GED	40.57	35.57		43.22	39.03	
Bachelors	34.19	37.13		38.60	39.33	
Under 25/Inapplicable	15.32	17.23		8.69	10.53	
Income relative to the federal poverty line						
Less than 125%	15.41	15.96		16.91	15.70	*
125%–200%	12.19	11.87		12.38	11.01	
200%–400%	30.90	30.47		30.34	29.89	
More than 400%	41.51	41.71		40.37	43.39	
Employed			*			
Yes	78.89	77.13		74.82	75.02	
No	21.11	22.87		25.18	24.98	
Insurance			*			
Private	63.60	60.40		65.61	63.02	***
Public	6.88	7.01		8.20	7.09	
Insured any time last year	29.53	32.57		26.18	29.89	
Self-reported health						
Excellent	61.73	60.54		59.39	58.46	
Good	27.13	27.74		28.01	29.77	
Fair/Poor	11.14	11.72		12.62	11.77	
# of chronic conditions	.46 (0.006)	.42 (.02)	**	.48 (0.006)	.42 (.01)	***
# of household Members	2.9 (.02)	3.06 (.04)	***	2.87 (.02)	3.16 (0.03)	***
Medical expense	621.33 (7.53)	608.72(52.7)		787.61 (12.46)	602.30(38.88)	***
LEP						
English Only	87.13	82.96	***	88.28	83.22	***
English Proficient	5.05	6.54		4.67	8.13	
LEP	7.82	10.49		7.05	8.64	

* p < 0.05, ** p<.01, *** p <.001

(2) Individual, tract, and/or county-level data missing among adults age 18-64

(3) Individual, tract, and/or county-level data missing among women age 21-64

Figure 4.4. Analytic Samples for Aim 3

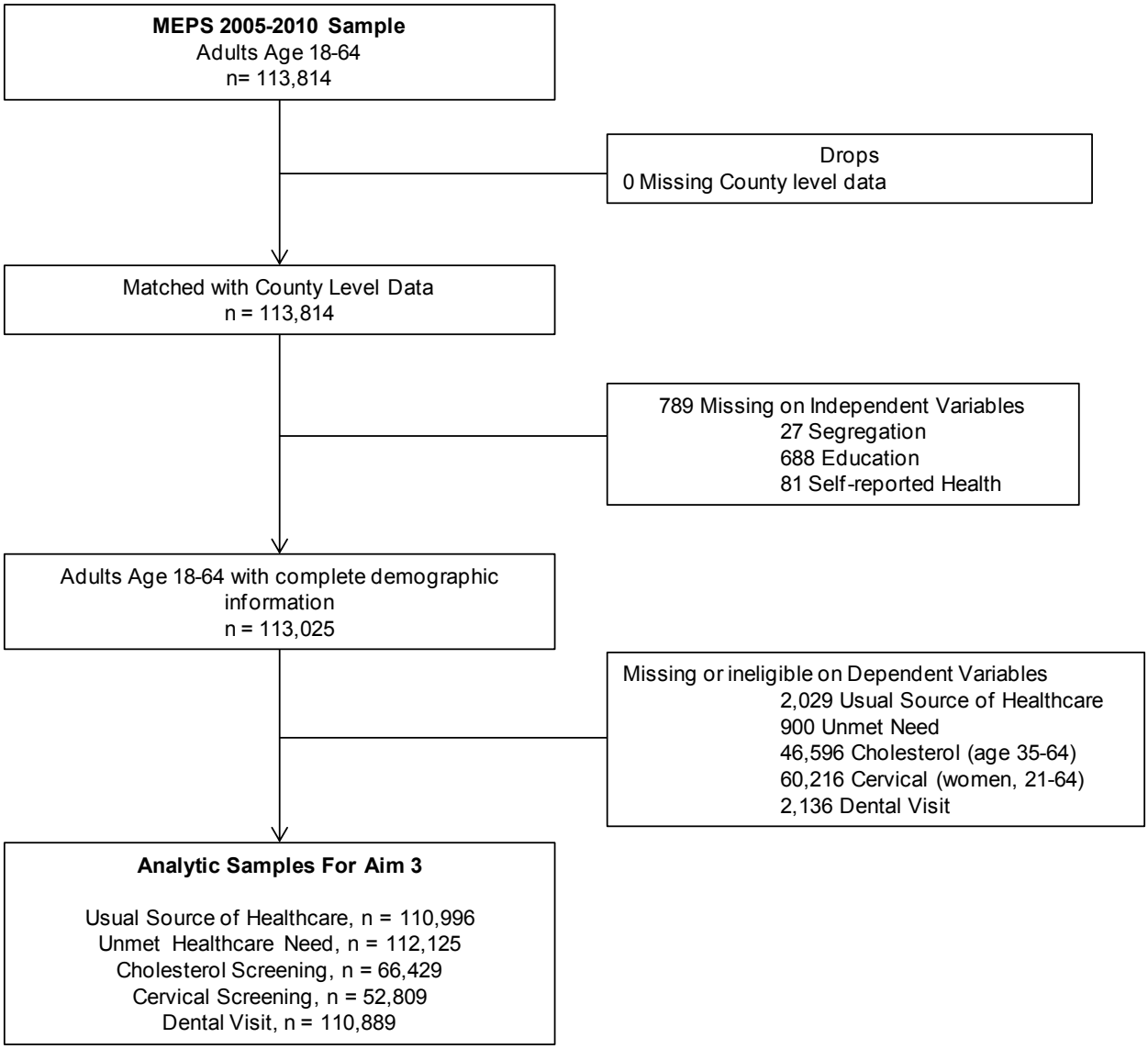


Table 4.7. Aim 3 Sensitivity Analyses: Weighted Analytic Samples compared to Excluded Samples

	Largest Analytic Sample (Unmet Need)	Excluded Sample[2]	*p*	Smallest Analytic Sample (Cervical Screening)	Excluded Sample[3]	*p*
n	112,125	1,689		52,809	3,783	
Unmet Healthcare Need						
Yes	13.14	11.14				
No	86.86	88.86				
Cervical Screening						
Yes				86.08	81.44	
No				13.92	18.56	
Gender			***			
Male	49.4	60.34				
Female	50.6	39.66				
Age	40.4 (0.1)	41.5 (0.5)	*	42.11 (0.1)	40.46 (0.4)	***
Race/Ethnicity			***			***
White, NH	66.27	53.26		66.91	56.1	
Black, NH	11.95	17.84		12.52	16.61	
Hispanic	14.87	19.11		13.71	15.26	
Other	6.91	9.79		6.85	12.02	
Educational Attainment			***			***
Less than High School	9.87	14.81		9.47	11.97	
High School/GED	40.25	39.22		42.81	38.22	
Bachelors +	34.51	21.06		39.03	28.72	
Under 25	15.36	24.91		8.69	21.1	
Income relative to the federal poverty line			***			
Less than 125%	15.26	28.6		16.72	17.77	
125%–200%	12.1	16.69		12.27	11.97	
200%–400%	30.92	27.17		30.31	30.74	
More than 400%	41.71	27.55		40.7	39.52	
Insurance			***			***
Insured Private	63.67	41.75		65.81	56.49	
Insured Public	6.77	15.16		8.06	8.59	
Uninsured any time last year	29.56	43.1		26.13	34.93	
Self-reported health			***			**
Excellent	61.84	47.27		59.62	55.1	
Good	27.1	32.77		27.96	31.61	
Fair/Poor	11.06	19.96		12.43	13.29	
Region						***
NE	18.31	16.72		18.18	22.14	
MW	21.94	19.1		22.09	18.84	
South	36.42	37.01		36.77	35.16	
West	23.33	27.17		22.96	23.86	

* p < 0.05, ** p<.01, *** p <.001

(2) Individual data missing among adults age 18-64

(3) Individual data missing among women age 21-64

Table 4.8. Aim 2: Multi-Level Models with No Variables

	Usual Source of Healthcare		Unmet Healthcare Need		Cholesterol Screening		Dental Visit		Cervical Screening	
	Est	SE	Est	SE	Est	SE	Est	SE	Est	SE
Level 1 Units	104334		105306		62743		104528		49839	
Level 2 Units	16248		16259		10366		16268		12266	
Avg Obs per group	6.4		6.5		6.1		6.4		4.1	
Level 3 Units	1517		1518		1217		1520		1332	
Avg Obs per group	68.8		69.4		51.4		68.8		37.4	
Constant	1.13	0.03***	-2.31	0.04***	2.15	0.04***	0.42	0.03***	2.35	0.04***
Variance (Level 2)	2.39	0.07	1.95	0.09	1.54	0.08	2.48	0.09	1.79	0.09
Variance (Level 3)	0.50	0.05	0.28	0.04	0.37	0.04	0.32	0.04	0.18	0.04
Log-Likelihood	-61808.8		-41495.1		-26727.0		-69078.7		-20184.8	

Scaled, Weighted Data.

* p < 0.05, ** p<.01, *** p <.001

Table 4.9. Aim 3: Multi-Level Models with No Variables

	Usual Source of Healthcare		Unmet Healthcare Need		Cholesterol Screening		Dental Visit		Cervical Screening	
	Est	SE	Est	SE	Est	SE	Est	SE	Est	SE
Level 1 Units	110996		112125		66426		110889		52809	
Level 2 Units	1526		1527		1221		1528		1335	
Avg Obs per group	72.7		73.4		54.4		72.6		39.6	
Constant	1.02	0.03***	-1.93	0.03***	1.82	0.03***	0.35	0.03***	1.85	0.03***
Variance (Level 2)	0.73	0.06	0.45	0.04	0.48	0.04	0.60	0.05	0.36	0.04
Log-Likelihood	-71034.6		-46514.6		-29569.9		-79496.7		-22483.3	

Scaled, Weighted Data.

* p < 0.05, ** p<.01, *** p <.001

Table 5.1. Distribution of Rural-urban Measures, Medical Expenditure Panel Survey 2005-2010
Adults Age 18-64

Rural-urban Measure	n	%
	106,611	
Rural-Urban Commuting Area		
1 Urban	76,355	69.09
2 Semi-Urban	21,227	22.30
3 Rural	9,029	8.61
Metropolitan Statistical Area		
1 MSA	90,008	83.70
2 Non-MSA	16,603	16.30
Rural Urban Continuum Code		
1 Most Urban	59,989	53.99
2	20,114	19.59
3	9,713	9.93
4	5,418	6.04
5	2,527	1.87
6	5,239	4.90
7	2,232	2.46
8	562	0.47
9 Most Rural	817	0.76
Economic Typology Code		
1 Farming	1,856	1.38
2 Mining	1,033	0.73
3 Manufacturing	20,649	21.49
4 Federal/State Government	12,037	11.50
5 Services	46,433	42.31
6 Nonspecialized	24,603	22.59
Urban Rural Classification Scheme		
1 Most Urban	36,765	29.46
2	23,568	24.89
3	20,293	19.83
4	9,188	9.34
5	11,017	11.18
6 Most Rural	5,780	5.31

Weighted. Unmet Healthcare Need Sample.

Table 5.2. Comparison of Commonly Applied Rural-urban Measures, Adapted from Hart, Larson, and Lishner, 2005.[74]

	Geographical Unit	Characteristics	Strengths	Weaknesses
Rural-Urban Commuting Area Code (USDA, Economic Research Service)	Census tract	Multi-tiered taxonomy developed by University of Washington and the Economic Research Service, with funding from the Federal Office of Rural Health Policy and Economic Research Service. Uses census commuting data to classify census tracts on the basis of geography and work commuting flows between places.	Use of work commuting data differentiates rural areas according to their economic integration with urban areas and other rural areas. Sensitive to demographic change. The structure of the codes allows for many levels of generalization- from 2 groups (rural and urban) to 33.	Difficult to apply to health data that are often collected at the county or zip code area levels. Code is not as stable over time, when compared to other rural-urban measures. Complex structure of codes not easy to master for causal users. Recently updated in 2010.
Metropolitan/Non metro (Office of Management of Budget)	County	This OMB definition is used extensively in federal policy. Counties are assigned as metropolitan or nonmetropolitan. Nonmetropolitan counties are now designed as micropolitan or noncore based on the presence of an urban cluster (Areas with a population less than 50000 but greater than 2500) with a population of 10000 or more.	Useful for general definition of rural status. The methodology and county assignments were significantly changed in 2003. Underlying geographic unit (county) is very stable over time.	Substantial underbounding of rurality in many large metropolitan counties. The large size of counties often obscures intracounty differences.
Urban Rural Continuum Code (USDA, Economic Research Service)	County	Distinguishes metropolitan counties by the population size of their metro area, and nonmetropolitan counties by	Allows researchers to break county data into finer residential groups for the analysis of trends in nonmetro areas	Not as comparable to previous studies of healthcare access which use county as the unit of analysis. More difficult for policy

		degrees of urbanization and adjacency to a metro area.	that are related to population density and metro influence.	makers to target. Recently updated in 2013.
County Typology Codes (USDA, Economic Research Service)	County	Classifies all U.S. counties according to six non-overlapping categories of economic dependence including farming, mining, manufacturing, services, Federal/State government, and unspecialized counties.	The threshold for the economic type are set using nonmetro counties only. Counties that are classified as dependent upon any of those industries are termed nonspecialized. Metro counties coded for comparison.	The codes are primarily meant to be useful in the analysis of rural conditions, trends, and program needs. Provides policy-relevant information about diverse county conditions to policymakers, public officials, and researchers. Most recent code is from 2004.
Urban Rural Classification Scheme for Counties (National Center for Health Statistics)	County	Classifies six-levels based on OMB's 2000 for defining metropolitan statistical areas. The codes were chosen for their utility in studying health differences across the rural-urban continuum.	Differentiates between large central metro inner cities and suburbs.	Less familiar to policy-makers and researchers. Researchers have identified significant health differences between large central metro and fringe counties. Recently updated in 2013.

Table 5.3. Correlation Matrix of Rural-urban Measures by Socio-Economic and Healthcare Supply Characteristics, Adults Age 18-64

Variables	1	2	3	4	5	6	7	8	9	10	11
1. Rural Urban Commuting Area Code	-										
2. Urban Rural Classification Scheme	.61	-									
3. Rural Urban Continuum Code	.61	.91	-								
4. Economic Typology Code	-.26	-.30	-.31	-							
5. Metropolitan Statistical Area	.70	.64	.69	-.29	-						
6. Percent Poor	.17	.10	.28	-.03	.27	-					
7. Percent ≤ High School	.16	-.03	.11	.02	.23	.70	-				
8. Percent Black, Non-Hispanic	-.29	-.37	-.35	.08	-.22	.24	.16	-			
9. Percent Hispanic	-.34	.46	-.38	.27	-.28	.15	.45	.03	-		
10. Primary Care Physicians per 10,000	-.41	-.32	-.30	.05	-.31	-.26	-.44	.16	-.03	-	
11. Specialists per 10,000	-.59	-.60	-.55	.16	-.48	-.11	-.24	.42	.17	.82	-
12. Beds per 10,000	.15	.05	-.04	-.04	-.02	.34	.07	.34	-.09	.37	.43

Table 5.4. Rural-urban Measures by Socio-Economic and Healthcare Supply Characteristics, Adults Age 18-64

A. Rural Urban Commuting Area Code

	% <125 FPL	% < High School	% Black, NH	% Hispanic	PCP/10,000	Specialists/10,000	Beds/10,000
Urban	13.47	15.09	14.25	17.42	8.04	11.58	32.77
Semi-Urban	12.50	15.01	6.46	7.48	6.14	5.37	31.75
Rural	17.72	21.29	7.63	8.77	4.90	2.10	32.15

B. Metropolitan Statistical Area

	% <125 FPL	% < High School	% Black, NH	% Hispanic	PCP/10,000	Specialists/10,000	Beds/10,000
Metro	12.82	14.60	12.73	15.50	7.78	10.57	31.55
Non-Metro	16.76	18.89	7.49	7.56	5.65	3.51	37.28

C. Urban Rural Classification Scheme

	% <125 FPL	% < High School	% Black, NH	% Hispanic	PCP/10,000	Specialists/10,000	Beds/10,000
1 (Most Urban)	14.82	17.23	17.18	23.80	8.10	13.60	34.98
2	8.93	11.88	11.42	10.70	7.59	9.69	23.02
3	13.73	14.51	9.54	12.42	7.56	8.79	34.38
4	14.75	14.09	9.05	8.65	9.96	7.51	37.63
5	15.80	17.22	7.55	6.74	5.97	4.15	38.61
6 (Most Rural)	19.01	22.80	8.26	9.56	4.86	1.81	33.99

D. Rural Urban Continuum Code

	% <125 FPL	% < High School	% Black, NH	% Hispanic	PCP/10,000	Specialists/10,000	Beds/10,000
1 (Most Urban)	12.16	14.81	14.67	17.85	7.87	11.78	29.56
2	13.66	14.30	9.56	12.73	7.54	8.92	34.36
3	14.62	14.28	8.58	8.27	6.99	7.43	37.09
4	14.98	16.72	7.07	5.69	5.89	4.42	34.26
5	17.63	17.84	7.81	14.14	6.84	5.34	46.14
6	17.78	20.89	9.44	8.74	4.97	2.18	34.72
7	17.65	19.80	4.43	6.62	6.10	3.45	39.93
8	18.52	21.21	15.5	4.51	4.40	1.56	30.43
9 (Most Rural)	18.93	22.71	7.53	3.93	4.11	1.38	46.99

E. Economic Typology Code

	% <125 FPL	% < High School	% Black, NH	% Hispanic	PCP/10,000	Specialists/10,000	Beds/10,000
1 Farming	18.91	25.36	9.85	23.88	3.43	1.24	43.64
2 Mining	16.14	22.31	3.78	20.26	4.99	3.83	32.98
3 Manufacturing	13.38	15.86	8.28	6.12	6.18	5.52	29.41
4 Government	15.43	13.99	16.09	10.56	7.41	9.19	43.90
5 Services	12.50	14.37	13.90	17.16	8.74	13.43	33.50
6 Nonspecialized	13.92	16.47	9.92	17.40	6.13	6.42	27.02

PCP = Primary Care Physician

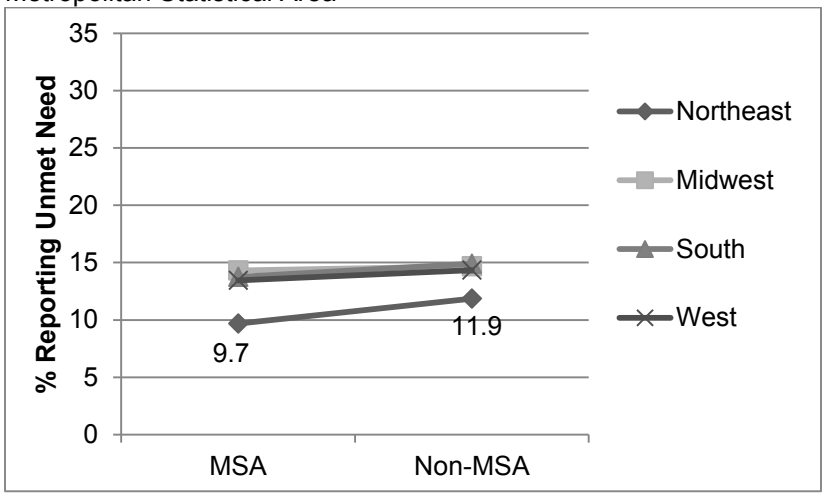
Table 5.5. Rural-urban Measures by Dependent Variable, Adults Age 18-64

