South Carolina
Rural Health Research Center

Diabetes & Cardiovascular Disease in Rural African Americans

Arch G. Mainous III, PhD
Dana E. King, MD
David R. Garr, MD
William S. Pearson, MHA

South Carolina
Rural Health Research Center
220 Stoneridge Drive, Suite 204
Columbia, SC 29210
Phone: 803-251-6317
Fax: 803-251-6319

February, 2003

Resource ID # 7593

Diabetes And Cardiovascular Disease In Rural African Americans

University of South Carolina
Arnold School of Public Health
Department of Health Administration

Diabetes & Cardiovascular Disease in Rural African Americans

Authors:

Arch G. Mainous III, PhD
Dana E. King, MD
David R. Garr, MD
William S. Pearson, MHA

Published by:

South Carolina Rural Health Research Center
220 Stoneridge Drive, Suite 204
Columbia, SC 29210
Phone: 803-251-6317
Fax: 803-251-6319

Janice C. Probst, PhD, Director
Saundra Glover, PhD, Deputy Director
Charity Moore, PhD, Associate Director

February, 2003

Funding Acknowledgments:

This report was prepared under Grant No. 6 UIC RH 00045-01 with the Federal Office of Rural Health Policy, Health Resources and Services Administration.

Jan Van Nostrand, Project Officer

Table of Contents

Executive Summary

Evidence indicates that rural individuals are more vulnerable to poor health outcomes and undiagnosed disease. Limited access to health care services results in fewer medical visits, under-diagnosis, and less optimal health outcomes. Rural and minority populations are particularly vulnerable to the consequences of lower access to care. This project investigated the association of race and rural residence on rates of diagnosis of diabetes and cardiovascular disease and indicators of good medical control among people with diabetes, hypertension and cardiovascular (CV) disease.

We analyzed of the National Health and Nutrition Examination Survey (NHANES) III, 1988-1994. NHANES III collected multi-stage, stratified, clustered samples from the US civilian, non-institutionalized population. This data allowed us to make population estimates for US adults. With assistance from the National Center for Health Statistics, we classified non-Hispanic white and non-Hispanic African American adults as living in a metropolitan statistical area (urban) or outside a metropolitan statistical area (rural). Significant findings:

- Among rural African Americans with diagnosed diabetes, 60.6% have inadequate diabetic control, versus 42.5% of urban whites.

- A quarter of rural African Americans with diagnosed diabetes (24.5%) have diabetic retinopathy, compared to only 11.6% of urban whites.

- Rural African Americans (7.5%) and urban African Americans (8.6%) were more likely than rural (2.8%) and urban (3.8%) whites to have *undiagnosed* diabetes.

- Nearly a quarter of rural African Americans who had been diagnosed with hypertension still had elevated diastolic blood pressure (23.2%), versus 13.5% of urban whites.

- Rural African Americans had the highest prevalence of *undiagnosed* diastolic hypertension (4.4%), and the second highest prevalence of undiagnosed systolic hypertension (6.2%).

The study documents the need to improve access to health care services in rural areas. Programmatic efforts to increase access would include:

- Increasing the number of health services access points in medically underserved rural and inner-city areas through the expansion of the Federally qualified Community Health Centers (FCHC) program. Providers offering a full range of support services, such as health education, and providing such services to low income persons, are needed.

- Regulatory reform and provision of technical assistance to facilities in rural areas wishing to become certified as diabetes education providers under Medicare, as a means of increasing the number of facilities providing this service.

- Continued support for rural Area Health Education Centers, both for training of new professionals and as a vehicle for providing continuing education to physicians, nurses and health educators currently serving in rural areas.

- Continued support for the Quentin N. Burdick Program for Rural Interdisciplinary Training. Both diabetes and hypertension require multiple disciplines for effective patient education and management. Practitioners who can develop and maintain such environments in rural practices are still in short supply.

It is unclear whether differences in diagnosis and control stem from cultural differences in diet, presentation of illness, adherence to treatment or even adequacy of treatment. Potential research questions include:

- What factors affect the quality of care provided by practitioners in rural areas? Some research suggests that rural primary care physicians are less likely to adhere to appropriate standards of diabetes care (Zoorob, 1996). More research addressing the role of rural residency tracks, continuing medical education, and the surrounding practice community in fostering adherence to current guidelines in the treatment of disease is needed.

- What socio-cultural factors can serve as barriers between rural, African American populations and local practitioners? Differences in control persisted even when respondents could name a "usual" provider, suggesting that factors in the patient/practitioner relationship, as well as absence of such a relationship, may affect care. Additional qualitative research is needed to define such problems and suggest effective interventions.

I. Introduction: Previous Research & Goals of the Present Study

Previous Research & Rural Disparities

Evidence indicates that rural individuals are more vulnerable to poor health outcomes and undiagnosed disease (Bolen, 1997). Limited access to health care services results in fewer medical visits, under-diagnosis, and less optimal health outcomes (Ayanian, 2000). Reduced access to care in rural areas may contribute to increased mortality rates observed in some rural regions. Addressing access to care disparities can lead to improved outcomes indistinguishable from fully insured persons with full access (Mancini, 2001). Rural and minority populations are particularly vulnerable to the consequences of lower access to care (Bolen, 1997; Gillanders, 1993).

Many rural Americans have limited access to health care (OPD, 1992) and live in areas that are underserved with primary care physicians (Kletke, 1991). For example, individuals with diabetes who live in the most sparsely populated communities report fewer physician office visits than their urban counterparts (Dansky, 1998). Some of the increased morbidity seen in rural people is due to the fact that those living in more remote areas must travel substantial distances to obtain primary medical care. This distance creates a barrier to initiating care, and an additional time barrier because of the significantly longer travel times required to reach a source of care, compared to urban residents (Van Nostrand, 1993). As a result, rural populations are more vulnerable to poor outcomes of chronic conditions that require frequent monitoring and primary care.

Another problem created by the lower availability of generalist primary care physicians in rural areas is that patients go to the nearest physician for care, whether or not he/she is trained in the treatment of their specific condition. Thus, physicians in other specialties are called upon to provide primary care rather than the specialized care for which they received training. The occurrence of this circumstance is supported by evidence that several specialties (e.g., obstetrician-gynecologists) have a significant number of visits outside their specialty domain, specifically for diabetes (Baldwin, 1999). This pattern of care may have a negative impact on health outcomes for rural patients with diabetes and other common health conditions.