	Usual Source of Healthcare (Yes %)	*p*	Unmet Need (Yes %)	*p*	Cholesterol Screening (Yes %)	*p*	Dental Visit (Yes %)	*p*	Cervical Screening (Yes %)	*p*
n	105,462		106,611		63,256		105,384		50,112	
Rural-Urban Commuting Area										
1 Urban	71.80	***	12.97		87.38	***	64.39	***	87.08	***
2 Semi-Urban	75.09		13.62		83.63		59.65		84.21	
3 Rural	77.34		14.02		79.15		51.63		82.10	
Metropolitan Statistical Area										
1 MSA	72.53	**	12.97		86.91	***	63.70	***	86.71	***
2 Non-MSA	75.37		14.39		80.17		54.50		82.38	
Rural Urban Continuum Code										
1 Most Urban	71.72	***	12.22	**	88.10	***	64.85	***	87.32	***
2	74.21		14.54		84.86		62.55		85.26	
3	73.86		13.86		84.18		60.16		86.35	
4	75.33		14.53		83.70		57.88		82.79	
5	69.42		15.42		77.99		51.38		82.94	
6	76.85		14.67		77.92		54.10		82.68	
7	73.99		14.61		79.62		51.93		81.81	
8	77.03		10.13		77.82		52.95		82.89	
9 Most Rural	81.18		11.90		79.06		48.58		78.65	
Economic Typology Code										
1 Farming	76.95	***	11.15		75.62	***	51.82	*	84.16	
2 Mining	65.59		17.43		80.10		46.41		80.47	
3 Manufacturing	77.14		14.31		83.45		60.04		84.87	
4 Federal/State Government	74.42		13.93		85.54		62.80		86.82	
5 Services	71.17		12.05		87.87		65.18		87.09	
6 Nonspecialized	71.76		13.95		85.05		59.68		84.83	
Urban Rural Classification Scheme										
1 Most Urban	68.40	***	12.52	***	87.32	***	62.21	***	86.26	***
2	75.74		11.95		88.78		68.04		88.33	
3	74.16		14.38		85.13		62.14		85.44	
4	74.18		14.11		83.84		60.89		86.51	
5	74.11		14.67		82.05		55.94		82.86	
6 Most Rural	77.32		13.84		76.90		51.25		81.34	

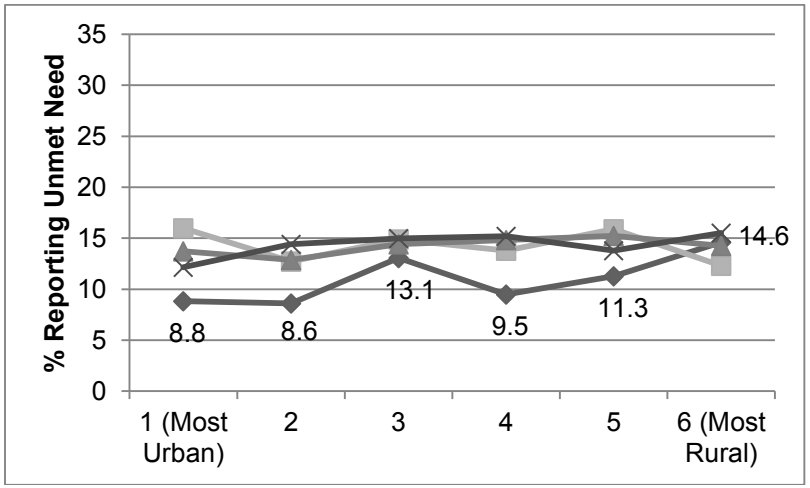
* $p < 0.05$, ** $p<.01$, *** $p <.001$

Figure 5.1. Rural-urban Measures by Report of Unmet Healthcare Need by U.S. Region, Adults Age 18-64

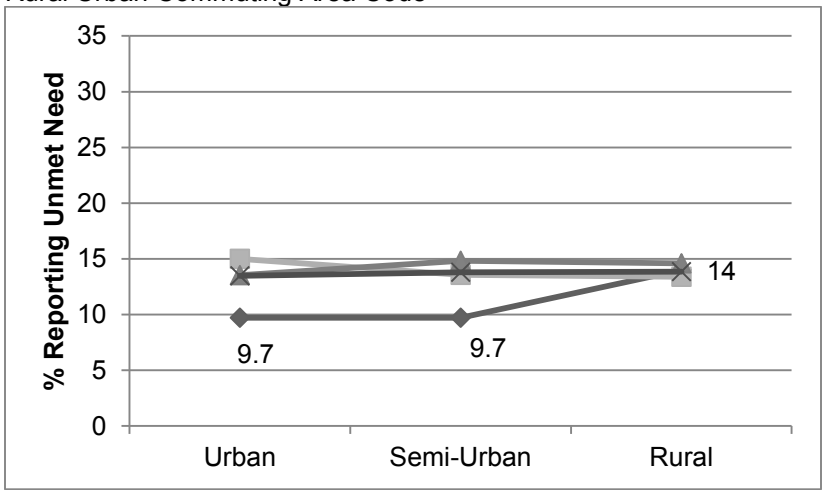
Metropolitan Statistical Area



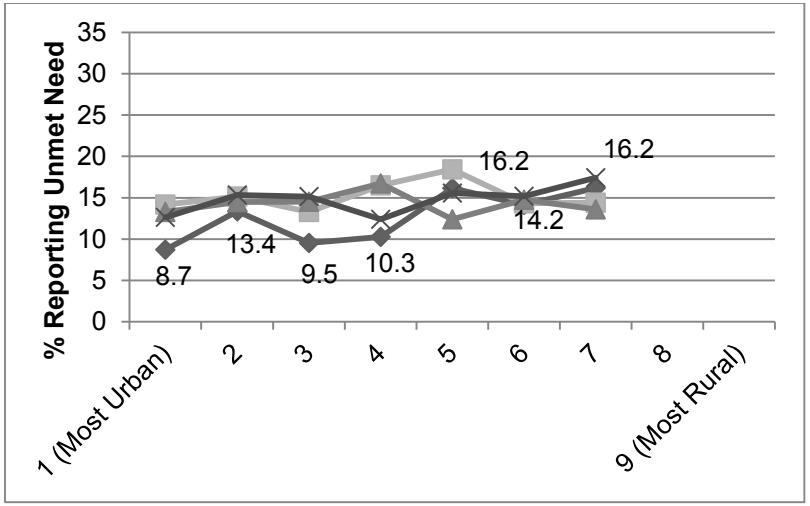
Urban Rural Classification Scheme



Rural Urban Commuting Area Code



Rural Urban Continuum Code



Economic Typology Code

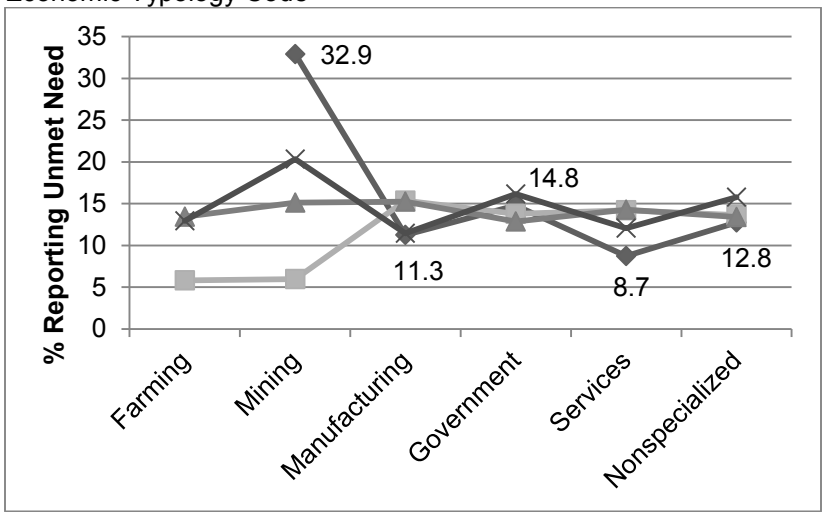
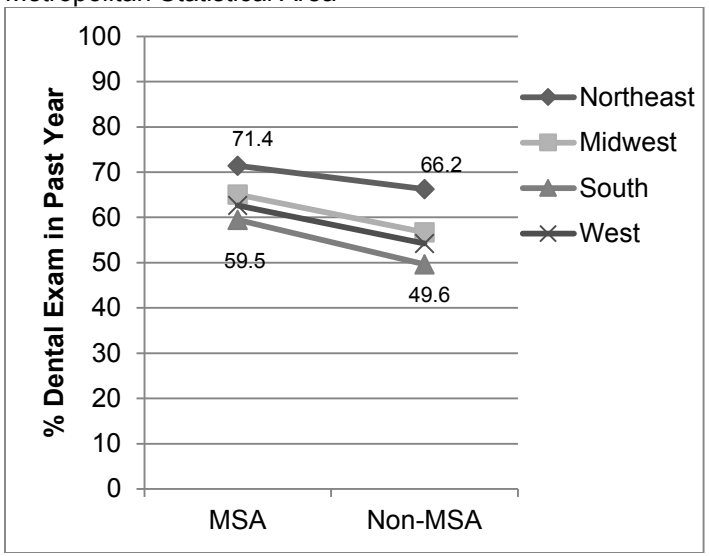
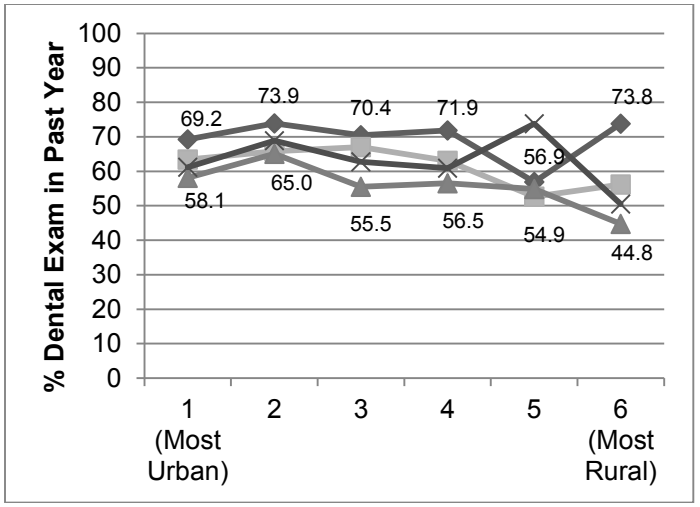


Figure 5.2. Rural-urban Measures by Report of Dental Visit by U.S. Region, Adults Age 18-64

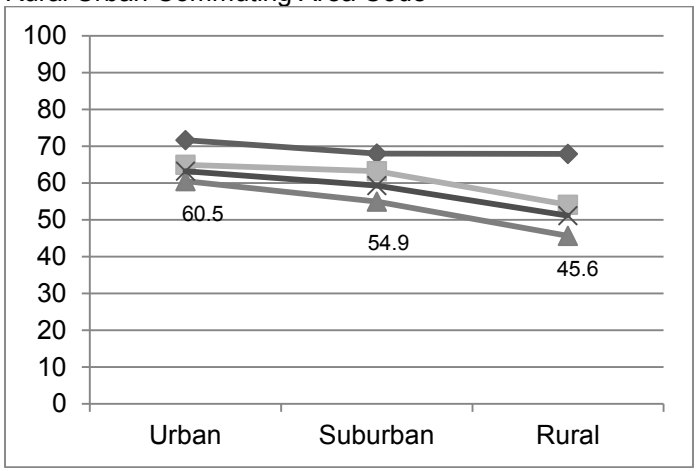
Metropolitan Statistical Area



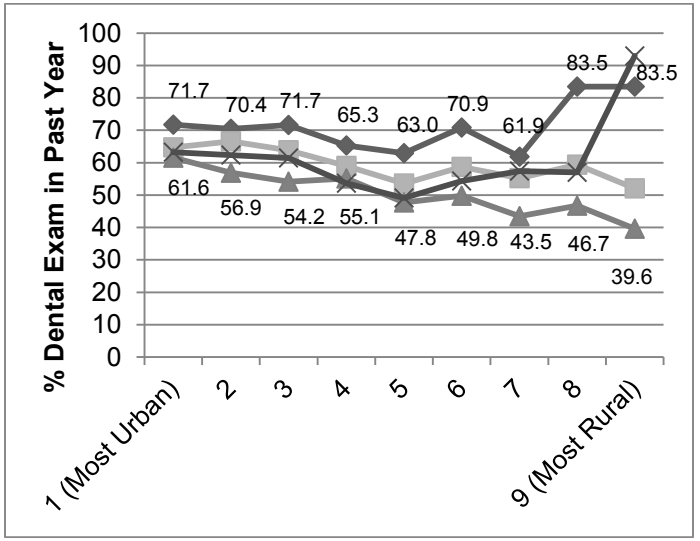
Urban Rural Classification Scheme



Rural Urban Commuting Area Code



Rural Urban Continuum Code



Economic Typology Code

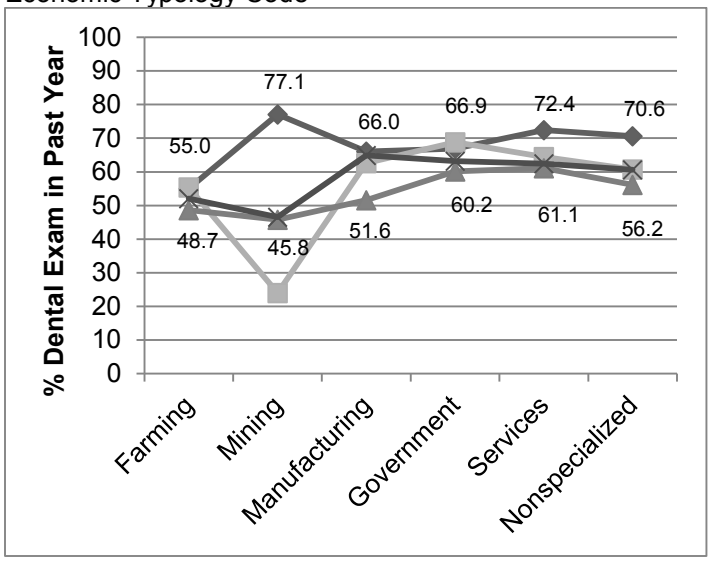


Table 6.1. Study Variables by Urban, Semi-Urban, and Rural Areas,[A] Adults Age 18-64

	Overall		Urban	Semi-Urban	Rural	
	n	Mean (Range) or %	Mean (Range) or %	Mean (Range) or %	Mean (Range) or %	*p*
County-Level						
Proportion Primary Care Physicians	105,306	7.3 (0-43.0)	8.0 (0-26.3)	6.2 (0-43.0)	4.9 (0-42.7)	***
Proportion Hospital Beds	105,306	32.5 (0-489.8)	32.8 (0-489.8)	31.8 (0-489.8)	32.2 (0-296.8)	***
Tract-Level						
Proportion in Poverty	105,306	18.0 (0-1)	17.7 (0-1)	16.7 (0-1)	23.76 (0-.9)	***
Individual-Level						
Gender						
Male	49,041	49.4	49.2	49.8	49.7	
Female	56,265	50.6	50.8	50.2	50.3	
Age	105,306	40.4 (18-64)	39.9 (18-64)	41.4 (18-64)	42.5 (18-64)	***
Race/Ethnicity						***
White, NH	50,633	66.6	59.6	82.3	81.7	
Black, NH	18,678	12.0	14.3	6.4	7.5	
Hispanic	27,622	14.7	17.9	7.3	7.7	
Other, NH	8,373	6.8	8.1	4.0	3.2	
Marital Status						***
Married	56,184	54.2	51.2	61.1	60.3	
Divorced/Widowed	16,804	15.5	15.5	15.0	17.4	
Single	32,318	30.3	33.4	23.9	22.3	
Educational Attainment						***
Less than High School	29,180	9.9	9.8	8.9	13.2	
High School/GED	42,303	40.6	37.4	46.8	50.1	
Bachelors	17,061	34.2	37.1	29.4	23.1	
Highest Degree Inapplicable/under 25	16,762	15.3	15.7	15.0	13.6	
Income relative to the federal poverty line						***
Less than 125%	32,949	15.4	15.3	14.2	19.6	
125%–200%	23,970	12.2	11.9	12.4	14.1	
200%–400%	16,510	30.9	29.6	32.6	36.8	
More than 400%	31,877	41.5	43.2	40.8	29.5	
Employed						**
Yes	78,475	78.9	79.3	78.7	76.2	
No	26,831	21.1	20.7	21.3	23.8	
Insurance						***
Insured Private	57,034	63.6	63.4	66.3	58.3	
Insured Public	10,638	6.9	6.9	5.9	9.3	

Uninsured any time last year	37,634	29.5	29.7	27.8	32.4	
Self-reported health						***
Excellent	60,400	61.7	62.9	60.9	54.4	
Good	30,882	27.1	26.6	27.2	31.1	
Fair/Poor	14,024	11.1	10.5	11.9	14.5	
# of chronic conditions						***
None	70,899	67.8	69.4	65.1	62.2	
One	23,922	23.0	22.3	24.4	25.0	
Two +	10,485	9.2	8.4	10.6	12.8	
# of household Members	105,306	2.9 (1-16)	2.9 (1-16)	2.91 (1-11)	2.92 (1-11)	***
Any out of pocket mdeical expense						***
Yes	76,132	77.6	76.6	79.9	79.3	
No	29,174	22.4	23.4	20.1	20.7	
LEP						***
English Only	81,256	87.1	83.6	95.2	94.6	
English Prof	7,203	5.1	6.5	1.8	1.7	
LEP	16,847	7.8	9.9	3.0	3.7	
Region						***
Northeast	16,526	18.8	21.5	13.4	10.7	
Midwest	21,020	22.2	18.9	28.0	33.0	
South	40,464	36.8	34.3	43.3	40.5	
West	27,296	22.2	25.2	15.3	15.8	

Weighted Data. Unmet Healthcare Need Sample. NH = Non-Hispanic

[A] Urban = Populations of 50,000+ (69%), Semi-Urban = Small cities/large town with populations of 10,000 to 49,999 and high commuting levels (22.4%), Rural = Small towns with populations below 10,000, lower commuting levels, or in isolated rural areas with more than an hour drive to the nearest city (9%), Rural = Small towns with populations below 10,000, lower commuting levels, or in isolated rural areas with more than an hour drive to the nearest city (9%)

* $p < 0.05$, ** $p<.01$, *** $p <.001$

Table 6.2. Percent Reporting Access to Healthcare for Urban, Semi-Urban, and Rural Areas,[A] by Race/Ethnicity, Adults Age 18-64

	Usual Source of Healthcare			Unmet Healthcare Need			Cholesterol Screening			Dental Visit			Cervical Screening		
	% Yes	95% CI		% Yes	95% CI		% Yes	95% CI		% Yes	95% CI		% Yes	95% CI	
Overall	73.0			13.2			85.8			62.3			86.0		
Urban															
White, NH	77.2	76.1,	78.2	13.6	12.9,	14.3	88.2	87.5,	88.9	69.7	68.7,	70.8	87.7	86.9,	88.5
Black, NH	69.6	68.4,	70.9	13.5	12.6,	14.4	89.6	88.7,	90.6	59.1	57.5,	60.7	90.7	89.9,	91.6
Hispanic	56.3	54.6,	58.1	11.4	10.3,	12.4	82.0	80.6,	83.4	51.1	49.0,	53.3	87.0	85.9,	88.9
Other, NH	67.3	65.2,	69.4	10.5	9.3,	11.8	84.9	83.2,	86.6	63.2	61.0,	65.3	78.1	75.8,	80.4
Semi-Urban															
White, NH	78.3	76.9,	79.8	13.9	12.7,	15.1	85.0	83.8,	86.1	62.1	60.2,	64.0	83.4	82.2,	84.6
Black, NH	65.6	62.4,	68.9	13.3	11.1,	15.6	83.2	80.0,	86.4	51.3	47.5,	55.1	88.1	86.1,	90.2
Hispanic	55.9	52.0,	59.8	11.4	9.2,	13.6	73.1	68.3,	77.9	46.2	41.7,	50.7	85.4	82.1,	88.7
Other, NH	77.1	72.0,	82.2	14.4	10.9,	17.9	82.6	78.6,	86.6	54.4	48.6,	60.2	85.0	80.9,	89.0
Rural															
White, NH	80.6	78.4,	82.8	14.9	13.2,	16.7	81.3	78.9,	83.7	53.7	51.2,	56.2	80.8	78.4,	83.2
Black, NH	75.1	71.2,	79.1	9.2	6.2,	12.2	74.0	68.0,	80.0	50.1	45.9,	54.3	85.6	81.2,	90.0
Hispanic	60.0	53.4,	66.7	12.4	9.3,	15.5	74.1	68.9,	79.4	38.6	34.5,	42.8	81.1	73.9,	88.2
Other, NH	80.3	71.2,	89.4	10.9	6.3,	15.6	78.5	69.7,	87.4	51.4	43.4,	59.4	84.3	74.6,	93.9
n	104,334			105,306			62,743			104,528			49,839		

Weighted Data. NH = Non-Hispanic, CI = Confidence Interval

[A] Urban = Populations of 50,000+ (69%), Semi-Urban = Small cities/large town with populations of 10,000 to 49,999 and high commuting levels (22.4%), Rural = Small towns with populations below 10,000, lower commuting levels, or in isolated rural areas with more than an hour drive to the nearest city (9%), Rural = Small towns with populations below 10,000, lower commuting levels, or in isolated rural areas with more than an hour drive to the nearest city (9%)

Table 6.3 Multi-Level Model Predicting the Odds of a Usual Source of Healthcare, Adults Age 18-64, n = 104,334

	Model 1				Model 2				Model 3			
	OR	95% CI		*p*	OR	95% CI		*p*	OR	95% CI		*p*
Area of Residence (ref = Urban)												
Semi-Urban	1.24	1.19	1.29	0.000	1.20	1.08	1.33	0.001	1.21	1.09,	1.33	0.000
Rural	1.46	1.37	1.57	0.000	1.30	1.10	1.53	0.002	1.52	1.29,	1.78	0.000
Race (ref = White, NH)												
Black, NH					0.74	0.67	0.82	0.000	0.94	0.85,	1.03	0.183
Hispanic					0.43	0.39	0.47	0.000	0.99	0.89,	1.12	0.930
Other, NH					0.61	0.52	0.71	0.000	0.82	0.70,	0.95	0.011
County-Level												
Primary Care Physicians/10,000									1.01	0.99,	1.03	0.397
Hospital Beds/10,000									1.01	1.00,	1.00	0.748
Tract-Level												
Proportion in Poverty [b]									0.99	0.95,	1.02	0.496
Individual-Level												
Female									1.75	1.67,	1.78	0.000
Age[a]									1.34	1.29,	1.78	0.000
Marital Status (ref = Married)												
Divorced									0.78	0.72,	0.86	0.000
Never Married									0.84	0.78,	0.91	0.000
Educational Attainment (ref = Bachelors +)												
Less than High School									0.76	0.68,	0.85	0.000
High School									0.98	0.91,	1.06	0.634
Highest Degree Inapplicable/under 25									1.58	1.40,	1.78	0.000
Income relative to federal poverty line (ref = over 400%)												
Less than 125%									0.68	0.62,	0.75	0.000
125%–200%									0.74	0.67,	0.81	0.000
200%–400%									0.85	0.79,	0.91	0.000
Unemployed (ref= Employed)									1.17	1.11,	1.24	0.000
Self-reported health (ref = Excellent)												
Good									1.09	1.03,	1.14	0.002
Fair/Poor									1.32	1.21,	1.44	0.000
# of Chronic Conditions (ref = none)												
One									1.70	1.60,	1.81	0.002
Two+									2.79	2.47,	3.14	0.000
# of Household Members									1.08	1.05,	1.10	0.000
Insurance (ref = Private Only)												
Public Only									1.53	1.36,	1.71	0.000
Uninsured at any time in past year									0.31	0.28,	0.34	0.000

Any out of pocket medical expense			3.40	3.22,	3.59	0.000
Limited English Prof. (ref = English only)						
English Prof			0.68	0.59,	0.78	0.000
LEP			0.64	0.55,	0.76	0.000
Controls						
Year			1.00	0.97,	1.02	0.863
Region (ref = Northeast)						
Midwest			0.57	0.47,	0.68	0.000
South			0.39	0.33,	0.46	0.000
West			0.45	0.38,	0.54	0.000
Variance at Level 2, Est (SE)	2.38 (.91)	2.26 (.09)	1.95 (.08)			
Variance at Level 3, Est (SE)	0.49 (.04)	0.42 (0.05)	0.22 (.04)			
Log likelihood statistic	-61792.59	-61311.42	-51729.16			

OR = Odds Ratio. CI = Confidence Interval. Scaled, Weighted Data.
[a] 10-year increase. [b] Standardized with mean = 0 & SD = 1

Table 6.4. Multi-Level Model Predicting the Odds of a Unmet Healthcare Need, Adults Age 18-64, n = 105,306

	Model 1				Model 2				Model 3			
	OR	95% CI		*p*	OR	95% CI		*p*	OR	95% CI		*p*
Area of Residence (ref = Urban)												
Semi-Urban	1.09	1.03	1.14	0.000	0.94	0.84	1.05	0.285	0.93	0.83	1.03	0.176
Rural	1.13	1.05	1.22	0.000	1.08	0.93	1.27	0.314	0.87	0.74	1.02	0.086
Race (ref = White, NH)												
Black, NH					0.85	0.76	0.94	0.002	0.68	0.61	0.76	0.000
Hispanic					0.76	0.68	0.86	0.000	0.80	0.70	0.92	0.001
Other, NH					0.78	0.68	0.91	0.001	0.79	0.68	0.93	0.004
County-Level												
Primary Care Physicians/10,000									1.02	1.00	1.04	0.046
Hospital Beds/10,000									1.00	1.00	1.00	0.704
Tract-Level												
Proportion in Poverty [b]									1.04	1.00	1.08	0.028
Individual-Level												
Female									1.35	1.28	1.42	0.000
Age [a]									0.95	0.91	0.98	0.001
Marital Status (ref = Married)												
Divorced									1.18	1.09	1.29	0.000
Never Married									1.03	0.94	1.14	0.509
Educational Attainment (ref = Bachelors +)												
Less than High School									0.91	0.81	1.02	0.114
High School									0.97	0.90	1.05	0.432
Highest Degree Inapplicable/under 25									0.64	0.56	0.73	0.000
Income relative to federal poverty line (ref = over 400%)												
Less than 125%									2.17	1.95	2.41	0.000
125%–200%									1.88	1.68	2.11	0.000
200%–400%									1.48	1.36	1.62	0.000
Unemployed (ref= Employed)									0.94	0.88	1.10	0.128
Self-reported health (ref = Excellent)												
Good									1.77	1.65	1.90	0.000
Fair/Poor									3.35	3.06	3.67	0.000
# of Chronic Conditions (ref = None)												
One									1.28	1.20	1.37	0.000
Two +									1.43	1.31	1.56	0.000
# of Household Members									0.80	0.78	0.82	0.000
Insurance (ref = Private Only)												
Public Only									1.58	1.40	1.77	0.000
Uninsured at any time in past year									2.70	2.49	2.93	0.000

Any out of pocket medical expense			1.62	1.50	1.74	0.000
Limited English Prof. (ref = English only)						
English Prof			0.91	0.77	1.09	0.298
LEP			0.68	0.57	0.82	0.000
Controls						
Year			0.99	0.96	1.01	0.372
Region (ref = Northeast)						
Midwest			1.50	1.24	1.81	0.000
South			1.40	1.17	1.67	0.000
West			1.63	1.33	1.99	0.000
Variance at Level 2, Est (SE)	1.95(0.09)	1.97 (.09)	1.55 (.08)			
Variance at Level 3, Est (SE)	0.28(.04)	0.27 (.03)	.19 (.03)			
Log likelihood statistic	-41493.69	-41457.14	-37674.82			

OR = Odds Ratio. CI = Confidence Interval. Scaled, Weighted Data.
[a] 10-year increase. [b] Standardized with mean = 0 & SD = 1

Table 6.5. Multi-Level Model Predicting the Odds of a Cholesterol Screening, Adults Age 34-64, n = 62,743

	Model 1				Model 2				Model 3			
	OR	95% CI		*p*	OR	95% CI		*p*	OR	95% CI		*p*
Area of Residence (ref = Urban)												
Semi-Urban	0.80	0.70	0.92	0.001	0.76	0.66	0.86	0.000	0.78	0.68	0.89	0.000
Rural	0.56	0.46	0.66	0.000	0.52	0.44	0.63	0.000	0.62	0.51	0.74	0.000
Race (ref = White, NH)												
Black, NH					1.05	0.94	1.17	0.391	1.63	1.44	1.85	0.000
Hispanic					0.51	0.45	0.57	0.000	1.32	1.15	1.52	0.000
Other, NH					0.71	0.6	0.82	0.000	0.90	0.76	1.08	0.257
County-Level												
Primary Care Physicians/10,000									1.02	1.00	1.05	0.020
Hospital Beds/10,000									1.00	0.99	1.00	0.009
Tract-Level												
Proportion in Poverty[b]									0.92	0.87	0.98	0.007
Individual-Level												
Female									1.42	1.30	1.55	0.000
Age [a]									1.60	1.51	1.69	0.000
Marital Status (ref = Married)												
Divorced									0.75	0.67	0.83	0.000
Never Married									0.61	0.55	0.68	0.000
Educational Attainment (ref = Bachelors +)												
Less than High School									0.48	0.42	0.55	0.000
High School									0.65	0.59	0.71	0.000
Income relative to federal poverty line (ref = over 400%)												
Less than 125%									0.55	0.47	0.64	0.000
125%–200%									0.58	0.51	0.66	0.000
200%–400%									0.70	0.63	0.78	0.000
Unemployed (ref= Employed)									1.11	1.00	1.23	0.056
Self-reported health (ref = Excellent)												
Good									1.18	1.09	1.28	0.000
Fair/Poor									1.17	1.03	1.32	0.016
# of Chronic Conditions (ref = None)												
One									2.27	2.08	2.49	0.000
Two+									5.60	4.81	6.52	0.000
# of Household Members									1.00	0.97	1.03	0.809
Insurance (ref = Private Only)												
Public Only									1.14	0.96	1.35	0.132
Uninsured at any time in past year									0.43	0.39	0.47	0.000
Out of pocket medical expenses									3.18	2.95	3.44	0.000

Limited English Prof. (ref = English only)						
English Prof			0.96	0.80	1.14	0.604
LEP			0.97	0.82	1.16	0.763
Controls						
Year			1.08	1.05	1.11	0.000
Region (ref = Northeast)						
Midwest			0.45	0.36	0.55	0.000
South			0.66	0.54	0.81	0.000
West			0.49	0.40	0.61	0.000
Variance at Level 2, Est (SE)	1.55(.08)	1.51 (.08)	1.25 (.07)			
Variance at Level 3, Est (SE)	0.32(.04)	0.32 (.04)	.26 (.03)			
Log likelihood statistic	-267705.42	-26567.81	-22305.72			

OR = Odds Ratio. CI = Confidence Interval. Scaled, Weighted Data.

[a] 10-year increase. [b] Standardized with mean = 0 & SD = 1

Table 6.6. Multi-Level Model Predicting the Odds of a Dental Visit, Adults Age 18-64, n=104,520

	Model 1				Model 2				Model 3			
	OR	95% CI		*p*	OR	95% CI		*p*	OR	95% CI		*p*
Area of Residence (ref = Urban)												
Semi-Urban	0.86	0.78	0.96	0.006	0.81	0.73	0.90	0.000	0.92	0.85	1.00	0.064
Rural	0.52	0.44	0.60	0.000	0.48	0.42	0.56	0.000	0.78	0.69	0.89	0.000
Race (ref = White, NH)												
Black, NH					0.81	0.73	0.89	0.000	1.25	1.13	1.39	0.000
Hispanic					0.57	0.53	0.62	0.000	1.20	1.09	1.32	0.000
Other, NH					0.68	0.61	0.76	0.000	0.82	0.73	0.92	0.001
County-Level												
Primary Care Physicians/10,000									1.04	1.02	1.05	0.000
Hospital Beds/10,000									1.00	1.00	1.00	0.483
Tract-Level												
Proportion in Poverty [b]									0.84	0.81	0.87	0.000
Individual-Level												
Female									1.68	1.60	1.76	0.000
Age[a]									1.02	0.99	1.05	0.180
Marital Status (ref = Married)												
Divorced									0.84	0.78	0.91	0.000
Never Married									0.92	0.86	0.98	0.015
Educational Attainment (ref = Bachelors +)												
Less than High School									0.39	0.35	0.43	0.000
High School									0.58	0.54	0.63	0.000
Highest Degree Inapplicable/under 25									0.96	0.87	1.07	0.498
Income relative to federal poverty line (ref = over 400%)												
Less than 125%									0.43	0.40	0.47	0.000
125%–200%									0.46	0.43	0.51	0.000
200%–400%									0.63	0.59	0.67	0.000
Unemployed (ref= Employed)									1.00	0.94	1.06	0.944
Self-reported health (ref = Excellent)												
Good									0.78	0.73	0.82	0.000
Fair/Poor									0.57	0.53	0.61	0.000
# of Chronic Conditions (ref = None)												
One									0.94	0.89	0.99	0.027
Two+									0.74	0.68	0.81	0.000
# of Household Members									1.04	1.02	1.06	0.000
Insurance (ref = Private Only)												
Public Only									0.62	0.56	0.68	0.000
Uninsured at any time in past year									0.34	0.32	0.36	0.000

Any out of pocket medical expenses			2.37	2.24	2.59	0.000
Limited English Prof. (ref = English only)						
English Prof			0.98	0.85	1.13	0.817
LEP			0.97	0.87	1.09	0.637
Controls						
Year			1.00	0.95	1.06	0.888
Region (ref = Northeast)						
Midwest			0.70	0.62	0.71	0.000
South			0.63	0.56	0.71	0.000
West			0.78	0.68	0.89	0.000
Variance at Level 2, Est (SE)	2.47 (0.09)	2.33(0.09)	1.51(0.06)			
Variance at Level 3, Est (SE)	0.27(0.04)	0.25(0.03)	0.07(0.01)			
Log likelihood statistic	-69044.49	-68809.07	-60953.59			

OR = Odds Ratio. CI = Confidence Interval. Scaled, Weighted Data.
[a] 10-year increase. [b] Standardized with mean = 0 & SD = 1

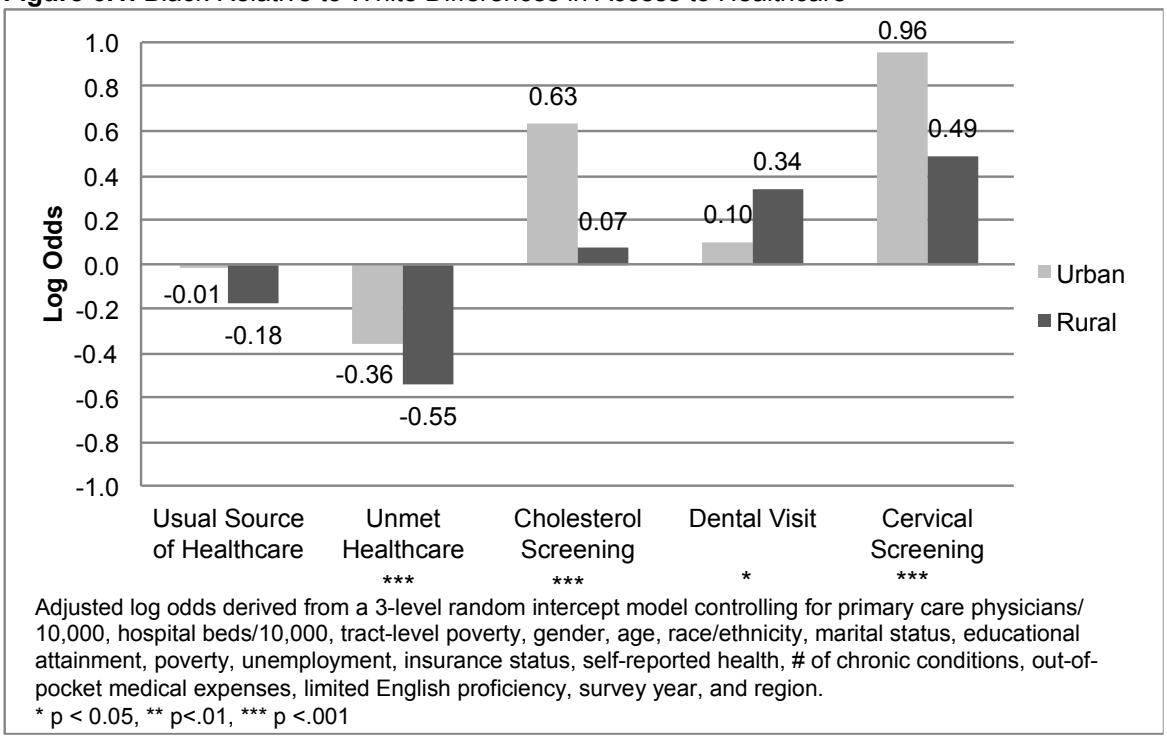
Table 6.7. Multi-Level Model Predicting the Odds of a Cervical Screening, Women Age 21-64, n = 49,839

	Model 1				Model 2				Model 3			
	OR	95% CI		*p*	OR	95% CI		*p*	OR	95% CI		*p*
Area of Residence (ref = Urban)												
Semi-Urban	0.72	0.64	0.82	0.000	0.74	0.65	0.84	0.000	0.81	0.71	0.93	0.002
Rural	0.56	0.47	0.67	0.000	0.56	0.47	0.68	0.048	0.79	0.65	0.96	0.016
Race (ref = White, NH)												
Black, NH					1.58	1.38	1.81	0.000	2.53	2.18	2.95	0.000
Hispanic					1.15	1.01	1.34	0.000	1.96	1.60	2.39	0.000
Other, NH					0.52	0.43	0.61	0.000	0.66	0.54	0.79	0.000
County-Level												
Primary Care Physicians/10,000									1.04	1.02	1.07	0.000
Hospital Beds/10,000									1.00	1.00	1.00	0.765
Tract-Level												
Proportion in Poverty [b]									0.88	0.83	0.93	0.000
Individual-Level												
Age[a]									0.59	0.57	0.62	0.000
Marital Status (ref = Married)												
Divorced									0.65	0.58	0.73	0.000
Never Married									0.41	0.36	0.47	0.000
Educational Attainment (ref = Bachelors +)												
Less than High School									0.63	0.56	0.71	0.000
High School									0.59	0.49	0.71	0.000
Highest Degree Inapplicable/under 25									0.33	0.27	0.40	0.000
Income relative to federal poverty line (ref = over 400%)												
Less than 125%									1.03	0.87	1.23	0.723
125%–200%									0.80	0.68	0.93	0.004
200%–400%									0.81	0.71	0.91	0.001
Unemployed (ref= Employed)									0.72	0.65	0.79	0.000
Self-reported health (ref = Excellent)												
Good									0.86	0.79	0.94	0.021
Fair/Poor									0.66	0.59	0.74	0.000
# of Chronic Conditions (ref = None)												
One									1.01	0.91	1.12	0.871
Two +									0.86	0.74	0.99	0.036
# of Household Members									1.00	0.97	1.03	0.864
Insurance (ref = Private Only)												
Public Only									1.12	0.93	1.35	0.218
Uninsured at any time in past year									0.50	0.45	0.56	0.000
Any out of pocket medical expenses									3.05	2.78	3.33	0.000

Limited English Prof. (ref = English only)						
English Prof			0.54	0.45	0.65	0.000
LEP			0.87	0.72	1.06	0.164
Controls						
Year			0.99	0.96	1.02	0.481
Region (ref = Northeast)						
Midwest			0.73	0.60	0.89	0.004
South			0.80	0.67	0.97	0.022
West			0.77	0.62	0.94	0.012
Variance at Level 2, Est (SE)	1.80(.09)	1.80(.10)	1.55 (0.09)			
Variance at Level 3, Est (SE)	0.12(.03)	0.13(.03)	0.07(.03)			
Log likelihood statistic	-20157.60	-20042.7	-18226.06			