A greater proportion of rural than urban people are elderly, uninsured and poor (OTA, 1990), which creates economic and social barriers to access. Rural patients have fewer resources to use to overcome the barriers to access to care that they face. A national study involving over 100,000 patients documents that uninsured adults are more likely to report that they could not see a doctor when needed due to cost. Further, the study revealed that the problem was more pronounced in people in poor health. Cardiovascular risk reduction and diabetes care were less optimal among uninsured adults (Ayanian, 2000). The problems of distance and fewer available primary care physicians are compounded by lack of health insurance among rural residents.

Race also has been correlated with disease prevalance and health outcomes. African-Americans have higher rates of hypertension and diabetes than whites, and have a disproportionately higher rate of complications including peripheral vascular disease and amputations (Harris, 1998, Lackland, 1996). For example, 13.8% of African Americans between the ages of 50-59 years have type 2 diabetes compared to 7.5% of Caucasians. Diabetes mellitus is a common and potentially disabling chronic disease, affecting over 15 million people in the United States (Rubin, 1994). Persons with diabetes are at increased risk for a number of serious complications including retinopathy, renal disease and heart disease (Eastman, 1997,Wilson, 1998, Sanchez-Thorin, 1998).

In addition, the prevalence of hypertension among African Americans is higher than among Whites, and blood pressure control tends to be poorer (Joint National Committee, 1997). Prevalance in African Americans in the United States is 50% higher than in Caucasians, and the mortality rate from CV disease is 50% higher. Cardiovascular (CV) disease and hypertension are common and potentially serious chronic diseases that affect millions of people in the United States. Persons with hypertension or CV disease are at increased risk for a number of serious complications including stroke and congestive heart failure (Burt 1995). Individuals with hypertension and CV disease require ongoing access to medical care and control of blood pressure to prevent complications. African-Americans represent a vulnerable population that is more likely to suffer adverse consequences from the lower access to care found in rural areas.

Study Goals

Despite the evidence that diabetes and cardiovascular disease are more prevalent among African Americans and that rural populations have barriers to care that may negatively impact health care services for patients, it is unclear whether *rural African Americans* are disproportionately affected. Further, in the case of diabetes and cardiovascular disease (due to a relatively long asymptomatic period even after developing the disease), the extent of decreased access to medical services may result in under-diagnosis in rural African American patients. Addressing these issues using the results of the current project will have significant implications for rural health policy and the distribution of manpower and resources. Thus, the study reported here had two goals:

- To investigate the association of race and rural residence with rates of *diagnosis* of the common chronic conditions of diabetes and cardiovascular disease, and

- To assess the association of race and rural residence with indicators of good *medical control* among people with diabetes and cardiovascular (CV) disease.

Policies and programs that have explicit goals to address the needs of the underserved (e.g., National Health Service Corps; federal designation as a health care professions shortage area; HRSA's rural outreach grant program) or implicit goals regarding the same populations (HRSA's Title VII programs), must focus on problems causing increased morbidity and mortality. The current study is part of an ongoing strategy to characterize the health care problems of rural and minority populations.

II. Characteristics of Rural African Americans, 1988 – 1994

Demographics

Rural African Americans are an older population than urban African Americans. While only 25% of urban African Americans are age 50 or older, 34% of rural African Americans have reached this age (Table 1). Conversely, while 46% of urban African Americans fall in the 17-34 age group, only 39% of rural African Americans do so. Thus, more rural African Americans are at the age at which chronic conditions such as diabetes and cardiovascular disease are likely to emerge.

While education levels were generally lower in rural areas, rural African Americans were the least educated group studied. Only 15% of rural African American adults had any education beyond high school, versus 47% for urban whites.

Health Status and Health Care Utilization

Rural adults in general were more likely to describe their health status as "fair" or "poor," and less likely to describe it as "excellent." Rural African American adults had the worst self reported health, with nearly one in three persons (29%) falling in the "fair" to "poor" category (Table 1). Relevant to the diseases addressed in this study, rural African Americans were more likely to be overweight (60%) than any other group examined (Table 2).

Rural adults, both white and African American, were more likely to report that they had a usual provider than were their urban peers. Despite knowing where they might go for care, rural African American adults were more likely than any other group to report no physician visits within the past year (Table 2). On the other hand, African Americans, both urban and rural, were slightly more likely than whites to report being hospitalized within the past year.

III. Diabetes among Rural African Americans

Diabetes Prevalence

Rural African Americans (8.7%) are more likely than urban African Americans or whites, particularly urban whites (4.3%), to have been told by a physician that they have diabetes (Table 3.)

Diabetes Control

Hemoglobin A1C (HbA1C), because it does not vary from day to day in response to diet but changes more slowly, is used as an indicator of long-term control of blood sugar among persons with diabetes. Among persons who have been told by a physician that they have diabetes, rural African Americans are the least likely to have their diabetes under control. Among rural African Americans with diagnosed diabetes, 60.6% have elevated levels of HbA1C.

In contrast, fewer than half (42.9%) of urban whites with diabetes have poor control of their blood glucose. The American Diabetes Association stresses that in the care of patients with diabetes that in addition to glycemic control, patients need to have good control of blood pressure and lipids (e.g., cholesterol) because of the implications for cardiovascular disease among patients with diabetes. Rural African Americans were more likely to have elevated low density lipoprotein levels (LDL cholesterol) and elevated systolic blood pressure indicating worse control of glucose, lipids and blood pressure.

Diabetic retinopathy, a leading cause of blindness, is a further marker for poor control, indicating that damage to internal organs is beginning to occur. A quarter of rural African Americans with diagnosed diabetes (24.5%) have diabetic retinopathy, compared to only 11.6% of urban whites.

Elevated HbA1C levels may be used to detect diabetes in persons who have not had the condition diagnosed by a physician. Rural African Americans (7.5%) and urban African Americans (8.6%) were more likely than rural (2.8%) and urban (3.8%) whites to have undiagnosed diabetes (Table 6).

Persons with diabetes may suffer from co-morbidities, such as elevated blood pressure or cholesterol. When blood pressure, cholesterol levels and triglyceride levels among persons with diabetes were examined, rural African Americans were found to be more likely to have elevated systolic blood pressure. Rural African Americans did not suffer disproportionately from the other comorbidities.

Multivariate analysis

Factors in addition to race and residence may affect whether a persons has been diagnosed with diabetes and, if so, the level of control obtained.* Multivariate analysis was used to examine the relationship between the residence/racial categories and clinical outcomes for patients with diabetes while adjusting for potential confounding variables. In comparison to urban whites, rural African Americans were more than twice as likely to have undiagnosed diabetes (Odds Ratio=2.65; 95% CI 1.34-5.26; Table 6). Among patients with diagnosed diabetes, rural African Americans were more likely than urban whites to have elevated HbA1C levels (Odds Ratio=1.83; 95% CI 1.05-3.19; Table 4) but not diabetic retinopathy (Odds Ratio= 1.92; 95% CI 0.82-4.48; Table 5).

* Variables include age, sex, self-reported health status, BMI, family history, physician visits within last year, insurance coverage, level of income, level of continuity of care, and level of education.

IV. Hypertension and Cardiovascular Disease

Hypertension

Prevalence

Slightly more than a third of rural African Americans (33.7%) have been told by a doctor that they have hypertension, the primary risk factor for stroke, heart attack and chronic heart failure. This is markedly higher than the levels among urban African Americans (26.8%), or rural or urban whites (27.7% and 22.3%, respectively; Table 7).

In addition, rural African Americans were the racial/residence group most likely to have *undiagnosed* diastolic hypertension, based on three measurements of blood pressure. Rural African Americans had the highest prevalence of undiagnosed diastolic hypertension (4.4%), while rural whites (1.8%) and urban whites (1.9%) had prevalence of less than half that. Levels of undiagnosed systolic hypertension were higher among rural residents (6.6% of rural whites and 6.2% of rural African Americans) than among urban residents (5.4% of urban whites and 4.8% of urban African Americans; Table 8).

Multivariate analysis was used to determine whether race affected the probability of undiagnosed hypertension after controlling for socio-demographic factors. When age, health status, BMI, insurance, and health services use were taken into consideration, race and residence were no longer significantly related to undiagnosed elevated systolic blood pressure (Table 8). Similar analysis for undiagnosed diastolic hypertension revealed that urban African Americans were at higher risk (OR 2.52, CI 1.35-4.71), but rural African Americans were not (OR 1.67, CI 0.60-4.62; Table 9).

Blood Pressure Control

Among persons who have been diagnosed with hypertension, both control of hypertension and control of other risk factors for cardiovascular disease are important. Rural African Americans who had been diagnosed with hypertension were more likely than other groups to have elevated diastolic blood pressure (23.2%, versus 20.2% for urban African Americans, 11.0% for rural whites, and 13.5% for urban whites; Table 7). On the positive side, there were no differences by race/residence in levels of systolic

blood pressure, and rural African Americans were less likely to have elevated triglyceride levels than urban or rural whites.

Multivariate analysis confirmed poorer control of systolic blood pressure among diagnosed rural, African American patients. Compared to urban whites, both rural African Americans (OR 2.19, CI 1.48-3.24) and urban African Americans (OR 1.69, CI 1.22-2.36) were more likely to have elevated diastolic blood pressure (Table 11). Similarly, compared to urban whites, both rural African Americans (OR 1.47, CI 1.18-1.83) and urban African Americans (OR 1.58, CI 1.26-1.97) were more likely to have elevated systolic blood pressure (Table 10).

Cardiovascular Disease

Rates for self-reported physician diagnosis of stroke, myocardial infarction and congestive heart failure all differed significantly across race/residence groups. Prevalence of stroke was 2.4% among both rural and urban African Americans, versus 2.5% among rural whites and 1.9% among urban whites (Table 7). Rates of report myocardial infarction were highest among rural whites (5.7%, followed by urban whites (3.3%), rural African Americans (3.1%) and urban African Americans (2.7%). Rates of reported congestive heart failure were highest among rural African Americans (3.4%), followed by rural whites (3.1%), urban African Americans (2.4%) and urban whites (1.7%).

Control of Related Risk Factors

Among patients with diagnosed hypertension, rural African Americans and urban whites were more likely to have elevated total cholesterol (35.2% and 34.0%, respectively; Table 7). However, both rural African Americans (8.7%) and urban African Americans (9.2%) were less likely to have elevated triglycerides than urban or rural whites (21.9% and 19.6%, respectively).

Findings were similar among persons with diagnosed cardiovascular disease. Rural African Americans were less likely to have elevated triglycerides (12.9%) than were urban African Americans (14.6%), rural whites (22.2%), or urban whites (25.8%). African Americans, both rural (19.2%) and urban (15.6%) were also more likely to have

elevated diastolic blood pressure than were rural and urban whites (6.0% and 5.1%, respectively).

V. Conclusions and Policy Implications

Conclusions

Rural African Americans were less likely to be properly diagnosed and less likely to be effectively treated for diabetes and hypertension than other population groups. African Americans were known to have a higher prevalence of diabetes and hypertension, but the status of African Americans living in rural areas has not been quantified until now. Significant findings include:

- Among rural African Americans with diagnosed diabetes, 60.6% have inadequate diabetic control, versus 42.5% of urban whites.

- A quarter of rural African Americans with diagnosed diabetes (24.5%) have diabetic retinopathy, compared to only 11.6% of urban whites.

- Rural African Americans (7.5%) and urban African Americans (8.6%) were more likely than rural (2.8%) and urban (3.8%) whites to have *undiagnosed* diabetes.

- Nearly a quarter of rural African Americans who had been diagnosed with hypertension still had elevated diastolic blood pressure (23.2%), versus 13.5% of urban whites.

- Rural African Americans had the highest prevalence of *undiagnosed* diastolic hypertension (4.4%), and the second highest prevalence of undiagnosed systolic hypertension (6.2%).

The findings present a clear challenge to the health care delivery system. Both access to care and quality of care issues are raised by the presence of undetected disease and incompletely treated disease in the rural African American population.

Programmatic recommendations

The present study documents the need to improve health outcomes among rural African Americans with diabetes and cardiovascular disease. Both conditions are best addressed through ongoing, multidisciplinary disease management, optimally including health educators, certified diabetes educators, and nutritionists, as well as physicians and nursing professionals. Disease management programs are difficult to implement in rural areas suffering from practitioner shortages. Programmatic efforts to increase access would include the following:

- Increase the number of health services access points in medically underserved rural and inner-city areas through the expansion of the FCHC program. Providers offering a full range of support services, such as health education, and providing such services to low income persons, are needed.