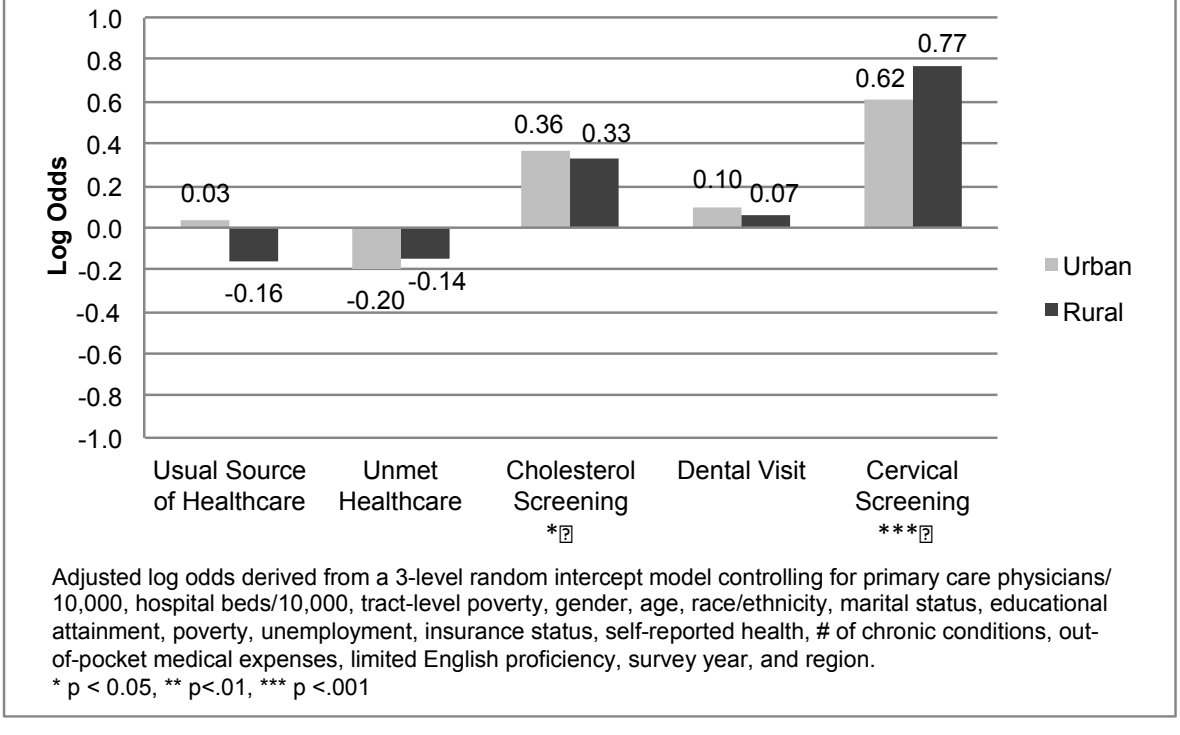
OR = Odds Ratio. CI = Confidence Interval. Scaled, Weighted Data.
[a] 10-year increase. [b] Standardized with mean = 0 & SD = 1

Figure 6.1. Black Relative to White Differences in Access to Healthcare



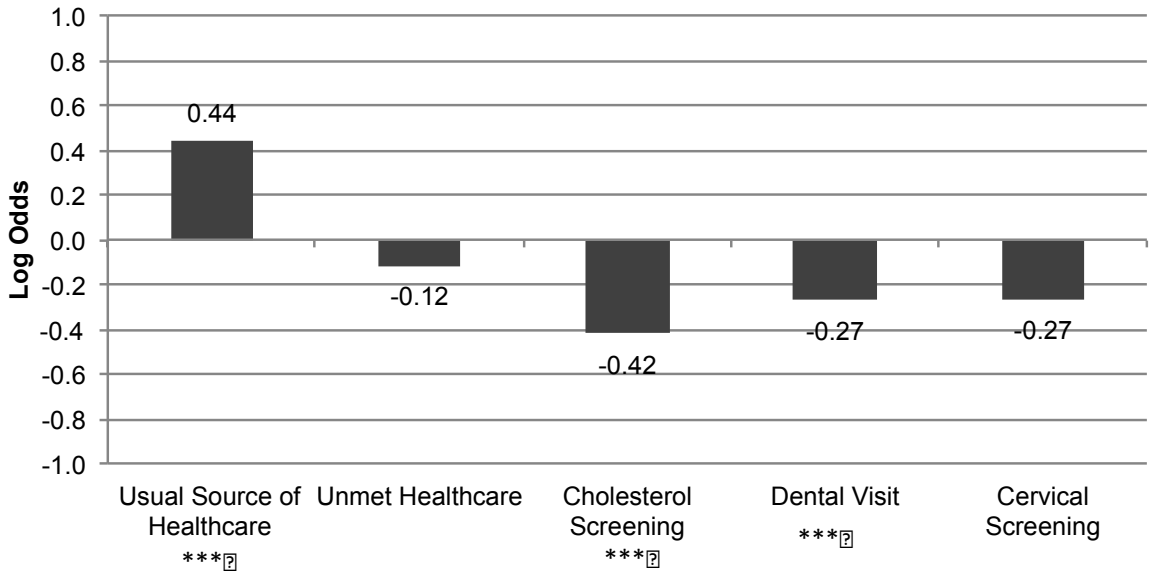
Adjusted log odds derived from a 3-level random intercept model controlling for primary care physicians/ 10,000, hospital beds/10,000, tract-level poverty, gender, age, race/ethnicity, marital status, educational attainment, poverty, unemployment, insurance status, self-reported health, # of chronic conditions, out-of-pocket medical expenses, limited English proficiency, survey year, and region.
* p < 0.05, ** p<.01, *** p <.001

Figure 6.2. Hispanic Relative to White Differences in Access to Healthcare



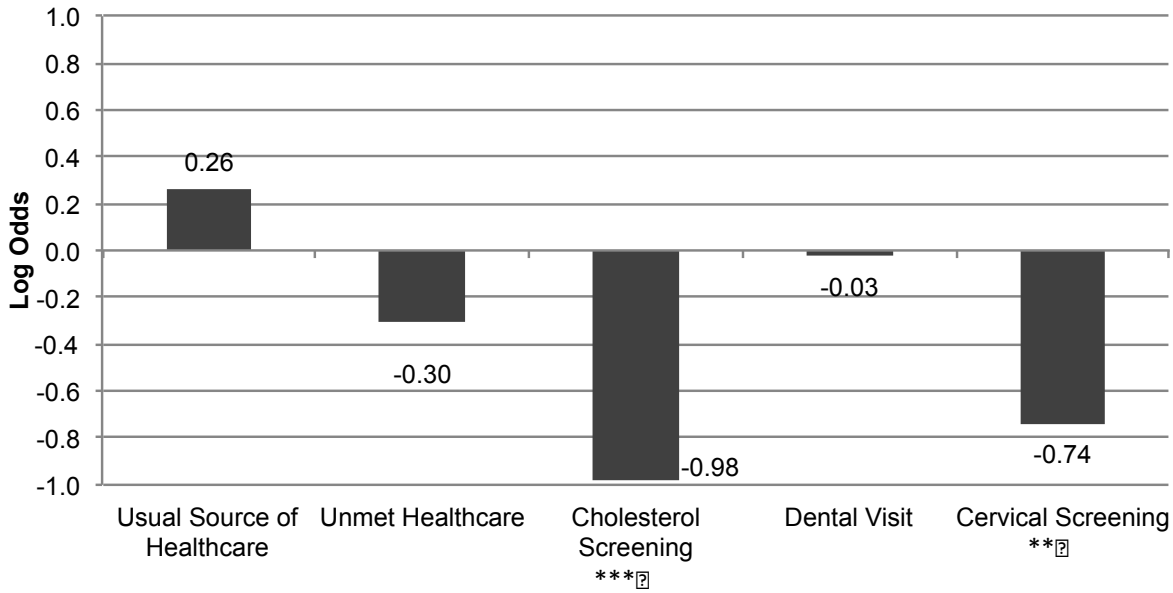
Adjusted log odds derived from a 3-level random intercept model controlling for primary care physicians/ 10,000, hospital beds/10,000, tract-level poverty, gender, age, race/ethnicity, marital status, educational attainment, poverty, unemployment, insurance status, self-reported health, # of chronic conditions, out-of-pocket medical expenses, limited English proficiency, survey year, and region.
* p < 0.05, ** p<.01, *** p <.001

Figure 6.3. Access to Healthcare of Rural Whites Relative to Urban Whites



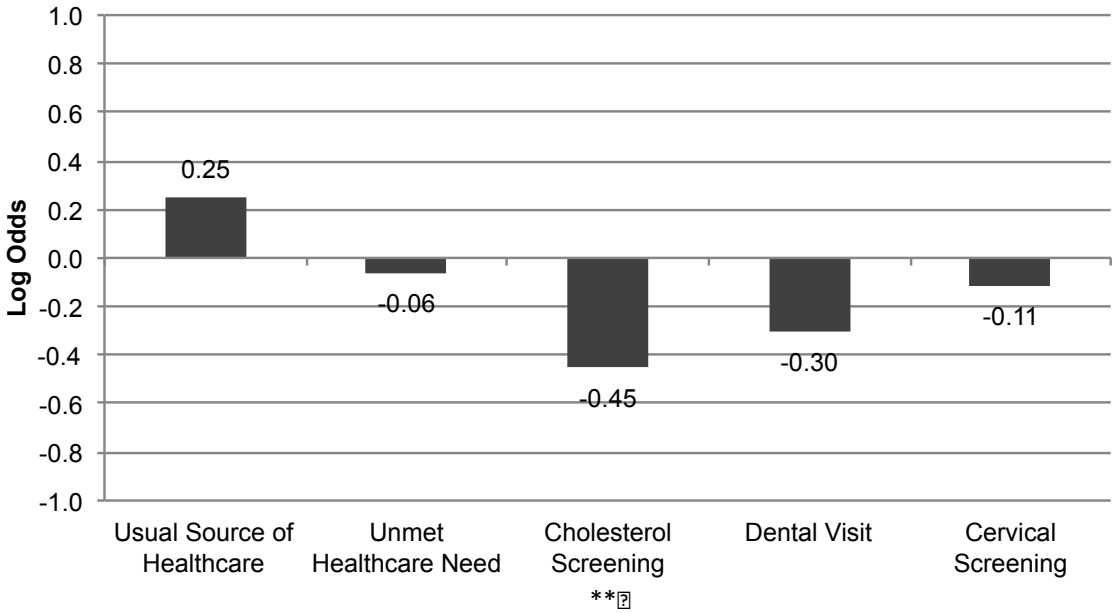
Adjusted log odds derived from a 3-level random intercept model controlling for primary care physicians/ 10,000, hospital beds/10,000, tract-level poverty, gender, age, race/ethnicity, marital status, educational attainment, poverty, unemployment, insurance status, self-reported health, # of chronic conditions, out-of-pocket medical expenses, limited English proficiency, survey year, and region.
* p < 0.05, ** p<.01, *** p <.001

Figure 6.4. Access to Healthcare of Rural Blacks Relative to Urban Blacks



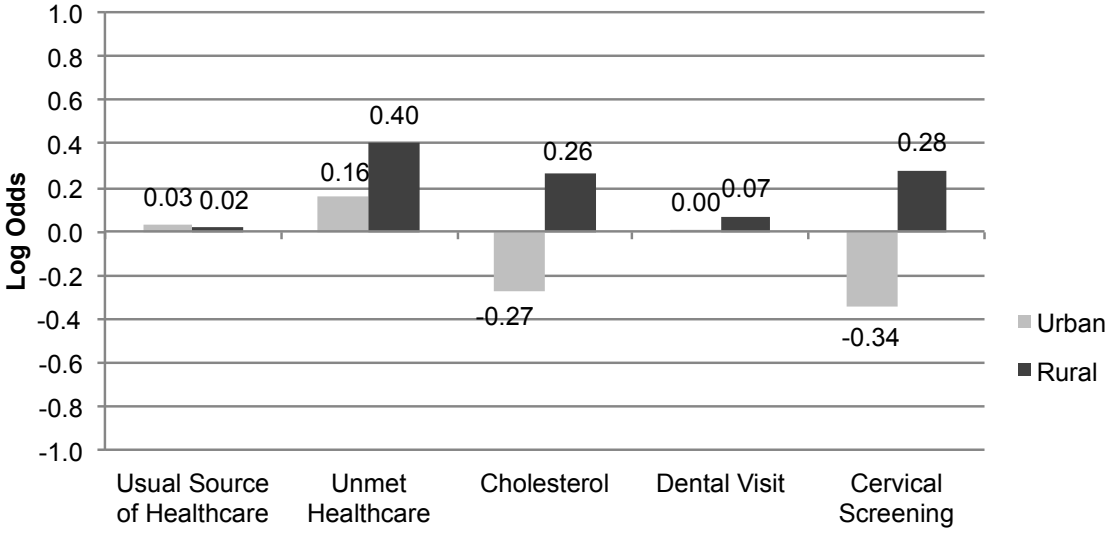
Adjusted log odds derived from a 3-level random intercept model controlling for primary care physicians/ 10,000, hospital beds/10,000, tract-level poverty, gender, age, race/ethnicity, marital status, educational attainment, poverty, unemployment, insurance status, self-reported health, # of chronic conditions, out-of-pocket medical expenses, limited English proficiency, survey year, and region.
* p < 0.05, ** p<.01, *** p <.001

Figure 6.5. Access to Healthcare of Rural Hispanics Relative to Urban Hispanics



Adjusted log odds derived from a 3-level random intercept model controlling for primary care physicians/ 10,000, hospital beds/10,000, tract-level poverty, gender, age, race/ethnicity, marital status, educational attainment, poverty, unemployment, insurance status, self-reported health, # of chronic conditions, out-of-pocket medical expenses, limited English proficiency, survey year, and region.
* p < 0.05, ** p<.01, *** p <.001

Figure 6.6. Hispanic relative to Black Differences in Access to Healthcare



Adjusted log odds derived from a 3-level random intercept model controlling for primary care physicians/ 10,000, hospital beds/10,000, tract-level poverty, gender, age, race/ethnicity, marital status, educational attainment, poverty, unemployment, insurance status, self-reported health, # of chronic conditions, out-of-pocket medical expenses, limited English proficiency, survey year, and region.
* p < 0.05, ** p<.01, *** p <.001

Table 7.1. Study Variables by Rural and Urban Areas[A], Adults Age 18-64

		Overall	Urban	Rural	
	n	Mean (Range) or %	Mean (Range) or %	Mean (Range) or %	*p*
County Level					
Black Segregation	112,125	0.12 (0-0.45)	0.13 (0-0.45)	0.06 (0-0.35)	***
Hispanic Segregation	112,125	0.11 (0-0.59)	0.12 (0.01-0.47)	0.51 (0-.59)	***
Proportion in Poverty	112,125	13.41 (2.8-47.3)	12.79 (2.8-47.3)	16.77 (3.2-47.3)	***
Primary Care Physicians/10,000	112,125	7.38 (0-42.95)	7.70 (0-42.95)	5.65 (0-42.68)	***
Hospital Beds/10,000	112,125	32.32 (0-489.84)	31.43 (0-489.84)	37.18 (0-489.84)	
Individual Level					
Gender					
Male	52,311	49.40	49.35	49.65	
Female	59,814	50.60	50.65	50.35	
Age	112,125	40.4 (18-64)	40.2 (18-64)	41.5 (18-64)	***
Race/Ethnicity					***
White, NH	53,486	66.27	63.39	81.91	
Black, NH	19,742	11.95	12.69	7.89	
Hispanic	29,761	14.87	16.43	6.37	
Other	9,136	6.91	7.48	3.83	
Educational Attainment					***
Less than High School	18,165	9.87	9.65	11.07	
High School/GED	44,685	40.25	38.81	48.10	
Bachelors +	31,353	34.51	36.15	25.59	
Highest Degree Inapplicable/under 25	17,922	15.36	15.39	15.25	
Income relative to the federal poverty line					***
Less than 125%	25,268	15.26	14.74	18.11	
125%–200%	17,515	12.10	11.66	14.52	
200%–400%	33,964	30.92	30.17	35.03	
More than 400%	35,378	41.71	43.44	32.34	
Insurance					**
Insured Private	60,799	63.67	64.31	60.20	
Insured Public	11,152	6.77	6.54	8.03	
Uninsured any time last year	40,174	29.56	29.15	31.77	
Self-reported health					***
Excellent	64,448	61.84	62.72	57.05	
Good	32,870	27.10	26.74	29.05	
Fair/Poor	14,807	11.06	10.54	13.90	
Region					***
Northeast	17,031	18.31	19.49	11.89	
Midwest	22,120	21.94	20.08	32.03	

South	42,447	26.42	35.32	42.41
West	30,527	23.33	25.10	13.67

Weighted Data. Unmet Healthcare Need Sample. NH = Non-Hispanic

[A] Urban = Metropolitan: Populations of 50,000 persons+ with high degree or social and economic integration with urban core, Rural = Micropolitan (Population 10,000 – 49,999) & Non-Metropolitan (Population < 10,000)

* p < 0.05, ** p<.01, *** p <.001

Table 7.2. Study Variables for Adults in Highly Segregated Rural and Urban Areas[A], Adults Age 18-64

	Overall	High Black Segregation		High Hispanic Segregation	
		Urban	Rural	Urban	Rural
	Mean (Range) or %	Mean (SE) or %	Mean (SE) or %	Mean (SE) or %	Mean (SE) or %
County Level					
Black Segregation	0.12 (0-0.45)	26.30 (0.3)	16.67 (0.9)		
Hispanic Segregation	0.11 (0-0.59)			23.88 (0.4)	13.20 (1.3)
County Poverty	13.41 (2.8-47.3)	15.08 (0.3)	19.65 (0.9)	14.95 (0.4)	18.11 (0.8)
Primary Care Physicians/10,000	7.38 (0-42.95)	8.23 (0.1)	5.07 (0.3)	7.28 (0.1)	4.96 (0.4)
Hospital Beds/10,000	32.32 (0-489.84)	41.37 (1.2)	43.65 (5.0)	29.00 (0.4)	42.22 (10.1)
Individual Level					
Gender					
Male	49.40	48.56	48.64	50.24	50.03
Female	50.60	51.44	51.36	49.76	49.97
Age	40.41 (.1)	39.94 (0.2)	41.49 (0.4)	39.92 (0.2)	41.50 (0.3)
Race/Ethnicity					
White, NH	66.27	50.81	70.68	38.22	68.84
Black, NH	11.95	28.11	23.64	11.91	9.12
Hispanic	14.87	15.09	1.93	39.48	19.95
Other	6.91	6.00	3.75	10.38	2.09
Educational Attainment					
Less than High School	9.87	9.75	12.32	16.14	15.20
High School/GED	40.25	39.35	48.20	34.89	44.25
Bachelors +	34.51	35.97	23.70	33.04	23.89
Highest Degree Inapplicable/under 25	15.36	15.93	15.78	15.22	16.66
Income relative to the federal poverty line					
Less than 125%	15.26	16.98	20.96	14.26	19.01
125%–200%	12.10	12.75	16.74	18.72	15.40
200%–400%	30.92	30.79	33.13	29.01	35.38
More than 400%	41.71	39.79	29.17	38.00	30.20
Insurance					
Insured Private	63.67	59.88	57.07	54.65	55.19
Insured Public	6.77	8.38	7.97	7.50	7.86
Uninsured any time last year	29.56	31.74	34.96	37.85	39.95
Self-reported health					
Excellent	61.84	62.35	54.57	61.48	56.65
Good	27.10	26.30	30.35	27.77	30.57
Fair/Poor	11.06	11.35	15.08	10.75	12.78

Region					
NW	18.31	23.52	11.95	11.81	5.8
MW	21.94	22.81	15.39	8.33	16.3
South	26.42	53.67	72.40	29.48	48.9
West	23.33	0.0	0.26	50.38	29.0

Weighted Data. Unmet Healthcare Need Sample, n = 112,125. NH = Non-Hispanic
High Segregation = ≥ 75th percentile on isolation index
[A] Urban = Metropolitan: Populations of 50,000 persons+ with high degree or social and economic integration with urban core, Rural = Micropolitan (Population 10,000 – 49,999) & Non-Metropolitan (Population < 10,000)

Table 7.3. Unadjusted Estimates of Access to Healthcare for Highly Segregated Rural and Urban Areas[A]

		High Black Segregation			High Hispanic Segregation		
	Overall	Urban	Rural	*p*	Urban	Rural	*p*
Usual Source of Healthcare	72.92	70.03	75.58	**	63.58	72.51	***
Unmet Healthcare Need	13.14	12.87	13.23		11.00	12.83	
Cholesterol Screening	85.90	88.60	80.55	***	86.44	79.07	***
Cervical Screening	86.08	87.53	84.08	***	86.57	80.03	***
Dental Visit	62.47	63.95	53.23	***	59.44	51.05	***