- Regulatory reform and provision of technical assistance to facilities in rural areas wishing to become certified as diabetes education providers under Medicare, as a means of increasing the number of facilities providing this service.

- Continued support for rural Area Health Education Centers, both for training of new professionals and as a vehicle for providing continuing education to physicians, nurses and health educators currently serving in rural areas.

- Continued support for the Quentin N. Burdick Program for Rural Interdisciplinary Training. Both diabetes and hypertension require multiple disciplines for effective patient education and management. Practitioners who can develop and maintain such environments in rural practices continue to be needed.

Research Recommendations

Determining sources for disparities is outside the realm of this study. It is unclear whether differences in diagnosis and control stem from cultural differences in diet,

presentation of illness, adherence to treatment or even adequacy of treatment. However, we can offer several potential research questions.

- *What factors affect the quality of care provided by practitioners in rural areas*? Some research suggests that rural primary care physicians are less likely to adhere to appropriate standards of diabetes care (Zoorob, 1996). More research addressing the role of rural residency tracks, continuing medical education, and the surrounding practice community in fostering adherence to current guidelines in the treatment of disease is needed.

- *What socio-cultural factors can serve as barriers between rural, African American populations and local practitioners?* Differences in control persisted even when respondents could name a "usual" provider, suggesting that factors in the patient/practitioner relationship, as well as absence of such a relationship, may affect care. Additional qualitative research is needed to define such problems and suggest effective interventions.

APPENDIX I: Methods

Method

The study is an analysis of the National Health and Nutrition Examination Survey (NHANES) III, 1988-1994. NHANES III collected multi-stage, stratified, clustered samples from the US civilian, non-institutionalized population. The National Center for Health Statistics (NCHS) administered the survey to a randomly selected group of approximately 40,000 residents in 89 communities across the United States. Detailed information on the plan and operation of the NHANES III has been previously published (NCHS, 1994).

To examine the relationship between race, residence and medical condition indicators, three of the five NHANES data files were selected for analysis: the household adult data file, examination data file, and laboratory data file. All NHANES III public use data files are linked by a common survey participant variable. The variable consistently identifies the same participant in each different data file. We excluded any person who did not participate in all three parts of the survey.

The household adult data file contains the results of the questionnaire administered to all adults in the survey population described above. Adults are defined by NCHS as any non-institutionalized civilian 17 years of age or older. The adult interviews were conducted in English and Spanish by highly trained field staff.

The examination and lab data files contain the results of the exams and labs performed on survey participants who followed up their household interview as requested with a visit to one of the NHANES mobile examination centers (MEC). Survey participants were examined within a month of completing their household interview. A less comprehensive home examination was available to those participants who were unable to leave their home.

The analysis of the NHANES III was modified to accurately investigate rural/urban issues. The public use data set contains a rural/urban variable that is based on USDA criteria that was selected by the National Center for Health Statistics (NCHS) to protect respondent confidentiality. In discussions with NCHS staff this USDA rural/urban variable would not give the degree of differentiation of communities to appropriately

investigate rural/urban issues. Working with the NCHS Research Data Center we were able to merge respondent residence in a Metropolitan Statistical Area, data not available in the public use datasets, with the other public use NHANES III data. All findings reported in this study were checked at the Research Data Center by the confidentiality officer prior to being released to the investigators.

Variables

Independent variables:

- *Race*: The subject's race and ethnicity as self-reported. We used the NHANES III racial/ethnic categories of "nonhispanic white" and "nonhispanic black".

- *Rural/Urban residence:* Residence in a Metropolitan Statistical Area (MSA) was categorized as urban while residence outside an MSA was considered rural for the purposes of this study.

Dependent Variables

- *Diagnosed Diabetes*: A diagnosis of diabetes was assessed by an item asking if a doctor has ever told the subject that he or she has diabetes. Individuals with gestational diabetes were excluded from this categorization.

- *Undiagnosed Diabetes:* Based on the laboratory values obtained during the examination, individuals who had glycosylated hemoglobin percentages greater than 7 were considered to have diabetes. The use of HbA1c as a population screener for diabetes has shown significant utility.[16,17] This assessment of HbA1c was cross-classified by the subjects' report of whether a doctor has ever told them that they have diabetes. Individuals who had not been told that they had diabetes but had high glycosylated hemoglobin were considered to have undiagnosed diabetes.

- *Diabetes Control:* Among patients with diagnosed diabetes we assessed glycemic control and the presence of diabetic retinopathy. For glycemic control we classified individuals according HbA1c >8 as having poor control since this level corresponds

to the American Diabetes Association action point for glycemic control. We also assessed the presence of diabetic retinopathy, which was based on a self-report of a physician diagnosis. Because the ADA suggests that appropriate management of diabetes should include a focus on glycemic control, lipid control, and blood pressure we also examined lipids (e.g., cholesterol) and blood pressure as indicators of control.

- *Diagnosed Hypertension:* A diagnosis of hypertension was assessed by an item asking if the respondent had ever been told on at least two occasions by a doctor that he or she has high blood pressure/hypertension.

- *Undiagnosed Hypertension:* Based on the examination data, the mean value of three blood pressure measurements using standard sphygmomanometers was used to represent blood pressure. The examination values for hypertension was blood pressure elevated >140mm Hg systolic or >90mm Hg diastolic. Individuals who had not been told that they had high blood pressure but had high systolic or diastolic blood pressure on examination were considered to have undiagnosed hypertension.

- *Blood Pressure Control:* Among patients with diagnosed hypertension we assessed systolic and diastolic blood pressure for control. Control was defined as blood pressure ≤140mm Hg systolic or ≤90mm Hg diastolic.

- *Cardiovascular Disease:* Prior cardiovascular disease was addressed via self-reports of physician diagnosed congestive heart failure, heart attacks and strokes.

Covariates/Confounding Variables

- *Perceived Health Status*: A single-item health status rating was used as an indicator of health status.

- *Use of Health Care Services for Diabetes:* Individuals who report that they have diabetes were asked about insulin use, ongoing glucose measurements, eye exams for retinopathy as well as a previous diagnosis of retinopathy.