Highly Segregated: ≥ 75th percentile on isolation index

[A] Urban = Metropolitan: Populations of 50,000 persons+ with high degree or social and economic integration with urban core, Rural = Micropolitan (Population 10,000 – 49,999) & Non-Metropolitan (Population < 10,000)

Table 7.4. Multi-level Models Predicting the Odds of a Usual Source of Healthcare, Adults age 18-64, n = 110,996

	Black Residential Segregation								Hispanic Residential Segregation							
	Model 1				Model 2				Model 1				Model 2			
	OR	95% CI		*p*	OR	95% CI		*p*	OR	95% CI		*p*	OR	95% CI		*p*
County Level																
Black Segregation[a]	0.92	0.85	0.99	0.03	0.95	0.89	1.01	0.130								
Rural					1.21	1.07	1.38	0.003					1.21	1.07	1.38	0.003
Hispanic Segregation[a]									0.81	0.75	0.88	0.000	0.92	0.86	0.97	0.005
Proportion Poor					0.94	0.89	0.99	0.050					0.94	0.89	1.01	0.063
Primary Care Physicians/10,000					1.00	0.98	1.01	0.620					1.00	0.98	1.01	0.616
Hospital Beds/10,000					1.01	1.00	1.00	0.040					1.00	1.00	1.00	0.282
Individual Level																
Female (ref = Male)					1.88	1.81	1.96	0.000					1.88	1.81	1.96	0.000
Age[b]					1.46	1.42	1.50	0.000					1.46	1.43	1.50	0.000
Race/Ethnicity (ref = White, NH)																
Black, NH					0.92	0.84	1.01	0.090					0.92	0.84	1.01	0.000
Hispanic					0.79	0.72	0.87	0.000					0.79	0.72	0.88	0.000
Other, NH					0.71	0.64	0.79	0.000					0.71	0.64	0.79	0.000
Educational Attainment (ref = Bachelors +)																
Less than High School					0.74	0.67	0.81	0.000					0.74	0.67	0.81	0.000
High School/GED					0.98	0.92	1.05	0.619					0.98	0.92	1.05	0.607
Highest Degree Inapplicable/under 25					1.58	1.45	1.73	0.000					1.58	1.45	1.73	0.000
Income relative to federal poverty line (ref = over 400%)																
Less than 125%					0.68	0.63	0.74	0.000					0.68	0.63	0.74	0.000
125%–200%					0.71	0.66	0.76	0.000					0.71	0.66	0.76	0.000
200%–400%					0.83	0.78	0.88	0.000					0.83	0.78	0.88	0.000
Insurance (ref = Insured Private)																
Insured Public					1.32	1.20	1.47	0.000					1.32	1.20	1.47	0.000
Uninsured any time last year					0.30	0.27	0.32	0.000					0.30	0.27	0.32	0.000
Self-reported health (ref = Excellent)																
Good					1.25	1.20	1.31	0.000					1.25	1.20	1.31	0.000
Fair/Poor					1.89	1.77	2.03	0.000					1.89	1.77	2.03	0.000
Region (ref = Northeast)																
Midwest					0.67	0.56	0.81	0.000					0.68	0.57	0.81	0.000
South					0.50	0.42	0.59	0.000					0.49	0.42	0.58	0.000
West					0.49	0.40	0.59	0.000					0.53	0.44	0.64	0.000
Constant, Est (SE)	2.70 (0.08)				1.23 (0.15)				2.44 (0.03)				1.19 (0.14)			
Variance at Level 2, Est (SE)	0.68 (0.06)				0.47 (0.05)				0.45 (0.04)				0.47 (0.05)			
Log likelihood statistic	-71009.9				-61705				-46513				-61702			

Scaled, Weighted Data. [a] Standardized with mean = 0 & SD = 1. [b] 10-year increase.

Table 7.5. Multi-Level Model Predicting the Odds of Unmet Healthcare Need, Adults Age 18-64, n = 112,125

	Black Residential Segregation								Hispanic Residential Segregation							
	Model 1				Model 2				Model 1				Model 2			
	OR	95% CI		*p*	OR	95% CI		*p*	OR	95% CI		*p*	OR	95% CI		*p*
County Level																
Black Segregation[a]	0.96	0.90	1.02	0.165	0.99	0.93	1.07	0.858								
Rural					0.91	0.80	1.05	0.186					0.91	0.81	1.03	0.151
Hispanic Segregation[a]									0.96	0.90	1.02	0.165	0.99	0.92	1.06	0.763
Proportion Poor					0.98	0.92	1.05	0.584					0.98	0.92	1.04	0.560
Primary Care Physicians/10,000					1.03	1.01	1.05	0.009					1.03	1.01	1.05	0.008
Hospital Beds/10,000					1.00	1.00	1.00	0.725					1.00	1.00	1.00	0.758
Individual Level																
Female (ref = Male)					1.34	1.28	1.41	0.000					1.34	1.28	1.41	0.000
Age[b]					1.04	1.02	1.07	0.001					1.04	1.02	1.07	0.001
Race/Ethnicity (ref = White, NH)																
Black, NH					0.70	0.64	0.76	0.000					0.70	0.64	0.76	0.000
Hispanic					0.58	0.52	0.64	0.000					0.58	0.52	0.65	0.000
Other					0.68	0.60	0.78	0.000					0.68	0.60	0.78	0.000
Education (ref = Bachelors +)																
Less than High School					0.79	0.71	0.87	0.000					0.79	0.71	0.87	0.000
High School/GED					0.93	0.86	0.99	0.034					0.93	0.86	0.99	0.034
Highest Degree Inapplicable/under 25					0.72	0.64	0.80	0.000					0.72	0.64	0.80	0.000
Income relative to federal poverty line (ref = over 400%)																
Less than 125%					1.90	1.73	2.08	0.000					1.90	1.73	2.08	0.000
125%–200%					1.70	1.54	1.87	0.000					1.70	1.54	1.87	0.000
200%–400%					1.40	1.29	1.51	0.000					1.40	1.29	1.51	0.000
Insurance (ref = private)																
Insured Public					1.59	1.44	1.76	0.000					1.59	1.44	1.76	0.000
Uninsured any time last year					2.29	2.13	2.47	0.000					2.29	2.13	2.47	0.000
Self-reported health (ref = Excellent)																
Good					1.80	1.69	1.91	0.000					1.80	1.69	1.91	0.000
Fair/Poor					3.66	3.40	3.94	0.000					3.66	3.40	3.94	0.000
Region (ref = Northeast)																
Midwest					1.34	1.12	1.61	0.002					1.34	1.11	1.62	0.003
South					1.29	1.09	1.52	0.003					1.29	1.09	1.52	0.003
West					1.48	1.21	1.80	0.000					1.49	1.23	1.80	0.000
Constant, Est (SE)	0.14 (0.003)				0.03 (0.004)				0.14 (0.004)				0.03 (0.004)			
Variance at Level 2, Est (SE)	0.45(.03)				0.36(0.03)				0.44(0.04)				0.36(0.03)			
Log likelihood statistic	-46513.53				-42806.36				-46513.53				-42806.34			

Scaled, Weighted Data. [a] Standardized with mean = 0 & SD = 1. [b] 10-year increase.

Table 7.6. Multi-Level Model Predicting the Odds of Cholesterol Screening, Adults Age 35-64, n = 66,426

	Black Residential Segregation								Hispanic Residential Segregation							
	Model 1				Model 2				Model 1				Model 2			
	OR	95% CI		*p*	OR	95% CI		*p*	OR	95% CI		*p*	OR	95% CI		*p*
County Level																
Black Segregation[a]	1.17	1.09	1.24	0.000	1.11	1.04	1.19	0.001								
Rural					0.88	0.76	1.01	0.068					0.85	0.74	0.97	0.020
Hispanic Segregation[a]									1.05	0.96	1.15	0.311	1.09	1.01	1.18	0.033
Proportion Poor					0.92	0.87	0.98	0.014					0.93	0.87	0.99	0.026
Primary Care Physicians/10,000					1.02	1.00	1.04	0.075					1.02	1.00	1.04	0.038
Hospital Beds/10,000					1.00	1.00	1.00	0.051					1.00	1.00	1.00	0.078
Individual Level																
Female (ref = Male)					1.55	1.45	1.67	0.000					1.55	1.45	1.67	0.000
Age[b]					1.83	1.74	1.92	0.000					1.83	1.74	1.92	0.000
Race/Ethnicity (ref = White, NH)																
Black, NH					1.35	1.20	1.52	0.000					1.37	1.22	1.54	0.000
Hispanic					1.18	1.03	1.35	0.014					1.16	1.02	1.33	0.026
Other					0.88	0.77	1.02	0.091					0.88	0.77	1.02	0.089
Education (ref = Bachelors +)																
Less than High School					0.47	0.42	0.52	0.000					0.47	0.42	0.52	0.000
High School/GED					0.66	0.61	0.71	0.000					0.66	0.61	0.71	0.000
Income relative to federal poverty line (ref = over 400%)																
Less than 125%					0.53	0.47	0.60	0.000					0.53	0.47	0.60	0.000
125%–200%					0.55	0.49	0.61	0.000					0.55	0.49	0.61	0.000
200%–400%					0.68	0.63	0.74	0.000					0.68	0.63	0.74	0.000
Insurance (ref = private)																
Insured Public					1.14	0.98	1.32	0.087					1.14	0.98	1.32	0.086
Uninsured any time last year					0.39	0.36	0.42	0.000					0.39	0.36	0.42	0.000
Self-reported health (ref = Excellent)																
Good					1.43	1.33	1.53	0.000					1.43	1.33	1.53	0.000
Fair/Poor					2.03	1.83	2.25	0.000					2.03	1.83	2.25	0.000
Region (ref = Northeast)																
Midwest					0.55	0.47	0.65	0.000					0.55	0.47	0.65	0.000
South					0.74	0.63	0.87	0.000					0.76	0.64	0.89	0.001
West					0.61	0.51	0.73	0.000					0.54	0.45	0.64	0.000
Constant, Est (SE)	6.40 (0.19)				0.80 (0.12)				6.33 (.24)				0.81 (0.12)			
Variance at Level 2, Est (SE)	0.45(0.04)				0.34(0.03)				0.48(0.04)				0.34(0.03)			
Log likelihood statistic	-29555.13				26252.95				-29569.06				-26256.35			

Scaled, Weighted Data. [a] Standardized with mean = 0 & SD = 1. [b] 10-year increase.

Table 7.7. Multi-Level Model Predicting the Odds of Cervical Screening, Females Age 21-64, n= 52,809

	Black Residential Segregation								Hispanic Residential Segregation							
	Model 1				Model 2				Model 1				Model 2			
	OR	95% CI		*p*	OR	95% CI		*p*	OR	95% CI		*p*	OR	95% CI		*p*
County Level																
Black Segregation[a]	1.13	1.08	1.20	0.000	1.07	1.01	1.14	0.021								
Rural					1.02	0.89	1.16	0.824					0.96	0.84	1.10	0.583
Hispanic Segregation[a]									1.02	0.95	1.09	0.567	0.99	0.93	1.06	0.817
Proportion Poor					0.96	0.90	1.01	0.125					0.97	0.92	1.03	0.306
Primary Care Physicians/10,000					1.03	1.01	1.05	0.003					1.03	1.01	1.05	0.001
Hospital Beds/10,000					1.00	1.00	1.00	0.244					1.00	1.00	1.00	0.422
Individual Level)																
Age[b]					0.75	0.72	0.79	0.000					0.75	0.72	0.79	0.000
Race/Ethnicity (ref = White, NH)																
Black, NH					1.76	1.54	2.01	0.000					1.79	1.57	2.05	0.000
Hispanic					1.46	1.29	1.65	0.000					1.46	1.29	1.66	0.000
Other					0.57	0.49	0.67	0.000					0.58	0.49	0.67	0.000
Education (ref = Bachelors +)																
Less than High School					0.75	0.63	0.90	0.002					0.75	0.63	0.90	0.002
High School/GED					0.82	0.74	0.90	0.000					0.82	0.74	0.90	0.000
Income relative to federal poverty line (ref = over 400%)																
Less than 125%					0.68	0.59	0.78	0.000					0.68	0.59	0.78	0.000
125%–200%					0.64	0.56	0.74	0.000					0.64	0.56	0.73	0.000
200%–400%					0.72	0.64	0.80	0.000					0.72	0.64	0.80	0.000
Insurance (ref = private)																
Insured Public					0.76	0.66	0.88	0.000					0.76	0.66	0.88	0.000
Uninsured any time last year					0.42	0.38	0.46	0.000					0.42	0.38	0.46	0.000
Self-reported health (ref = Excellent)																
Good					0.91	0.84	0.98	0.020					0.91	0.84	0.98	0.018
Fair/Poor					0.73	0.66	0.81	0.000					0.73	0.66	0.81	0.000
Region (ref = Northeast)																
Midwest					0.75	0.64	0.88	0.000					0.73	0.62	0.86	0.000
South					0.81	0.69	0.95	0.008					0.81	0.70	0.95	0.011
West					0.79	0.66	0.94	0.007					0.75	0.63	0.88	0.000
Constant, Est (SE)	6.5 (0.17)				3.81 (0.18)				6.39 (0.04)				3.79(0.18)			
Variance at Level 2, Est (SE)	0.33 (0.04)				0.21 (0.03)				0.36 (0.04)				0.22 (0.03)			
Log likelihood statistic	-22471.35				-21124.22				-22483.15				-21127.42			

Scaled, Weighted Data. [a] Standardized with mean = 0 & SD = 1. [b] 10-year increase.

Table 7.8. Multi-Level Model Predicting the Odds of Dental Visit, Adults Age 18-64, n= 110,889

	Black Residential Segregation								Hispanic Residential Segregation							
	Model 1				Model 2				Model 1				Model 2			
	OR	95% CI		*p*	OR	95% CI		*p*	OR	95% CI		*p*	OR	95% CI		*p*
County Level																
Black Segregation[a]	1.02	0.97	1.07	0.498	1.07	1.03	1.12	0.000								
Rural					0.96	0.87	1.06	0.445					0.90	0.82	0.99	0.003
Hispanic Segregation[a]								0.000	0.93	0.90	0.96	0.000	0.99	0.96	1.03	0.599
Proportion Poor					0.90	0.86	0.94	0.000					0.93	0.90	0.95	0.000
Primary Care Physicians/10,000					1.03	1.02	1.04	0.000					1.03	1.02	1.04	0.000
Hospital Beds/10,000					1.00	1.00	1.00	0.430					1.04	0.99	1.00	0.626
Individual Level																
Female (ref = Male)					1.74	1.67	1.80	0.000					1.73	1.67	1.80	0.000
Age[b]					1.05	1.03	0.07	0.000					1.05	1.03	0.07	0.000
Race/Ethnicity (ref = White, NH)																
Black, NH					1.01	0.94	1.09	0.737					1.02	0.95	1.09	0.572
Hispanic					1.03	0.96	1.10	0.397					1.03	0.97	1.11	0.316
Other					0.79	0.71	0.87	0.000					0.80	0.72	0.87	0.000
Education (ref = Bachelors +)																
Less than High School					0.38	0.35	0.42	0.000					0.38	0.35	0.42	0.000
High School/GED					0.57	0.53	0.61	0.000					0.57	0.53	0.61	0.000
Highest Degree Inapplicable/under 25					0.87	0.80	0.95	0.001					0.87	0.80	0.95	0.001
Income relative to federal poverty line (ref = over 400%)																
Less than 125%					0.43	0.41	0.46	0.000					0.43	0.41	0.46	0.000
125%–200%					0.47	0.44	0.51	0.000					0.47	0.44	0.51	0.000
200%–400%					0.62	0.58	0.65	0.000					0.62	0.58	0.65	0.000
Insurance (ref = private)																
Insured Public					0.57	0.53	0.62	0.000					0.57	0.53	0.62	0.000
Uninsured any time last year					0.34	0.33	0.36	0.000					0.34	0.33	0.36	0.000
Self-reported health (ref = Excellent)																
Good					0.80	0.76	0.84	0.000					0.80	0.76	0.84	0.000
Fair/Poor					0.60	0.57	0.64	0.000					0.60	0.57	0.64	0.000
Region (ref = Northeast)																
Midwest					0.74	0.67	0.83	0.000					0.72	0.66	0.79	0.000
South					0.69	0.62	0.77	0.000					0.69	0.63	0.75	0.000
West					0.90	0.79	1.02	0.103					0.84	0.76	0.94	0.002
Constant, Est (SE)	1.42(0.04)				1.34 (0.10)				1.36(.03)				1.34 (0.10)			
Variance at Level 2, Est (SE)	0.60 (0.05)				0.21 (0.02)				0.60(0.05)				0.21 (0.02)			
Log likelihood statistic	-79496.3				-69276.76				-79492.76				-69280.02			

Scaled, Weighted Data. [a] Standardized with mean = 0 & SD = 1. [b] 10-year increase.

Table 7.9. Multi-Level Model Predicting the Odds of Usual Source of Healthcare By Rural and Urban, Adults Age 18-64

A. BLACK SEGREGATION	Urban								Rural							
	Model 1				Model 2				Model 1				Model 2			
	AOR	Lower	Upper	*p*	AOR	Lower	Upper	*p*	AOR	Lower	Upper	*p*	AOR	Lower	Upper	*p*
Black Segregation	0.95	0.89	1.01		0.94	0.87	1.01		0.99	0.84	1.18		0.97	0.81	1.64	
Black Segregation*Black					1.08	0.99	1.17						1.20	0.89	1.63	
Proportion Poor	0.95	0.90	1.01		0.96	0.89	1.03		0.94	0.83	1.06		0.93	0.83	1.05	
Primary Care Physicians/10,000	1.00	0.99	1.03		1.00	0.98	1.03		0.98	0.94	1.02		0.98	0.94	1.02	
Hospital Beds/10,000	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	

B. HISPANIC SEGREGATION	Urban								Rural							
	Model 1				Model 2				Model 1				Model 2			
	AOR	Lower	Upper	*p*	AOR	Lower	Upper	*p*	AOR	Lower	Upper	*p*	AOR	Lower	Upper	*p*
Hispanic Segregation	0.90	0.85	0.96	***	0.88	0.82	0.94	***	0.95	0.81	1.21		0.87	0.72	1.04	
Hispanic Segregation*Hispanic					1.11	1.02	1.22	**					1.42	0.94	2.17	
Proportion Poor	0.97	0.90	1.04		0.96	0.90	1.04		0.94	0.83	1.05		0.93	0.82	1.04	
Primary Care Physicians/10,000	1.01	0.99	1.03		1.01	0.99	1.03		0.98	0.38	1.02		0.98	0.94	1.02	
Hospital Beds/10,000	1.00	1.00	1.00		1.00	1.00	1.00		1.00	0.99	1.00		1.00	0.99	1.00	

Scaled, Weighted Data. Segregation and Proportion Poor: Standardized with mean = 0 and SD = 1. All Model estimates are derived from a 2-level random intercept model as described in the text which adjusts for gender, age, race/ethnicity, education, poverty, insurance status, self-reported health, and region. Model 2 includes a segregation x race/ethnicity interaction term.

* p < 0.05, ** p<.01, *** p <.001

Table 7.10. Multi-Level Model Predicting the Odds of Unmet Healthcare Need by Urban and Rural, Adults Age 18-64

A. BLACK SEGREGATION	**Urban**								**Rural**							
	Model 1				Model 2				Model 1				Model 2			
	AOR	Lower	Upper	*p*	AOR	Lower	Upper	*p*	AOR	Lower	Upper	*p*	AOR	Lower	Upper	*p*
Black Segregation	1.01	0.94	1.10		1.04	0.95	1.12		0.96	0.83	1.10		1.00	0.87	1.14	
Black Segregation*Black					0.87	0.80	0.95	***					0.66	0.47	0.91	**
Proportion Poor	1.03	1.01	1.06		1.03	1.00	1.06		0.93	0.84	1.03		0.93	0.84	1.03	
Primary Care Physicians/10,000	1.03	1.00	1.06	*	1.03	1.00	1.05	*	1.02	1.00	1.00		1.02	0.98	1.05	
Hospital Beds/10,000	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	

B. HISPANIC SEGREGATION	**Urban**								**Rural**							
	Model 1				Model 2				Model 1				Model 2			
	AOR	Lower	Upper	*p*	AOR	Lower	Upper	*p*	AOR	Lower	Upper	*p*	AOR	Lower	Upper	*p*
Hispanic Segregation	0.97	0.90	1.06		0.93	0.82	1.05		1.04	0.88	1.21		1.10	0.94	1.30	
Hispanic Segregation*Hispanic					1.02	0.94	1.11						0.79	0.65	0.96	*
Proportion Poor	1.03	1.00	1.06		1.03	1.00	1.06		0.92	0.83	1.02		0.92	0.84	1.02	
Primary Care Physicians/10,000	1.03	1.00	1.06	*	1.03	1.01	1.06	*	1.02	0.98	1.05		1.02	0.98	1.05	
Hospital Beds/10,000	0.99	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	

Scaled, Weighted Data. Segregation and Proportion Poor: Standardized with mean = 0 and SD = 1. All Model estimates are derived from a 2-level random intercept model as described in the text which adjusts for gender, age, race/ethnicity, education, poverty, insurance status, self-reported health, and region. Model 2 includes a segregation x race/ethnicity interaction term.

* p < 0.05, ** p<.01, *** p <.001

Table 7.11. Multi-Level Model Predicting the Odds of Cholesterol Screening by Urban and Rural, Adults Age 35-64

A. BLACK SEGREGATION	**Urban**								**Rural**							
	Model 1				Model 2				Model 1				Model 2			
	AOR	Lower	Upper	*p*	AOR	Lower	Upper	*p*	AOR	Lower	Upper	*p*	AOR	Lower	Upper	*p*
Black Segregation	1.13	1.05	1.21	***	1.12	1.04	1.20	***	1.09	0.94	1.27		1.12	0.95	1.31	
Black Segregation*Black					1.05	0.94	1.18						0.82	0.61	1.12	
Proportion Poor	0.99	0.92	1.07		0.99	0.92	1.07		0.89	0.79	1.00	*	0.89	0.80	1.00	
Primary Care Physicians/10,000	1.03	1.01	1.05	**	1.03	1.01	1.05	**	1.01	0.97	1.04		1.01	0.97	1.04	
Hospital Beds/10,000	0.99	0.99	1.00	***	0.99	0.99	1.00	***	1.00	1.00	1.00		1.00	1.00	1.00	

B. HISPANIC SEGREGATION	**Urban**								**Rural**							
	Model 1				Model 2				Model 1				Model 2			
	AOR	Lower	Upper	*p*	AOR	Lower	Upper	*p*	AOR	Lower	Upper	*p*	AOR	Lower	Upper	*p*
Hispanic Segregation	1.07	0.99	1.17		1.06	0.97	1.16		1.05	0.87	1.27		1.07	0.85	1.35	
Hispanic Segregation*Hispanic					1.06	0.94	1.20						0.93	0.76	1.14	
Proportion Poor	1.00	0.92	1.08		1.00	0.92	1.08		0.90	0.80	1.01		0.90	0.80	1.01	
Primary Care Physicians/10,000	1.03	1.01	1.06	**	1.03	1.01	1.06	**	1.01	0.97	1.04		1.01	0.97	1.04	
Hospital Beds/10,000	1.00	0.99	1.00	***	1.00	0.99	1.00	**	1.00	1.00	1.00		1.00	1.00	1.00	

Scaled, Weighted Data. Segregation and Proportion Poor: Standardized with mean = 0 and SD = 1. All Model estimates are derived from a 2-level random intercept model as described in the text which adjusts for gender, age, race/ethnicity, education, poverty, insurance status, self-reported health, and region. Model 2 includes a segregation x race/ethnicity interaction term.

* p < 0.05, ** p<.01, *** p <.001

Table 7.12. Multi-Level Model Predicting the Odds of Cervical Screening by Urban and Rural, Females Age 21-64

A. BLACK SEGREGATION	**Urban**								**Rural**							
	Model 1				Model 2				Model 1				Model 2			
	AOR	Lower	Upper	*p*	AOR	Lower	Upper	*p*	AOR	Lower	Upper	*p*	AOR	Lower	Upper	*p*
Black Segregation	1.06	0.99	1.14		1.04	0.97	1.11		1.06	0.89	1.25		1.04	0.87	1.23	
Black Segregation*Black					1.21	1.09	1.36	***					1.23	0.80	1.88	
Proportion Poor	0.91	0.85	0.98	*	0.91	0.85	0.98	*	1.03	0.93	1.15		1.03	0.93	1.15	
Primary Care Physicians/10,000	1.04	1.01	1.06	**	1.04	1.01	1.06		1.00	0.96	1.05		1.00	0.96	1.05	
Hospital Beds/10,000	0.99	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		0.99	1.00	1.00	

B. HISPANIC SEGREGATION	**Urban**								**Rural**							
	Model 1				Model 2				Model 1				Model 2			
	AOR	Lower	Upper	*p*	AOR	Lower	Upper	*p*	AOR	Lower	Upper	*p*	AOR	Lower	Upper	*p*
Hispanic Segregation	1.02	0.95	1.10		1.04	0.97	1.12		0.93	0.77	1.11		0.96	0.74	1.26	
Hispanic Segregation*Hispanic					0.91	0.80	1.03						0.90	0.68	1.19	
Proportion Poor	0.92	0.85	0.99	*	0.92	0.85	1.00	*	1.04	0.94	1.16		1.05	0.94	1.17	
Primary Care Physicians/10,000	1.04	1.01	1.06	*	1.04	1.01	1.06	**	1.00	0.96	1.05		1.00	0.96	1.05	
Hospital Beds/10,000	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.01		1.00	1.00	1.00	

Scaled, Weighted Data. Segregation and Proportion Poor: Standardized with mean = 0 and SD = 1. All Model estimates are derived from a 2-level random intercept model as described in the text which adjusts for gender, age, race/ethnicity, education, poverty, insurance status, self-reported health, and region. Model 2 includes a segregation x race/ethnicity interaction term.

* p < 0.05, ** p<.01, *** p <.001

Table 7.13. Multi-Level Model Predicting the Odds of Dental Visit by Urban and Rural, Adults Age 18-64

A. BLACK SEGREGATION	**Urban**								**Rural**							
	Model 1				Model 2				Model 1				Model 2			
	AOR	Lower	Upper	*p*	AOR	Lower	Upper	*p*	AOR	Lower	Upper	*p*	AOR	Lower	Upper	*p*
Black Segregation	1.08	1.04	1.12	***	1.07	1.03	1.11	***	1.11	0.99	1.26		1.09	0.96	1.24	
Black Segregation*Black					1.07	1.00	1.15	*					1.17	0.89	1.54	
Proportion Poor	0.89	0.86	0.92	***	0.89	0.86	0.93	***	0.92	0.85	1.01		0.92	0.85	1.00	
Primary Care Physicians/10,000	1.03	1.01	1.04	***	1.03	1.01	1.04	***	1.04	1.00	1.07	*	1.03	1.00	1.07	*
Hospital Beds/10,000	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	

B. HISPANIC SEGREGATION	**Urban**								**Rural**							
	Model 1				Model 2				Model 1				Model 2			
	AOR	Lower	Upper	*p*	AOR	Lower	Upper	*p*	AOR	Lower	Upper	*p*	AOR	Lower	Upper	*p*
Hispanic Segregation	1.00	0.95	1.04		1.00	0.95	1.04		0.93	0.80	1.08		0.86	0.74	1.01	
Hispanic Segregation*Hispanic					1.04	1.00	1.10						1.30	1.00	1.70	
Proportion Poor	0.90	0.85	0.94	***	0.90	0.85	0.94	***	0.94	0.86	1.02		0.93	0.86	1.01	
Primary Care Physicians/10,000	1.03	1.01	1.04	***	1.03	1.01	1.04	***	1.03	1.00	1.07	*	1.03	1.00	1.07	*
Hospital Beds/10,000	1.00	1.00	1.01		1.00	1.00	1.01		0.99	1.00	1.00		1.00	1.00	1.00	

Scaled, Weighted Data. Segregation and Proportion Poor: Standardized with mean = 0 and SD = 1. All Model estimates are derived from a 2-level random intercept model as described in the text which adjusts for gender, age, race/ethnicity, education, poverty, insurance status, self-reported health, and region. Model 2 includes a segregation x race/ethnicity interaction term.

* p < 0.05, ** p<.01, *** p <.001

REFERENCES

1. Eberhardt MS, Ingram DD, Makus DM. Urban and rural health chartbook. Hyattsville, MD: National Center for Health Statistics; 2001.
2. Xu KT. Usual Source of Care in Preventive Service Use: A Regular Doctor versus a Regular Site. Health Serv Res 2002;37(6):1509-1529.
3. Lambrew JM, Defriese GH, Carey TS, Ricketts TC, Biddle AK. The Effects of Having a Regular Doctor on Access to Primary Care. Med Care 1996;34(2):138-151.
4. O'Malley AS. After-Hours Access To Primary Care Practices Linked With Lower Emergency Department Use And Less Unmet Medical Need. Health Aff (Millwood) 2013;32(1):175-183.
5. Bennett KJ, Olatosi, B., Probst, J.C. Health Disparities: A Rural-Urban Chartbook. Columbia, SC: South Carolina Rural Health Research Center; 2008.
6. Larson S, Fleishman JA. Rural-Urban Differences in Usual Source of Care and Ambulatory Service Use. Med Care 2003;41(7):65-74.
7. Chan L, Hart GL, Goodman DC. Geographic Access to Health Care for Rural Medicare Beneficiaries. J Rural Health 2006;22(2):140-146.
8. Casey MM, Call KT, Klinger JM. Are Rural Residents Less Likely to Obtain Recommended Preventive Healthcare Services? Am J Prev Med 2001;21(3):182-188.
9. Doescher MP, Jackson JE. Trends in Cervical and Breast Cancer Screening Practices Among Women in Rural and Urban Areas of the United States. J Public Health Management Practice 2009;15(3):200-209.
10. Diez Roux AVM, C. Neighborhoods and health. Ann N Y Acad Sci 2010;1186:125-145.
11. Kawachi I, Berkman LF. Neighbourhoods and Health. USA: Oxford University Press; 2003.
12. Probst JC, Moore CG, Glover SH, Samuels ME. Person and Place: The Compounding Effects of Race/Ethnicity and Rurality on Health. Am J Public Health 2004;94(10):1695-1703.
13. Bennett KJ, Probst JC, Bellinger JD. Receipt of Cancer Screening Services: Surprising Results for Some Rural Minorities. J Rural Health 2011;28:63-72.
14. Mueller K, Ortega ST, Parker K, Patil K. Health Status and Access to Care Among Rural Minorities. J Health Care Poor Underserved 1999;10(2):230-249.
15. Gaskin D, Dinwiddie GY, Chan KS, McCleary R. Residential Segregation and Disparities in Health Care Services Utilization. Med Care Res Rev 2011;69(2):158-175.
16. Gaskin DJ, Price A, Brandon DT, LaVeist TA. Segregation and Disparities in Health Services Use. Med Care Res Rev 2009;66(5):578-589.
17. Andersen RM. Revisiting the Behavioral Model and Access to Medical Care: Does it Matter? J Health Soc Behav 1995;36(1):1-10.
18. Gulzar L. Access to Health Care. J Nurs Scholarsh 1999;31(1):13-19.
19. Schur CL, Franco SJ. Access to health care. In: Ricketts TC, editor. Rural Health in the United States. New York, NY: Oxford University Press; 1999. p. 25-37.
20. U.S. Department of Health and Human Services. Access to care - Healthy People 2020. In; 2013.
21. Corbie-Smith G, Flagg EW, Doyle JP, O'Brien MA. Influence of Usual Source of Care on Differences by Race/Ethnicity in Receipt of Preventive Services. J Gen Intern Med 2002;17(6):458-464.
22. Starfield B, Shi L. The Medical Home, Access to Care, and Insurance: A Review of Evidence. Pediatrics 2004;113(Supplement 4):1493-1498.
23. Shi L, Nie, X., Wang, T.F. Type of Usual Source of Care and Access to Care. J Ambul Care Manage 2013;36(3):209-221.
24. Zuvekas SH, Taliaferro GS. Pathways to Access: Health Insurance, The Health Care Delivery System, And Racial/Ethnic Disparities, 1996-1999. Health Aff (Millwood) 2003;22(2):139-153.
25. Summary Health Statistics for U.S. Adults: National Health Interview Survey, 2011: Center for Disease Control; 2012.
26. Shi L, Stevens GD. Vulnerability and Unmet Health Care Needs. J Gen Intern Med 2005;20(2):148-154.
27. Ricketts TC, Goldsmith LJ. Access to health services research: The battle of the frameworks. Nurs Outlook 2005;53:274-280.

28. Peterson LE, Litaker, DG. County-Level Poverty Is Equally Associated With Unmet Health Care Needs in Rural and Urban Settings. J Rural Health 2010;26(4):373-382.
29. Diamant AL, Hays RD, Morales LS, Ford W, Calmes D, Asch S, et al. Delays and Unmet Need for Health Care Among Adult Primary Care Patients in a Restructured Urban Public Health System. Am J Public Health 2004;94(5):783-789.
30. Agency for Healthcare Research and Quality. AHRQ at a Glance - AHRQ's Focus and Strategic Goals. In; 2012.
31. Yarnall KSH, Pollak KI, Østbye T, Krause KM, Michener JL. Primary Care: Is There Enough Time for Prevention? Am J Public Health 2003;93(4):635-641.
32. U.S. Preventive Services Task Force. Recommendations. In: Office UP, editor.; 2013.
33. Maciosek MV, Coffield AB, Flottemesch TJ, Edwards NM, Solberg LI. Greater Use Of Preventive Services In U.S. Health Care Could Save Lives At Little Or No Cost. Health Aff (Millwood) 2010;29(9):1656-1660.
34. Smedley BD, Stith AY, Nelson AR. Unequal Treatment. Washington, D.C.: National Academies Press; 2003.
35. Kirby JB, Taliaferro G, Zuvekas SH. Explaining Racial and Ethnic Disparities in Health Care. Med Care 2006;44(5):164-172.
36. Fiscella K, Williams DR. Health Disparities Based on Socioeconomic Inequities: Implications for Urban Health Care. Acad Med 2004;79(12):1139-1147.
37. Comer J, Mueller K. Access to Health Care: Urban-Rural Comparisons from a Midwestern Agricultural State. J Rural Health 1995;11(2):128-136.
38. Laditka JN, Laditka SB, Probst JC. Health care access in rural areas: Evidence that hospitalization for ambulatory care-sensitive conditions in the United States may increase with the level of rurality. Health & Place 2009;15(3):761-770.
39. Larson SL, Hill SC. Rural-Urban Differences in Employment-Related Health Insurance. J Rural Health 2005;21(1):21-30.
40. Klugman CM. Vast Tracts of Land: Rural Healthcare Culture. American Journal of Bioethics 2008;8(4):57-71.
41. Ricketts TC. The Changing Nature of Rural Health Care. Annu Rev Public Health 2000;21(1):639-657.
42. Fiscella K, Franks P, Doescher MP, Saver BG. Disparities in Health Care by Race, Ethnicity, and Language among the Insured; Findings from a National Sample. Med Care 2002;40(1):52-59.
43. Schoen C, Doty MM, Collins SR, Holmgren AL. Insured But Not Protected: How Many Adults Are Underinsured? Health Aff (Millwood) 2005;W5:289-302.
44. Bodenheimer T, Wagner EH, Grumbach K. Improving primary care for patients with chronic illness: The chronic care model, part 2. JAMA 2002;288(15):1909-1914.
45. Macintyre S, Ellaway A, Cummins S. Place effects on health: how can we conceptualise, operationalise and measure them? Soc Sci Med 2002;55:125-139.
46. Litaker DG, Koroukian, S.M., Love, T.E. Context and Healthcare Access: Looking beyond the Individual. Med Care 2005;43(6):531-540.
47. Andersen RM, Yu H, Wyn R, Davidson PL, Brown ER, Teleki S. Access to Medical Care for Low-Income Persons: How do Communities Make a Difference? Med Care Res Rev 2002;59(4):384-411.
48. Link BG, Phelan J. Social Conditions As Fundamental Causes of Disease. J Health Soc Behav 1995;35:80-94.
49. Kirby JB, Kaneda T. Neighborhood Socioeconomic Disadvantage and Access to Health Care. J Health Soc Behav 2005;46(15):15-31.
50. Coughlin SS, Leadbetter S, Richards T, Sabatino SA. Contextual analysis of breast and cervical cancer screening and factors associated with health care access among United States women, 2002. Soc Sci Med 2008;66(2):260-275.
51. Zhang P, Tao G, Irwin KL. Utilization of Preventive Medical Services in the United States: A Comparison Between Rural and Urban Populations. J Rural Health 2000;16(4):349-356.
52. Sibley LM, Weiner JP. An evaluation of access to health care services along the rural-urban continuum in Canada. BMC Health Serv Res 2011;11(20):1-11.
53. Hall MJ, Marsteller J, Owings M. Factors Influencing Rural Residents' Utilization of Urban Hospitals. U.S. Department of Health and Human Services 2010.

54. Arcury TA, Gesler WM, Preisser JS, Sherman J, Spencer J, Perin J. The Effects of Geography and Spatial Behavior on Health Care Utilization among the Residents of a Rural Region. Health Serv Res 2005;40(1):135-156.
55. Wang F, Luo W. Assessing spatial and nonspatial factors for healthcare access: towards an integrated approach to defining health professional shortage areas. Health & Place 2005;11(2):131-146.
56. Larson S, Correa-de-Araujo, R. Preventive Health Examinations: A Comparison Along the Rural-Urban Continuum. Womens Health Issues 2006;16:80-88.
57. Ahn S, Burdine J, Smith M, Ory M, Phillips C. Residential Rurality and Oral Health Disparities: Influences of Contextual and Individual Factors. J Prim Prev 2011;32(1):29-41.
58. Smith KB, Humphreys JS, Wilson MGA. Addressing the health disadvantage of rural populations: How does epidemiological evidence inform rural health policies and research? Aust J Rural Health 2008;16(2):56-66.
59. Dansky KH, Dirani R. The use of health care services by people with Diabetes in rural areas. J Rural Health 1998;14:129-137.
60. Coben JH, Tiesman HM, Bossarte RM, Furbee PM. Rural–Urban Differences in Injury Hospitalizations in the U.S., 2004. Am J Prev Med 2009;36(1):49-55.
61. Lishner DMR, Levine P, Patrick D. Access to primary health care among persons with disabilities in rural areas: a summary of the literature. J Rural Health 1996;12:45-53.
62. Eberhardt MS, Pamuk ER. The Importance of Place of Residence: Examining Health in Rural and Nonrural Areas. Am J Public Health 2004;94(10):1682-1686.
63. Gamm L, Castillo G, Pittman S. Access to Quality Health Services in Rural Areas- Primary Care: A Literature Review. College Station, TX: The Texas A&M University System Health Science Center, School of Rural Public Health, Southwest Rural Health Research Center; 2003.
64. Ziller EC, Lenardson JD, Coburn AF. Health Care Access and Use Among the Rural Uninsured. J Health Care Poor Underserved 2012;23(3):1327 - 1345.
65. Strickland J, Strickland DL. Barriers to Preventive Health Services for Minority Households in the Rural South. J Rural Health 1996;12(3):206- 217.
66. Probst JC, Laditka SB, Wang J-Y, Johnson AO. Effects of residence and race on burden of travel for care: cross sectional analysis of the 2001 US National Household Travel Survey. BMC Health Serv Res 2007;7(40):1-13.
67. Arcury TA, Preisser JS, Gesler WM, Powers JM. Access to Transportation and Health Care Utilization in a Rural Region. J Rural Health 2005;21(1):31-38.
68. Jones CA, Parker TS, Ahearn M, Mishra AK, Variyam JN. Health Status and Health Care Access of Farm and Rural Populations: U.S. Department of Agriculture; 2009.
69. Sarnquist C, Soni, S, Hwang, H, Topol, BB, Mutima, S, Maldonado, YA. Rural HIV-infected women's access to medical care: ongoing needs in California. AIDS Care: Psychological and Socio-medical Aspects of AIDS/HIV 2011;23(7):792-796.
70. Heckman TG, Somlai AM, Kalichman SC, Franzoi SL, Kelly JA. Psychosocial Differences Between Urban and Rural People Living With HIV/AIDS. J Rural Health 1998;14(2):138-145.
71. Garrison MEB. Determinants of the Quality of Life of Rural Families. J Rural Health 1998;14(2):146-154.
72. Robillard H, High D, Sebastian J, Pisaneschi J, Perritt L, Mahler DM. Ethical issues in primary health care: A survey of practitioners' perceptions. J Community Health 1989;14(1):9-17.
73. Smutny G. Patterns of Growth and Change: Depicting the Impacts of Restructuring in Idaho. Prof Geogr 2010;54(3):438-453.
74. Hart LG, Larson, Eric H., Lishner, Denise M. Rural Definitions for Health Policy and Research. Am J Public Health 2005;95(7):1149-1155.
75. Duncan OD, Reiss AJ. Social characteristics of urban and rural communities. New York: Wiley; 1956.
76. Brown D, Swanson L. Challenges for rural America in the twenty-first century. Pennsylvania State University: University Park; 2003.
77. Woods M. Rural. New York: Routledge; 2010.
78. Jackson JE. The Impact of the Built Environment on Health: An Emerging Field. Am J Public Health 2003;93(9):1382-1384.
79. Murdock SH, Cline M, Zey M. Challenges in the Analysis of Rural Populations in the United States. International Handbook of Rural Demography 2012;3:7-15.