- *Access to Care and Utilization*: The subject's reported whether they had a usual place for health care and if so, a usual doctor. Further, outpatient visits and hospital stays in the past 12 months were assessed, as well as an indicator of how long it has been since the last doctor visit.

- *Demographics*: Age, sex, insurance status, income, and education

Analysis Plan

Population estimates were computed to examine the similarities and differences between rural African American and Caucasian adults. Sampling weights provided by the National Center for Health Statistics were used to compute weighted parameter estimates and standard errors. The SUDAAN statistical package was used to provide unbiased national estimates representative of the adult civilian, noninstitutionalized population.

Chi square analyses were used to compare the categorical data. Logistic regression models were computed on the outcomes of glycated hemoglobin, blood pressure, and other clinical outcomes. These models included the predictor variables of race/residence, age, sex, income, insurance status, education, body mass index, time since diagnosis, perceived health status and access to care.

To estimate the prevalence of undetected diabetes mellitus and cardiovascular disease variables were created to indicate undetected disease. For diabetes, individuals who have glycated hemoglobin percentages greater than 7 were considered to have diabetes. This assessment was cross-classified by the subjects' report of whether a doctor has ever told them that they have diabetes to assess unrecognized disease. Individuals who had not been told that they had diabetes but had high glycated hemoglobin were considered to have undetected diabetes. Similar analyses were computed for hypertension using examination data and self-report data. The examination values for hypertension was blood pressure elevated >140 mm Hg systolic or >90mm Hg diastolic.

These variables of undiagnosed disease were compared to the race/residence variable in chi square analyses. Logistic regression models were computed on the

outcome of diagnosed or undiagnosed diabetes or hypertension with the predictor variables of race/residence, age, sex, income, insurance status, education, body mass index, perceived health status and access to care.

APPENDIX II: Supporting Tables

Table 1. Population Estimates of Demographic Characteristics of Adults

	Urban Whites	Rural Whites	Urban Afr. Amer.	Rural Afr. Amer.	p
N	111,795,708	29,607,096	18,049,480	2,754,284	
Age					<.01
17-34	36.3%	31.0%	46.2%	38.8%	
35-49	29.8%	24.0%	28.9%	26.8%	
50-64	17.4%	20.4%	14.0%	17.4%	
65+	16.4%	24.6%	10.9%	17.0%	
Sex					.02
Male	48.3%	47.5%	45.2%	43.7%	
Female	51.7%	52.5%	54.8%	56.3%	
Health Status					<.01
Excellent	22.7%	18.9%	18.0%	11.1%	
Very Good	34.9%	30.2%	24.7%	17.4%	
Good	30.6%	32.9%	36.5%	42.3%	
Fair	9.5%	13.9%	17.2%	22.3%	
Poor	2.3%	4.2%	3.6%	6.9%	
Income					<.01
< $20,000	24.7%	42.8%	52.0%	71.2%	
≥ $20,000	75.3%	57.2%	48.0%	28.8%	
Health Insurance					<.01
Yes	91.3%	87.6%	84.7%	85.6%	
No	8.7%	12.4%	15.3%	14.4%	
Highest Year Of School Completed					<.01
≤12	53.2%	71.5%	69.4%	85.3%	
>12	46.8%	28.4%	30.5%	14.7%	

Table 2. Health Conditions and Health Care Utilization by Race and Residence

	Urban Whites	Rural Whites	Urban Afr. Amer.	Rural Afr. Amer.	p
Continuity					<.01
None	20.8%	16.7%	24.9%	17.1%	
Usual Place	10.0%	7.0%	16.9%	9.6%	
Usual Provider	69.2%	76.3%	58.2%	73.3%	
Number of Times in Hosp. W/in Last Year					.01
0	88.3%	86.8%	84.6%	85.6%	
1	8.3%	9.9%	11.3%	10.6%	
>1	3.4%	3.2%	4.1%	3.8%	
Number Times Saw MD w/in Last year*					.04
0	20.2%	22.1%	21.9%	23.7%	
1	21.8%	20.1%	23.2%	22.2%	
>1	58.0%	57.7%	55.0%	54.1%	
How long since Saw MD*					.47
≤12 months	82.8%	80.8%	82.4%	81.7%	
>12 months	17.2%	19.1%	17.6%	18.3%	
BMI					<.01
≤25	49.2%	45.0%	42.1%	40.1%	
>25	50.7%	55.0%	57.9%	59.9%	

*** Theoretically, the number of people who saw an MD zero (0) times in the last year should match the number of people who saw an MD more than 12 months ago. However, differences in the number of responses to each of these two questions (19,884 vs. 15,003) accounts for the variation in data results.**

Table 3. Percent of Adults Diagnosed with Diabetes and Levels of Control and Comorbidity, by Race And Residence

	Urban Whites	Rural Whites	Urban Afr. Amer.	Rural Afr. Amer.	p
Doctor Told Diabetes	4.3%	6.2%	5.6%	8.7%	<.01
Diabetic Control					
Elevated HbA1c					<.01
>8%	42.9%	33.6%	45.7%	60.6%	
≤8%	57.1%	66.4%	54.3%	39.4%	
End Organ Disease					
Presence of Diabetic Retinopathy					<.01
Yes	11.6%	17.9%	25.1%	24.5%	
No	88.4%	82.1%	74.9%	75.5%	
Potential comorbidities					
Elevated Systolic BP					.01
>140 mm/Hg	36.3%	27.4%	43.6%	33.4%	
≤140 mm/Hg	63.7%	72.6%	56.4%	66.5%	
Elevated Diastolic BP					.08
>90 mm/Hg	3.3%	4.6%	8.9%	9.8%	
≤90 mm/Hg	96.6%	95.4%	91.1%	90.2%	
Elevated Total Cholesterol					.31
≥240 mg/dL	34.3%	31.6%	31.0%	42.5%	
<240 mg/dL	65.7%	68.4%	69.0%	57.5%	
Elevated LDL's					.05
≥160 mg/dL	8.0%	3.3%	7.2%	10.5%	
<160 mg/dL	92.0%	96.7%	92.8%	89.5%	
Lowered HDL's					.06
≤30 mg/dL	20.8%	21.6%	13.5%	23.6%	
>30 mg/dL	79.2%	78.4%	86.5%	76.4%	
Elevated Triglycerides					.40
>200 mg/dL	28.4%	28.5%	17.1%	22.5%	
≤200 mg/dL	71.6%	71.5%	82.9%	77.5%	