80. Burton LM, Garrett-Peters R, Eason JM. Morality, Identity, and Mental Health in Rural Ghettos. In: Social Disparities in Health and Health Care: Springer Science; 2011.
81. Farmer J, Bourke L, Taylor J, Marley JV, Dip JR, Bracksley S, et al. Culture and rural health. Aust J Rural Health 2012;20(5):243-247.
82. Hartley D. Rural Health Disparities, Population Health, and Rural Culture. Am J Public Health 2004;94(10):1675-1678.
83. Coburn AF, MacKinney AC, McBride TD, Mueller KJ, Slifkin RT, Wakefield MK. Choosing Rural Definitions: Implications for Health Policy. Rural Policy Research Institute Health Panel: UNMC; 2007.
84. National Center for Health Statistics. Urban-Rural Classification Scheme for Counties. CDC 2012;2(154).
85. Economic Research Services. Rural-Urban Continuum Codes. In: United States Department of Argriculture; 2013.
86. OMB. 2010 Standards for Delineating Metropolitan and Micropolitan Statistical Areas. In: Budget OoMa, editor.: Federal Register; 2010.
87. Urban Influence Codes. In: United States Department of Agriculture; 2013.
88. Kirby JB, Kaneda T. Access to Health Care: Does Neighborhood Residential Instability Matter? J Health Soc Behav 2006;47(2):142-155.
89. De Marco A, De Marco, M. Conceptualization and measurement of the neighborhood in rural settings: a systematic review of the literature. J Community Psychol 2010;38(1):99-114.
90. Finch BK, Phuong Do D, Heron M, Bird C, Seeman T, Lurie N. Neighborhood effects on health: Concentrated advantage and disadvantage. Health & Place 2010;16(5):1058-1060.
91. Kobetz E, Daniel M, Earp JA. Neighborhood poverty and self-reported health among low-income, rural women, 50 years and older. Health & Place 2003;9(3):263-271.
92. Baker PS, Bodner EV, Allman RM. Measuring Life-Space Mobility in Community-Dwelling Older Adults. J Am Geriatr Soc 2003;51(11):1610-1614.
93. McDade TW, Adair LS. Defining the “urban” in urbanization and health: a factor analysis approach. Soc Sci Med 2001;53(1):55-70.
94. Hofferth SL, Iceland J. Social Capital in Rural and Urban Communities. Rural Sociol 1998;63(4):574-598.
95. Coulton CJ, Korbin J, Chan T, Su M. Mapping residents' perceptions of neighborhood boundaries: a methodological note. Am J Community Psychol 2001;29(2):371- 383.
96. Gee GC. A Multilevel Analysis of the Relationship Between Institutional and Individual Racial Discrimination and Health Status. Am J Public Health 2002;92(4):615-623.
97. Shi L, Macinko, J. Changes in Medical Care Experiences of Racial and Ethnic Groups in the United States, 1996-2002. Int J Health Serv 2008;38(4):653-670.
98. National Healthcare Disparities Report. Rockville, MD: U.S. Department of Health and Human Services; 2012.
99. Hayward RA, Bernard AM, Freeman HE, Corey CR. Regular source of ambulatory care and access to health services. Am J Public Health 1991;81(4):434-438.
100. Statistics NCfH. Table 84. Use of Pap smears among women aged 18 and over, by selected characteristics: United States, selected years 1987–2010.; 2013.
101. Einbinder LC, Schulman KA. The Effect of Race on the Referral Process for Invasive Cardiac Procedures. Med Care Res Rev 2000;57(4 suppl):162-180.
102. Van Ryn M, Burke J. The effect of patient race and socio-economic status on physicians' perceptions of patients. Soc Sci Med 2000;50(6):813-828.
103. Jupka KA, Weaver NL, Sanders-Thompson VL, Caito NM, Kreuter M. African American Adults' Experiences with the Health Care System: In Their Own Words. Journal of Health Disparities Research and Practice 2008;2(3):17-32.
104. LaVeist TA, Nickerson KJ, Bowie JV. Attitudes about Racism, Medical Mistrust, and Satisfaction with Care among African American and White Cardiac Patients. Med Care Res Rev 2000;57(4 suppl):146-161.
105. Schulman KA, Berlin JA, Harless W, Kerner JF, Sistrunk S, Gersh BJ, et al. The Effect of Race and Sex on Physicians' Recommendations for Cardiac Catheterization. N Engl J Med 1999;340(8):618-626.
106. Shoff C, Yang T-C. Untangling the association among distrust, race, and social environment: A social disorganization perspective. Soc Sci Med 2012;74(9):1342-1352.

107. Stepanikova I, Mollborn S, Cook KS, Thom DH, Kramer RM. Patients' Race, Ethnicity, Language, and Trust in a Physician. J Health Soc Behav 2006;47(4):390-405.
108. Zuckerman S, Haley J, Roubideauz Y, Lillie-Blanton M. Health Service Access, Use, and Insurance Coverage Among American Indians/Alaska Natives and Whites: What Role Does the Indian Health Service Play? Am J Public Health 2004;94(1):53-59.
109. Weathers A, Minkovitz C, O'Campo P, Diener-West M. Access to care for children or migratory agricultural workers: factors associated with unmet need for medical care. Pediatrics 2004;113:e276-e282.
110. DeNavas-Walt C, Proctor BD, Smith JC. Income, Poverty, and Health Insurance Coverage in the United States: 2009. In: Estes C, Chapman S, Dodd C, Hollister B, Harrington C, editors. Health Policy: Crisis and Reform. 6 ed. Burlington, MA: Jones & Bartlett; 2013.
111. Smedley BD, Stith AY, Nelson AR. Unequal treatment: Confronting racial and ethnic disparities in health care. Washington, DC: National Academies Press.
112. Massey DSD, N.A. American Apartheid segregation and the making of the underclass. Cambridge, MA: Harvard University Press; 1993.
113. Williams DR, Collins C. Racial residential segregation: A fundamental cause of racial disparities in health. Public Health Rep 2001;116:404-416.
114. Williams DR. Race, Socioeconomic Status, and Health The Added Effects of Racism and Discrimination. Ann N Y Acad Sci 1999;896(1):173-188.
115. Massey DSD, N.A. The Dimensions of Residential Segregation. Soc Forces 1988;67(2):281-315.
116. Collins C, Williams D. Segregation and Mortality: The Deadly Effects of Racism? Sociol Forum 1999;14(3):495-523.
117. Bonilla-Silva E. Rethinking Racism: Toward a Structural Interpretation. Am Sociol Rev 1997;62(3):465-480.
118. Powell JA. Strutural Racism: Building Upon the Insights of John Calmore. North Carolina Law Review 2008;86(791).
119. Viruell-Fuentes EA, Miranda PY, Abdulrahim S. More than culture: Structural racism, intersectionality theory, and immigrant health. Soc Sci Med 2012;75(12):2099-2106.
120. Gee GC, Ford CL. Structural Racism and Health Inequities. Du Bois Review: Social Science Research on Race 2011;8(01):115-132.
121. Kramer MR, Hogue CR. Is Segregation Bad for Your Health? Epidemiol Rev 2009;31(1):178-194.
122. Charles CZ. The Dynamics of Racial Residential Segregation. Annu Rev Sociol 2003;29:167-207.
123. Massey DS. America becoming: racial trends and their consequences. Residential segregation neighorhood conditions in US metropolitan areas. In: America Becoming: Racial Trends and Their Consequences. Washington, DC: National Academy Press; 2001. p. 391-428.
124. Subramanian SV, Acevedo-Garcia D, Osypuk TL. Racial residential segregation and geographic heterogeneity in black/white disparity in poor self-rated health in the US: a multilevel statistical analysis. Soc Sci Med 2005;60(8):1667-1679.
125. Lichter DT, Parisi D, Taquino MC, Grice SM. Residential segregation in new Hispanic destinations: Cities, suburbs, and rural communities compared. Soc Sci Res 2010;39(2):215-230.
126. Vaughan Sarrazin MS, Campbell ME, Richardson KK, Rosenthal GE. Racial Segregation and Disparities in Health Care Delivery: Conceptual Model and Empirical Assessment. Health Serv Res 2009;44(4):1424-1444.
127. Smith DB, Feng Z, Fennell ML, Zinn JS, Mor V. Separate And Unequal: Racial Segregation And Disparities In Quality Across U.S. Nursing Homes. Health Aff (Millwood) 2007;26(5):1448-1458.
128. Bach PB, Pham, H.H., Schrag, D., Tate, R.C., Hargraves, J.L. Primary Care Physicians Who Treat Blacks and Whites. N Engl J Med 2004;351(6):575-584.
129. Haas JS, Phillips KA, Sonneborn D, McCulloch CE, Baker LC, Kaplan CP, et al. Variation in Access to Health Care for Different Racial/Ethnic Groups by the Racial/Ethnic Composition of an Individual's County of Residence. Med Care 2004;42(7):707-714.
130. Schulz AJ, Williams DR, Israel BA, Lempert LB. Racial and Spatial Relations as Fundamental Determinants of Health in Detroit. Milbank Q 2002;80(4):677-707.
131. Warner E, Gomez S. Impact of Neighborhood Racial Composition and Metropolitan Residential Segregation on Disparities in Breast Cancer Stage at Diagnosis and Survival Between Black and White Women in California. J Community Health 2010;35(4):398-408.

132. White K, Haas JS, Williams DR. Elucidating the Role of Place in Health Care Disparities: The Example of Racial/Ethnic Residential Segregation. Health Serv Res 2012;47(3):1278-1299.
133. White K, Borrell, L.N. Racial/ethnic residential segregation: Framing the context of health risk and health disparities. Health & Place 2011;17(2):438-448.
134. Kramer M, Cooper H, Drews-Botsch C, Waller L, Hogue C. Do measures matter? Comparing surface-density-derived and census-tract-derived measures of racial residential segregation. International Journal of Health Geographics 2010;9(1):29.
135. Diez Roux AV. Neighborhoods and health: where are we and were do we go from here? Rev Epidemiol Sante Publique 2007;55(1):13-21.
136. Beyer KM, Comstock S, Seagren R, Rushton G. Explaining place-based colorectal cancer health disparities: Evidence from a rural context. Soc Sci Med 2011;72(3):373-382.
137. Cole AM, Jackson JE, Doescher M. Colorectal Cancer Screening Disparities for Rural Minorities in the United States. J of Primary Care & Community Health 2012;4(2):106-111.
138. Auchincloss AH, van Nostrand, J., Ronsaville, D. Access to Health Care for Older Persons in the United States: Personal, Structural, and Neighborhood Characteristics. J Aging Health 2011;13(3):329-354.
139. CDC Health Disparities and Inequalities Report - United States, 2011. MMWR: Centers for Disease Control and Prevention; 2011.
140. Probst JC, Bellinger JD, Walsemann KM, Hardin J, Glover SH. Higher Risk of Death in Rural Black and Whites Than Urbanites Is Related to Lower Incomes, Education, and Health Coverage. Health Aff (Millwood) 2011;30(10):1872-1879.
141. Baldwin LM, Hollow WB, Casey S, Hart LG, Larson EH, Moore K, et al. Access to Speciality Health Care for Rural American Indians in Two States. J Rural Health 2008;24(3):269- 278.
142. Cunningham PJ, Cornelius LJ. Access to ambulatory care for American Indians and Alaska Natives; the relative importance of personal and community resources. Soc Sci Med 1995;40(3):393-407.
143. Viruell-Fuentes EA. Beyond acculturation: Immigration, discrimination, and health research among Mexicans in the United States. Soc Sci Med 2007;65(7):1524-1535.
144. Zambrana RE, Carter-Pokras O. Role of Acculturation Research in Advancing Science and Practice in Reducing Health Care Disparities Among Latinos. Am J Public Health 2010;100(1):18-23.
145. Cristancho S, Garces DM, Peters KE, Mueller BC. Listening to Rural Hispanic Immigrants in the Midwest: A Community-Based Partiipatory Assessment of Major Barriers to Health Care Access and Use. Qual Health Res 2008;18(5):633-646.
146. Rohrer JE, Kruse G, Zhang Y. Hispanic Ethnicity, Rural Residence, and Regular Source of Care. J Community Health 2004;29(1):1-13.
147. Berdahl TA, Kirby JB, Torres Stone RA. Access to Health Care for Nonmetro and Metro Latinos of Mexican Origin in the United States. Med Care 2007;45(7):647- 654.
148. Gresenz CR, Derose KP, Ruder T, Escarce JJ. Health Care Experiences of Hispanics in New and Traditional U.S. Destinations. Med Care Res Rev 2012;69(6):663-678.
149. Lichter DT, Parisi D, Grice SM, Taquino MC. National estimates of racial segregation in rural and small-town America. Demography 2007;44(3):563-581.
150. Albrecht DE, Albrecht CM, Murguia E. Minority Concentration, Disadvantage, and Inequality in the Nonmetropolitan United States Sociological Quarterly 2005;46(3):503-523.
151. Alba RD, Logan JR, Stults BJ. How Segregated Are Middle-Class African Americans? Soc Probl 2000;47(4):543-558.
152. Fong E, Shibuya K. Multiethnic Cities in North America. Annu Rev Sociol 2005;31:285-304.
153. Johnson JH, Parnell A, Joyner AM, Christman CJ, Marsh B. Racial apartheid in a small North Carolina town. Review of Black Political Economy 2004;31(4):89-107.
154. Ricketts TC. Rural health in the United States. New York, NY: Oxford University Press; 1999.
155. Duncan CM. Worlds apart: Why poverty persists in rural America. New Haven, CT: Yale University; 1999.
156. Parisi D, McLaughlin DK, Grice SM, Taquino M. Exiting TANF: Individual and Local Factors and Their Differential Influence Across Racial Groups. Social Science Quarterly 2006;87(1):76-90.
157. Lichter DT, Johnson KM. The Changing Spatial Concentration of America's Rural Poor Population*. Rural Sociol 2007;72(3):331-358.

158. Carter JS, Steelman LC, Mulkey LM, Borch C. When the rubber meets the road: effects of urban and regional residence on principle and implementation measures of racial tolerance. Soc Sci Res 2005;34(2):408-425.
159. Falk WW, Hunt LL, Hunt MO. Return Migrations of African-Americans to the South: Reclaiming a Land of Promise, Going Home, or Both? Rural Sociol 2004;69(4):490-509.
160. Aiken CS. A new type of black ghetto in the plantation South. Annals of the Association of American Geographers 1990;80(2):223-246.
161. Sampson RJ, Morenoff JD. Durable Inequality: Spatial Dynamics, Social Processes, and Persistence of Poverty in Chicago Neighborhoods. In: Bowles S, Durlauf S, Hoff K, editors. Poverty Traps. Princeton, NJ: Princeton University Press; 2006. p. 176-203.
162. Johnson KM. Rural Demographic Change in the New Century: Slower Growth, Increased Diversity: University of New Hampshire; 2012.
163. Resource on Poverty Measurement, Poverty Lines, and Their History. In. Office of the Assistant Secretary for Planning and Evaluation: U.S. Department of Health and Human Services; 2014.
164. Pickett KE, Pearl M. Multilevel analysis of neighbourhood socioeconomic context and health outcomes: a critical review. J Epidemiology Community Health 2001;55:111-122.
165. Kim D, Kawachi I. A Multilevel Analysis of Key Forms of Community- and Individual-Level Social Capital as Predictors of Self-Rated Health in the United States. Journal of Urban Health: Bulletin of the New York Academy of Medicine 2006;83(5):813- 826.
166. Mair C, Roux AVD, Galea S. Are neighbourhood characteristics associated with depressive symptoms? A review of evidence. J Epidemiol Community Health 2008;62(11):940-946.
167. Sampson RJ, Raudenbush SW, Earls F. Neighborhood and Violent Crime: A Multilevel Study of Collective Efficacy. Science 1997;277(5328):918-924.
168. Diez Roux AV, Merkin S, Arnett D, al e. Neighorhood of Residence and Incidence of Coronary Heart Disease. N Engl J Med 2001;345(2):99-106.
169. Winkleby M, Cubbin C, Ahn D. Effect of Cross-Level Interaction Between Individual and Neighborhood Socioeconomic Status on Adult Mortality Rates. Am J Public Health 2006;96(12):2145-2153.
170. Caughy MO, O'Campo PJ, Muntaner C. When being alone might be better: neighborhood poverty, social capital, and child mental health. Soc Sci Med 2003;57:227-237.
171. Jargowsky PA. Poverty and Place: Ghettos, Barrios, and the American City. New York, NY: Russell Sage Foundation; 1997.
172. Carlisle DM, Valdez RB, Shapiro MF, al e. Geographic variation in rates of selected surgical procedures with Los Angeles County. Health Services Report 1995;30:27-42.
173. Jolliffe D. Persistent poverty is more pervasive in nonmetro counties. Amber Waves 2004;2(4):11.
174. Beale CL, Gibbs, R.M. Severity and concentration of persistent high poverty in nonmetro areas. Amber Waves 2006;4(1):10-11.
175. Engelman KK, Hawley DB, Gazaway R. Impact of geographic barriers on the utilization of mammograms by older rural women. J Am Geriatrics Soc 2002;50:62-68.
176. Council HA. Poverty in Rural America. In. Washington, DC; 2011.
177. Coughlin SS, Thompson TD. Colorectal Cancer Screening Practices Among Men and Women in Rural and Nonrural Areas of the United States, 1999. J Rural Health 2004;20(2):118-124.
178. Lumsden LL. Extent of rural health service in the United States, 1925-29. Public Health Rep 1929;44(1202):1207.
179. Singh R, Lichter MI, Danzo A, Taylor J, Rosenthal T. The Adoption and Use of Health Information Technology in Rural Areas: Results of a National Survey. J Rural Health 2012;28(1):16-27.
180. Mansfield CJ, Wilson JL, Kobrinski EJ, Mitchell J. Premature mortality in the United States: the roles of geographic area, socioeconomic status, household type, and availability of medical care. Am J Public Health 1999;89(6):893-898.
181. Baldwin KA, Sisk RJ, Watts P, McCubbin J, Brockschmidt B, Marion LN. Acceptance of Nurse Practitioners and Physician Assistants in Meeting the Perceived Needs of Rural Communities. Public Health Nurs 1998;15(6):389-397.
182. Galea S, Vlahov D. Epidemiology and Urban Health Research. In: Handbook of urban health: populations, methods, and practice: Springer Science; 2005.
183. Frezen PD. Health Insurance Coverage in U.S. Urban and Rural Areas. J Rural Health 1993;9(3):204-214.