Table 4a. Odds Ratios for Diabetes Control Among Patients with Self-Reported Physician Diagnosed Diabetes

Adjusted Models*	Model One: Personal Characteristics		Model Two: Personal Characteristics and Health Services Use	
Diabetes	O.R.	95% CI	OR.	95% CI
Elevated HbA1c[1]				
Urban Whites	1.00	1.00-1.00	1.00	1.00-1.00
Rural Whites	0.68	0.43-1.06	0.60	0.37-0.97
Urban African Americans	1.07	0.71-1.60	0.97	0.59-1.59
Rural African Americans	1.86	1.11-3.11	1.83	1.05-3.19

Table 4b. Full presentation for Model 2, Personal and Health Use Characteristics Associated with Elevated HgbA1c Among Patients with Diabetes

Independent variables	Beta Coeff.	SE Beta	O.R.	95% C.I.
Group				
Urban Whites	0.00	0.00	1.00	1.00-1.00
Rural Whites	-0.51	0.24	0.60	0.37-0.97
Urban African Americans	-0.03	0.25	0.97	0.59-1.59
Rural African Americans	0.60	0.28	1.83	1.05-3.19
Age	-0.02	0.01	0.98	0.96-1.00
Sex				
Male	0.00	0.00	1.00	1.00-1.00
Female	0.04	0.23	1.04	0.66-1.64
Health Status	0.07	0.12	1.07	0.84-1.37
Body Mass Index	0.01	0.02	1.01	0.98-1.05
Insurance				
Have Insurance	0.00	0.00	1.00	1.00-1.00
No Insurance	0.03	0.46	1.03	0.41-2.62
Income				
Above $20,000	0.00	0.00	1.00	1.00-1.00
Below $20,000	-0.16	0.30	0.85	0.47-1.55
Education				
Highest Grade Comp.	0.04	0.05	1.04	0.94-1.14
Continuity				
No Continuity	0.00	0.00	1.00	1.00-1.00
Usual Source	-2.20	0.64	0.11	0.03-0.40
Usual Provider	-1.92	0.49	0.15	0.06-0.39
Number Times Saw MD Past 12 Months	-0.02	0.02	0.98	0.95-1.01
Length of Time With Diabetes	0.01	0.01	1.01	0.99-1.03

Table 5a. Odds Ratios for Diabetic Retinopathy Among Patients with Self-Reported Physician Diagnosed Diabetes

Adjusted Models* Diabetes	Model One Personal O.R.	95% CI	Model Two Personal & Use O.R.	95% CI
Presence of Diabetic Retinopathy[1]				
Urban Whites	1.00	1.00-1.00	1.00	1.00-1.00
Rural Whites	1.72	1.09-2.71	1.94	1.18-3.18
Urban African Americans	1.97	1.25-3.12	1.53	0.97-2.41
Rural African Americans	1.91	0.92-3.93	1.92	0.82-4.48

Table 5b. Full presentation for Model 2, Personal and Health Use Characteristics Associated with Diabetic Retinopathy Among Patients with Diabetes

Independent variables	Beta Coeff.	SE Beta	O.R.	95% C.I.
Group				
Urban Whites	0.00	0.00	1.00	1.00-1.00
Rural Whites	0.66	0.25	1.94	1.18-3.18
Urban African Americans	0.42	0.23	1.53	0.97-2.41
Rural African Americans	0.65	0.42	1.92	0.82-4.48
Age	-0.01	0.01	0.99	0.98-1.01
Sex				
Male	0.00	0.00	1.00	1.00-1.00
Female	0.45	0.31	1.57	0.85-2.90
Health Status	0.33	0.13	1.39	1.08-1.79
Body Mass Index	0.02	0.01	1.02	1.00-1.05
Insurance				
Have Insurance	0.00	0.00	1.00	1.00-1.00
No Insurance	-0.43	0.55	0.65	0.21-1.97
Income				
Above $20,000	0.00	0.00	1.00	1.00-1.00
Below $20,000	-0.19	0.31	0.83	0.44-1.55
Education				
Highest Grade Comp.	-0.04	0.04	0.96	0.89-1.05
Continuity				
No Continuity	0.00	0.00	1.00	1.00-1.00
Usual Source	2.27	0.87	9.71	1.69-55.97
Usual Provider	1.69	0.79	5.42	1.12-26.26
Number Times Saw MD Past 12 Months	0.01	0.01	1.01	0.98-1.03
Length of Time With Diabetes	0.04	0.01	1.04	1.02-1.07

Table 6a. Estimation of the Prevalence of Undiagnosed Diabetes and Factors Affecting Its Likelihood.

Undiagnosed Diabetes	
Urban Whites	3.7%
Rural Whites	2.8%
Urban African Americans	8.6%
Rural African Americans	7.5%

Table 6b. Odds Ratios for the Presence of Undiagnosed Diabetes.

Adjusted Models*	Model One Personal		Model Two Personal & Use	
	O.R.	95% CI	OR.	95% CI
Urban Whites	1.00	1.00-1.00	1.00	1.00-1.00
Rural Whites	0.84	0.48-1.49	0.79	0.40-1.56
Urban African Americans	2.16	1.58-2.97	2.19	1.47-3.26
Rural African Americans	2.16	1.25-3.75	2.65	1.34-5.26

Table 6c. Full presentation for Model 2, Personal and Health Use Characteristics Associated with Presence of Undiagnosed Diabetes

Independent variables	Beta Coeff.	SE Beta	O.R.	95% C.I.
Group				
Urban Whites	0.00	0.00	1.00	1.00-1.00
Rural Whites	-0.24	0.34	0.79	0.40-1.56
Urban African Americans	0.78	0.20	2.19	1.47-3.26
Rural African Americans	0.98	0.34	2.65	1.34-5.26
Age	-0.05	0.01	0.95	0.94-0.97
Sex				
Male	0.00	0.00	1.00	1.00-1.00
Female	0.68	0.33	1.97	1.02-3.81
Health Status	-0.35	0.13	0.71	0.55-0.92
Body Mass Index	-0.06	0.02	0.94	0.91-0.98
Insurance				
Have Insurance	0.00	0.00	1.00	1.00-1.00
No Insurance	0.12	0.53	1.13	0.39-3.26
Income				
Above $20,000	0.00	0.00	1.00	1.00-1.00
Below $20,000	-0.27	0.29	0.76	0.42-1.38
Education				
Highest Grade Comp.	0.13	0.04	1.14	1.05-1.23
Continuity				
No Continuity	0.00	0.00	1.00	1.00-1.00
Usual Source	-1.47	0.52	0.23	0.08-0.66
Usual Provider	-1.17	0.40	0.31	0.14-0.70
Family History of Diabetes				
Yes	0.41	0.24	1.51	0.92-2.46
No	0.00	0.00	1.00	1.00-1.00
Number Times Saw MD Past 12 Months	-0.01	0.02	0.99	0.95-1.03