184. Hartley D, Quam L, Lurie N. Urban and Rural Differences in Health Insurance and Access to Care. J Rural Health 1994;10(2):98-108.
185. Aday LA, Andersen R. A Framework for the Study of Access to Medical Care. Health Serv Res 1974;9(3):208-220.
186. Phillips KA, Morrison KR, Andersen RM, Aday LAA, R. Understanding the context of healthcare utilization: assessing environmental and provider-related variables in the behavioral model of utilization. Health Serv Res 1998;33(3):571-596.
187. Phelan JC, Link BG, Diez-Roux A, Kawachi I, Levin B. "Fundamental Causes" of Social Inequalities in Mortality: A Test of the Theory. J Health Soc Behav 2004;45(3):265-285.
188. Phelan JC, Link BG, Tehranifar P. Social Conditions as Fundamental Causes of Health Inequalities: Theory, Evidence, and Policy Implications. J Health Soc Behav 2010;51(1 suppl):S28-S40.
189. Lutfey K, Freese J. Toward Some Fundamentals of Fundamental Causality: Socioeconomic Status and Health in the Routine Clinic Visit for Diabetes. American Journal of Sociology 2005;110(5):1326-1372.
190. Link BG. Epidemiological Sociology and the Social Shaping of Population Health. J Health Soc Behav 2008;49(4):367-384.
191. House J, Williams DR. Understanding and Reducing Socioeconomic and Racial/Ethnic Disparities in Health. In: Smedley BD, Syme SL, editors. Promoting Health: Intervention Strategies from Social and Behavioral Research. Washington, DC: National Academy Press; 2000.
192. Link BG, Northridge ME, Phelan JC, Ganz ML. Social Epidemiology and the Fundamental Cause Concept: On the Structuring of Effective Cancer Screens by Socioeconomic Status. Milbank Q 1998;76(3):375-402.
193. Cummins S, Curtis S, Diez-Roux AV, Macintyre S. Understanding and representing 'place' in health research: A relational approach. Soc Sci Med 2007;65(9):1825-1838.
194. Araya R, Dunstan F, Playle R, Thomas H, Palmar S, Lewis G. Perceptions of Social Capital and the Built Environment and Mental Health. Soc Sci Med 2006;62:3072-3083.
195. Gordon-Larsen P, Nelson MC, Page P, Popkin BM. Inequality in the Built Environment Underlies Key Health Disparities in Physical Activity and Obesity. Pediatrics 2006;117(2):417-424.
196. Yang T-C, Matthews SA. The role of social and built environments in predicting self-rated stress: A multilevel analysis in Philadelphia. Health & Place 2010;16(5):803-810.
197. Krieger N. Theories for social epidemiology in the 21st century: an ecosocial perspective. Int J Epidemiol 2001;30(4):668-677.
198. Krieger N, Waterman PD, Chen JT, Rehkopf DH, Subramanian SV. Geocoding and monitoring US socioeconomic inequalities in health: an introduction to using area-based socio-economic measures -- The Public Health Disparities Geocoding Project monograph. In. Boston, MA: Harvard School of Public Health; 2004.
199. Fishcer CS. The Urban Experience. New York: Harcourt Brace Javanovich; 1976.
200. Krieger N. Got Theory? On the 21st c. CE Rise of Explicit use of Epidemiologic Theories of Disease Distribution: A Review and Ecosocial Analysis. Current Epidemiology Reports 2014;1(1):45-56.
201. Andersen RM, McCutchean, A., Aday, L.A. et al. Exploring dimensions of access to medical care. Health Serv Res 1983;18:49-74.
202. Ross CE, Mirowsky J. Neighborhood Socioeconomic Status and Health: Context or Composition? City & Community 2008;7(2):163-179.
203. Ku L, Matani S. Left Out: Immigrants' Access To Health Care And Insurance. Health Aff (Millwood) 2001;20(1):247-256.
204. Lu N, Samuels ME, Kletke PR, Whitler ET. Rural-Urban Differences in Health Insurance Coverage and Patterns Among Working-Age Adults in Kentucky. J Rural Health 2010;26:129-138.
205. Monnat SM, Beeler Pickett C. Rural/urban differences in self-rated health: Examining the roles of county size and metropolitan adjacency. Health & Place 2011;17(1):311-319.
206. Krieger N. Refiguring "Race": Epidemiology, Racialized Biology, and Biological Expressions of Race Relations. Int J Health Serv 2000;30(1):211-216.
207. Green A, Carney D, Pallin D, Ngo L, Raymond K, Iezzoni L, et al. Implicit Bias among Physicians and its Prediction of Thrombolysis Decisions for Black and White Patients. J Gen Intern Med 2007;22(9):1231-1238.
208. Williams DR, Collins C. US Socioeconomic and Racial Differences in Health: Patterns and Explanations. Annu Rev Sociol 1995;21:349-386.

209. Kaufman JS, Cooper RS, McGee DL. Socioeconomic Status and Health in Blacks and Whites: The Problem of Residual Confounding and the Resiliency of Race. Epidemiology 1997;8(6):621-628.
210. Chowdhury PP, Balluz L, Okoro C, Strine T. Leading Health Indicators: A Comparison of Hispanics with Non-Hispanic Whites and Non-Hispanic Blacks, United States 2004. Ethn Dis 2006;16:534-541.
211. Acevedo-Garcia D. Residential segregation and the epidemiology of infectious diseases. Soc Sci & Med 2000;51(8):1143-1161.
212. Gee GC, Devon CP-S. Environmental Health Disparities: A Framework Integrating Psychosocial and Environmental Concepts. Environ Health Perspect 2004;112(17):1645-1653.
213. Shihadeh ES, Ousey GC. Metropolitan Expansion and Black Social Dislocation: The Link between Suburbanization and Center-City Crime. Soc Forces 1996;75(2):649-666.
214. Foulkes M, Newbold KB. Poverty Catchments: Migration, Residential Mobility, and Population Turnover in Impoverished Rural Illinois Communities. Rural Sociol 2008;73(3):440-462.
215. Foulkes M, Schafft KA. The Impact of Migration on Poverty Concentration in the United States, 1995-2000. Rural Sociol 2010;75(1):90-110.
216. Lichter DT, Brown DL. Rural America in an Urban Society: Changing Spatial and Social Boundaries. Annu Rev Sociol 2011;37:565-592.
217. Wilson WJ. The Political and Economic Forces Shaping Concentrated Poverty. Political Science Quarterly 2008;123(4):555-571.
218. Bullough B. Alienation in the Ghetto. American Journal of Sociology 1967;72(5):469-478.
219. Wallace R. Urban desertification, public health and public order: 'Planned shrinkage', violent death, substance abuse and AIDS in the Bronx. Soc Sci Med 1990;31(7):801-813.
220. Geroniumus AT. To mitigate, resist, or undo: addressing structural influences on the health of urban populations. Am J Public Health 2000;90(6):867-872.
221. Kwate NOA. Fried chicken and fresh apples: Racial segregation as a fundamental cause of fast food density in black neighborhoods. Health & Place 2008;14(1):32-44.
222. LaVeist TA. Segregation, Poverty, and Empowerment: Health Consequences for African Americans. The Milbank Quarterly 1993;71(1):41-64.
223. The Medical Expenditure Panel Survey: Full-Year Consolidate Data File. In: Quality AfHRa, editor.: U.S. Department of Health and Human Services; 2010.
224. American Community Survey. In. U.S. Census Bureau: 5-Year Data Release; 2013.
225. Census. American Community Survey: 2005-2009 Estimates. In: Data Ferrett. Generated by Julia Caldwell using the DataFerrett: U.S. Census Bureau; 2010. p. .
226. Area Health Resource File: National County-level Health Resource Information Database. In: Health Resources and Services Administration; 2013.
227. American Community Survey. Geographic Tracts and Block Groups in 2005-2009 ACS 5-year Estimates with Geographic Code and Defintion Problems. In: U.S. Census Bureau; 2011.
228. Cunningham PJ, Kemper, P. The Uninsured Getting Care: Where You Live Matters. Center for Studying Health System Change; 1998.
229. Weintraub WS, Daniels SR, Burke LE, Franklin BA, Goff DC, Hayman LL, et al. Value of Primordial and Primary Prevention for Cardiovascular Disease: A Policy Statement From the American Heart Association. Circulation 2011;124(8):967-990.
230. Hoyert DL, Xu, J. Deaths: Preliminary Data for 2011. National Vital Statistics System: CDC; 2012.
231. Cramer DW. The role of cervical cytology in the declining morbidity and mortality of cervical cancer. Cancer 1974;34(6):2018-2027.
232. New Screening Guidelines for Cervical Cancer. In: Cancer C, editor.: American Cancer Society; 2012.
233. Metropolitan and Micropolitan Statistical Area. In: U.S. Census Bureau; 2000.
234. Ricketts TC, Johnson-Webb KD, Taylor P. Definitions of Rural: A Handbook for Health Policy Makers and Researchers: Health Resources and Services Administration; 1998.
235. County Typology Code. In: Service ER, editor.: United States Department of Agriculture; 2004.
236. Rural-Urban Commuting Area Codes. In: Service ER, editor.: United States Department of Agriculture; 2000.
237. WWAMI Rural Health Research Center. Rural Urban Commuting Area Code. In; 2014.
238. Hailu A, VanEenwyk, J. Guidelines for Using Rural-Urban Classification Systems for Public Health Assessment 2009.

239. Wallace AE, Lee R, MacKenzie TA, West AN, Wright S, Booth BM, et al. A Longitudinal Analysis of Rural and Urban Veterans' Health-Related Quality of Life. J Rural Health 2010;26(2):156-163.
240. Weeks WB, Kazis LE, Shen Y, Cong Z, Ren XS, Miller D. Differences in health-related quality of life in rural and urban veterans. Am J Public Health 2004;94(10):1762-1767.
241. Acevedo-Garcia D, Lochner KA, Osypuk TL, Subramanian SV. Future Directions in Residential Segregation and Health Research: A Multilevel Approach. Am J Public Health 2003;93(2):215-221.
242. Massey DS, Rothwell J, Domina T. The Changing Bases of Segregation in the United States. The ANNALS of the American Academy of Political and Social Science 2009;626(1):74-90.
243. Ko M, Needleman J, Derose KP, Laugesen MJ, Ponce NA. Residential Segregation and the Survival of U.S. Urban Public Hospitals. Med Care Res Rev 2013.
244. Guagliardo MF. Spatial accessibility of primary care: concepts, methods and challenges. International Journal of Health Geographics 2004;3(3).
245. Fiscella K, Franks P, Gold MR, Clancy CM. Inequality in quality: Addressing socioeconomic, racial, and ethnic disparities in health care. JAMA 2000;283(19):2579-2584.
246. Hargraves JL, Hadley, J. The Contribution of Insurance Coverage and Community Resources to Reducing Racial/Ethnic Disparities in Access to Care. Health Serv Res 2003;38(3):809-829.
247. Ponce NA, Hays RD, Cunningham WE. Linguistic Disparities in Health Care Access and Health Status Among Older Adults. J Gen Intern Med 2006;21(7):786-791.
248. Shen YC, McFeeters, J. Out-of-Pocket Health Spending Between Low- and Higher-Income Populations: Who is at Risk of Having High Expenses and High Burdens? Med Care 2006;44(3):200-209.
249. Institute for Digital Research and Education. Multiple Imputation in Stata. In. UCLA.
250. Heeringa SG, West BT, Berglund PA. Applied Survey Data Analysis. Boca Raton, FL: Chapman & Hall; 2010.
251. Pooled Linkage Variance Estimation File. In: Survey MEP, editor.: Agency for Healthcare Research and Quality; 2013.
252. Muthen BO, Satorra, A. Complex Sample Data in Structural Equation Modeling. In: Marsden PV, editor. Sociological Methodology. Washington, DC: American Sociological Association; 1995.
253. Carle AC. Fitting multilevel models in complex survey data with design weights: Recommendations. BMC Med Res Methodol 2009;9(29).
254. Rabe-Hesketh S, Skrondal, A. Multilevel modelling of complex survey data. Journal of the Royal Statistical Society: Series A (Statistics in Society) 2006;169(4):805-827.
255. Kershaw KN, Diez Roux AV, Burgard SA, Lisabeth LD, Mujahid MS, Schulz AJ. Metropolitan-Level Racial Residential Segregation and Black-White Disparities in Hypertension. Am J Epidemiol 2011.
256. Rabe-Hesketh S, Skrondal, A., Pickles, A. GLLAMM Manuel: University of California, Berkeley; 2004.
257. Asparouhov T. Sampling weights in latent variable modeling. Structural Equation Modeling 2005;12(3):411-434.
258. Merlo J. Multilevel analytical approaches in social epidemiology: measures of health variation compared with traditional measures of association. J Epidemiol Community Health 2003;57(8):550-552.
259. Merlo J, Chaix B, Ohlsson H, Beckman A, Johnell K, Hjerpe P, et al. A brief conceptual tutorial of multilevel analysis in social epidemiology: using measures of clustering in multilevel logistic regression to investigate contextual phenomena. J Epidemiol Community Health 2006;60(4):290-297.
260. Rabe-Hesketh S, Skrondal A, Pickles A. Maximum likelihood estimation of limited and discrete dependent variable models with nested random effects. Journal of Econometrics 2005;128(2):301-323.
261. Rabe-Hesketh S, Skrondal, A. Multilevel and Longitudinal Modeling Using Stata. College Station, TX: Stata Press; 2008.
262. Mood C. Logistic Regression: Why We Cannot Do What We Think We Can Do, and What We Can Do About It. European Sociological Review 2010;26(1):67-82.
263. Aneshensel CS. Theory-Based Data Analysis for Social Sciences. Thousand Oaks, CA: Sage Publications; 2013.
264. Hall SA, Kaufman JS, Ricketts TC. Defining Urban and Rural Areas in U.S. Epidemiologic Studies. Journal of Urban Health: Bulletin of the New York Academy of Medicine 2006;83(2):162- 175.
265. Cromarities J, Bucholtz S. Defining the "Rural" in Rural America. In: Service ER, editor.: USDA; 2008.
266. Ziller E, Coburn AF, Anderson N, Loux SL. Uninsured Rural Families. J Rural Health 2008;24(1):1-11.

267. Glover SH, Moore CG, Probst JC, Samuels ME. Disparities in Access to Care Among Rural Working-age Adults. J Rural Health 2004;20(3):193-205.
268. Centers for Disease Control and Prevention. Racial and Ethnic Approaches to Community Health. In.
269. CDC. National Breast and Cervical Cancer Early Detection Program (NBCCEDP). In; 2015.
270. Rudavsky R, Pollack CE, Mehrotra A. The Geographic Distribution, Ownership, Prices, and Scope of Practice at Retail Clinics. Ann Intern Med 2009;151(5):315-320.
271. Mehrotra A, Wang MC, Lave JR, Adams JL, McGlynn EA. Retail Clinics, Primary Care Physicians, And Emergency Departments: A Comparison Of Patients' Visits. Health Aff (Millwood) 2008;27(5):1272-1282.
272. Warren J. Rural Public Health: Best Practices and Preventive Models. New York, NY: Springer Publishing Company; 2014.
273. Rempel SL. Building a Conceptual Anthropological Framework of Rural American Medicine: Understanding the Culture of Rural Physicians and Factors Influencing Retention. In. St. Louis, MO: Department of Anthropology; 2012.
274. Kempf AM, Remington PL. New Challenges for Telephone Survey Research in the Twenty-First Century. Annu Rev Public Health 2007;28(1):113-126.
275. Benjamins MR, Kirby JB, Bond Huie SA. County characteristics and racial and ethnic disparities in the use of preventive services. Prev Med 2004;39(4):704-712.
276. Gaines TL, Caldwell JT, Ford CL, Mulatu MS, Godette DC. Relationship between a CDC Expanded HIV Testing Initiative and Past-Year Testing by Race/Ethnicity: A Multilevel Analysis of BRFSS. In; 2015.
277. What is a Health Center? In: HRSA, editor. Primary Care: The Health Center Program; 2015.
278. Massey DS, Denton NA. Hypersegregation in US metropolitan areas: black and Hispanic segregation along five dimensions. Demography 1989;August:373.
279. Gresenz CR, Rogowski J, Escarce JJ. Community Demographics and Access to Health Care among U.S. Hispanics. Health Research and Educational Trust 2009;44(5, Part 1):1542-1562.
280. Prentice JC. Neighborhood effects on primary care access in Los Angeles. Soc Sci Med 2006;62:1291-1303.
281. Chang E, Chan KS. Variations in Asian Americans: How Neighborhood Concordance Is Associated With Health Care Access and Utilization. Am J Public Health 2014;105(1):66-68.
282. Yinger J. Closed Doors, Opportunities Lost: The Continuing Costs of Housing Discrimination. New York, NY; 1995.
283. Komaromy M, Grumbach K, Drake M, al e. The role of black and Hispanic physicians in providing health care for underserved populations. N Engl J Med 1996;334:1305-1310.
284. LaVeist TA, Nuru-Jeter A. Is Doctor-Patient Race Concordance Associated with Greater Satisfaction with Care? J Health Soc Behav 2002;43(3):296-306.
285. LaVeist TA. Linking residential segregation to the infant-mortality race disparity in US cities. Sociology and Social Research 1989;73:90-94.
286. Blanchard TC. Conservative Protestant Congregations and Racial Residential Segregation: Evaluating the Closed Community Thesis in Metropolitan and Nonmetropolitan Counties. Am Sociol Rev 2007;72:416-433.
287. Anderson GH, J. The growing burden of chronic disease in America. Public Health Rep 2004;119(3):263-270.
288. Diez Roux AV. Estimating neighborhood health effects: the challenges of causal inference in a complex world. Soc Sci Med 2004;58:1953-1960.
289. Burton LM, Lichter DT, Baker RS, Eason JM. Inequality, Family Processes, and Health in the "New" Rural America. Am Behav Sci 2013.
290. Stange KC, Zyzanski SJ, Smith TF, Kelly R, Langa DM, Flocke SA, et al. How Valid Are Medical Records and Patient Questionnaires for Physician Profiling and Health Services Research?: A Comparison With Direct Observation of Patient Visits. Med Care 1998;36(6).
291. Smedley BD. Moving Beyond Access: Achieving Equity In State Health Care Reform. Health Aff (Millwood) 2008;27(2):447-455.
292. Gelberg L, Andersen RM, Leake BD. The Behavioral Model for Vulnerable Populations: Application to Medical Care Use and Outcomes for Homeless People. Health Serv Res 2000;34(6):1273-1302.

293. Bradley EH, McGraw SA, Curry L, Buckser A, King KL, Kasl SV, et al. Expanding the Andersen Model: The Role of Psychosocial Factors in Long-Term Care Use. Health Serv Res 2002;37(5):1221-1242.
294. CDC. Cervical Cancer Rates by Race and Ethnicity. In; 2014.
295. Singh GK. Rural-urban trends and patterns in cervical cancer mortality, incidence, stage, and survival in the United States, 1950-2008. J Community Health 2012;37(1):217-23.
296. Keppel KG, Pearchy JN, Heron MP. Is There Progress Toward Eliminating Racial/Ethnic Disparities in the Leading Causes of Death? Public Health Rep 2010;125(5):689-697.
297. Press R, Carrasquillo O, Sciacca RR, Giardina E-GV. Racial/Ethnic Disparities in Time to Follow-Up after an Abnormal Mammogram. J Womens Health 2008;17(6):923-930.
298. Allen JD, Shelton RC, Harden E, Goldman RE. Follow-up of abnormal screening mammograms among low-income ethnically diverse women: Findings from a qualitative study. Patient Educ Couns 2008;72(2):283-292.
299. Committee on Practice Ambulatory Medicine. AAP Principles Concerning Retail-Based Clinics. In: Pediatrics; 2014. p. e794-e797.
300. Bohmer R. The Rise of In-Store Clinics — Threat or Opportunity? N Engl J Med 2007;356(8):765-768.
301. Commission on Social Determinants of Health. Closing the gap in a generation: health equity through action on the social determinants of health. Final Report of the Commission on Social Determinants of Health. Geneva: World Health Organization; 2008.