Table 7a. Similarities and Differences Among Adults with Diagnosed Hypertension or History of Cardiovascular Disease

	Urban Whites	Rural Whites	Urban Afr. Amer.	Rural Afr. Amer.	p
Doctor Told Hypertension	22.3%	27.7%	26.8%	33.7%	<.01
Doctor Told Stroke	1.9%	2.5%	2.4%	2.4%	<.01
Doctor Told Myocardial Infarction	3.3%	5.7%	2.7%	3.1%	.01
Doctor Told Congestive Heart Failure	1.7%	3.1%	2.4%	3.4%	.01

Table 7b. Physiological Characteristics in Adults with Hypertension

	Urban Whites	Rural Whites	Urban Afr. Amer.	Rural Afr. Amer.	p
Elevated Total Cholesterol					<.01
≥240 mg/dL	34.0%	30.7%	24.4%	35.2%	
<240 mg/dL	66.0%	69.3%	75.6%	64.8%	
Elevated LDL's					.86
≥160 mg/dL	9.2%	8.9%	8.8%	10.1%	
<160 mg/dL	90.8%	91.1%	91.2%	89.9%	
Lowered HDL's					.60
≤30 mg/dL	14.1%	12.2%	14.3%	15.3%	
>30 mg/dL	85.8%	87.8%	85.7%	84.7%	
Elevated Triglycerides					<.01
>200 mg/dL	21.9%	19.6%	9.2%	8.7%	
≤200 mg/dL	78.1%	80.4%	90.8%	91.3%	
Elevated Systolic BP					.17
>140 mm/Hg	38.3%	37.4%	41.3%	43.4%	
≤140 mm/Hg	61.7%	62.6%	58.7%	56.6%	
Elevated Diastolic BP					<.01
>90 mm/Hg	13.5%	11.0%	20.2%	23.2%	
≤90 mm/Hg	86.5%	89.0%	79.8%	76.8%	

Table 7c. Physiological Characteristics in Adults with Stroke, Myocardial Infarction, and Congestive Heart Failure

	Urban Whites	Rural Whites	Urban Afr. Amer.	Rural Afr. Amer.	p
Elevated Total Cholesterol					.20
≥240 mg/dL	36.9%	36.1%	28.9%	36.5%	
<240 mg/dL	63.1%	63.9%	71.1%	63.5%	
Elevated LDL's					.43
≥160 mg/dL	11.9%	10.7%	8.2%	8.2%	
<160 mg/dL	88.1%	89.3%	91.8%	91.8%	
Lowered HDL's					.15
≤30 mg/dL	17.9%	15.9%	16.8%	26.2%	
>30 mg/dL	82.1%	84.1%	83.2%	73.8%	
Elevated Triglycerides					.03
>200 mg/dL	25.8%	22.2%	14.6%	12.9%	
≤200 mg/dL	74.2%	77.7%	85.4%	87.1%	
Elevated Systolic BP					.51
>140 mm/Hg	43.5%	40.2%	40.1%	44.6%	
≤140 mm/Hg	56.5%	59.8%	59.8%	55.4%	
Elevated Diastolic BP					<.01
>90 mm/Hg	5.1%	6.0%	15.6%	19.2%	
≤90 mm/Hg	94.9%	93.9%	84.4%	80.8%	

Table 8a. Estimation of the Prevalence of Undiagnosed Systolic Hypertension and Factors Affecting Its Likelihood.

Undiagnosed Systolic Hypertension	
Urban Whites	5.4%
Rural Whites	6.6%
Urban African Americans	4.8%
Rural African Americans	6.2%

Table 8b. Odds Ratios for Undiagnosed Elevated Systolic Blood Pressure

Adjusted Models*	Model One Personal		Model Two Personal & Use	
	O.R.	95% CI	OR.	95% CI
Elevated Systolic Blood Pressure				
Urban Whites	1.00	1.00-1.00	1.00	1.00-1.00
Rural Whites	0.93	0.68-1.26	0.90	0.67-1.21
Urban African Americans	1.11	0.87 -1.42	0.99	0.76-1.31
Rural African Americans	1.00	0.81-1.23	0.96	0.75-1.23

Table 8c. Full presentation for Model 2, Personal and Health Use Characteristics Associated with Undiagnosed Elevated Systolic Blood Pressure

Independent variables	Beta Coeff.	SE Beta	O.R.	95% C.I.
Group				
Urban Whites	0.00	0.00	1.00	1.00-1.00
Rural Whites	-0.10	0.15	0.90	0.67-1.21
Urban African Americans	-0.01	0.14	0.99	0.76-1.31
Rural African Americans	-0.04	0.12	0.96	0.75-1.23
Age	0.05	0.00	1.05	1.04-1.06
Sex				
Male	0.00	0.00	1.00	1.00-1.00
Female	-0.32	0.08	0.73	0.61-0.86
Health Status	-0.34	0.05	0.71	0.64-0.80
Body Mass Index	-0.04	0.12	0.96	0.94-0.98
Insurance				
Have Insurance	0.00	0.00	1.00	1.00-1.00
No Insurance	0.51	0.29	1.66	0.94-2.96
Income				
Above $20,000	0.00	0.00	1.00	1.00-1.00
Below $20,000	-0.12	0.12	0.88	0.69-1.13
Education				
Highest Grade Comp.	-0.01	0.01	0.99	0.96-1.02
Continuity				
No Continuity	0.00	0.00	1.00	1.00-1.00
Usual Source	-0.47	0.28	0.62	0.35-1.10
Usual Provider	-0.60	0.19	0.55	0.38-0.80
Number Times Saw MD Past 12 Months	-0.08	0.02	0.93	0.88-0.97

Table 9a. Estimation of the Prevalence of Undiagnosed Diastolic Hypertension and Factors Affecting Its Likelihood.

Undiagnosed Diastolic Hypertension	
Urban Whites	1.9%
Rural Whites	1.8%
Urban African Americans	3.2%
Rural African Americans	4.4%

Table 9b. Odds Ratios for Undiagnosed Elevated Diastolic Blood Pressure

Adjusted Models*	Model One Personal		Model Two Personal & Use	
	O.R.	95% CI	OR.	95% CI
Elevated Diastolic Blood Pressure				
Urban Whites	1.00	1.00-1.00	1.00	1.00-1.00
Rural Whites	0.95	0.55-1.62	1.30	0.45-3.76
Urban African Americans	1.78	1.29–2.45	2.52	1.35-4.71
Rural African Americans	2.16	1.29-2.99	1.67	0.60-4.62

Table 9c. Full presentation for Model 2, Personal and Health Use Characteristics Associated with Undiagnosed Elevated Diastolic Blood Pressure

Independent variables	Beta Coeff.	SE Beta	O.R.	95% C.I.
Group				
Urban Whites	0.00	0.00	1.00	1.00-1.00
Rural Whites	-0.05	0.27	0.95	0.55-1.62
Urban African Americans	0.58	0.16	1.78	1.29-2.45
Rural African Americans	0.77	0.26	2.16	1.29-3.62
Age	-.02	0.01	0.98	0.97-1.00
Sex				
Male	0.00	0.00	1.00	1.00-1.00
Female	-0.96	0.20	0.38	0.26-0.57
Health Status	-0.49	0.11	0.61	0.49-0.76
Body Mass Index	0.01	0.02	1.01	0.98-1.05
Insurance				
Have Insurance	0.00	0.00	1.00	1.00-1.00
No Insurance	0.34	0.34	1.41	0.71-2.81
Income				
Above $20,000	0.00	0.00	1.00	1.00-1.00
Below $20,000	0.12	0.28	1.12	0.64-1.98
Education				
Highest Grade Comp	-0.00	0.03	1.00	0.93-1.07
Continuity				
No Continuity	0.00	0.00	1.00	1.00-1.00
Usual Source	-0.43	0.31	0.65	0.35-1.21
Usual Provider	-0.43	0.25	0.65	0.40-1.07
Number Times Saw MD Past 12 Months	-0.10	0.06	0.91	0.80-1.03

Table 10a. Odds Ratios for Systolic Blood Pressure Control Among Patients with Self-Reported Physician Diagnosed Hypertension

Adjusted Models*	Model One Personal		Model Two Personal & Use	
	O.R.	95% CI	OR.	95% CI
Elevated Systolic Blood Pressure				
Urban Whites	1.00	1.00-1.00	1.00	1.00-1.00
Rural Whites	0.81	0.59-1.12	0.79	0.57-1.09
Urban African Americans	1.53	1.24 -1.89	1.58	1.26-1.97
Rural African Americans	1.42	1.16-1.73	1.47	1.18-1.83

Table 10b. Full presentation for Model 2, Personal and Health Use Characteristics Associated with Elevated Systolic Blood Pressure Among Those Diagnosed with Hypertension

Independent variables	Beta Coeff.	SE Beta	O.R.	95% C.I.
Group				
Urban Whites	0.00	0.00	1.00	1.00-1.00
Rural Whites	-0.24	0.16	0.79	0.57-1.09
Urban African Americans	0.45	0.11	1.58	1.26-1.97
Rural African Americans	0.39	0.11	1.47	1.18-1.83
Age	0.07	0.00	1.07	1.06-1.08
Sex				
Male	0.00	0.00	1.00	1.00-1.00
Female	-0.13	0.09	0.88	0.72-1.06
Health Status	0.01	0.04	1.01	0.92-1.11
Body Mass Index	0.03	0.01	1.03	1.01-1.05
Insurance				
Have Insurance	0.00	0.00	1.00	1.00-1.00
No Insurance	0.15	0.24	1.16	0.71-1.90
Income				
Above $20,000	0.00	0.00	1.00	1.00-1.00
Below $20,000	0.10	0.09	1.10	0.93-1.31
Education				
Highest Grade Comp.	0.00	0.02	1.00	0.96-1.04
Continuity				
No Continuity	0.00	0.00	1.00	1.00-1.00
Usual Source	0.13	0.33	1.14	0.59-2.21
Usual Provider	0.13	0.18	1.14	0.79-1.65
Number Times Saw MD Past 12 Months	-0.02	0.01	0.98	0.97-1.00

Table 11a. Odds Ratios for Diastolic Blood Pressure Control Among Patients with Self-Reported Physician Diagnosed Hypertension

Adjusted Models*	Model One Personal		Model Two Personal & Use	
	O.R.	95% CI	OR.	95% CI
Elevated Diastolic Blood Pressure				
Urban Whites	1.00	1.00-1.00	1.00	1.00-1.00
Rural Whites	0.86	0.61-1.22	0.86	0.59-1.26
Urban African Americans	1.72	1.29 –2.30	1.69	1.22-2.36
Rural African Americans	2.06	1.37-3.09	2.19	1.48-3.24

Table 11b. Full presentation for Model 2, Personal and Health Use Characteristics Associated with Elevated Diastolic Blood Pressure Among Those Diagnosed with Hypertension

Independent variables	Beta Coeff.	SE Beta	O.R.	95% C.I.
Group				
Urban Whites	0.00	0.00	1.00	1.00-1.00
Rural Whites	-0.15	0.19	0.86	0.59-1.26
Urban African Americans	0.53	0.16	1.69	1.22-2.36
Rural African Americans	0.79	0.19	2.19	1.48-3.24
Age	-0.01	0.01	0.99	0.98-1.00
Sex				
Male	0.00	0.00	1.00	1.00-1.00
Female	-1.06	0.15	0.35	0.26-0.47
Health Status	0.07	0.07	1.07	0.93-1.23
Body Mass Index	0.02	0.01	1.02	1.00-1.04
Insurance				
Have Insurance	0.00	0.00	1.00	1.00-1.00
No Insurance	-0.35	0.28	0.71	0.41-1.23
Income				
Above $20,000	0.00	0.00	1.00	1.00-1.00
Below $20,000	0.03	0.22	1.03	0.66-1.61
Education				
Highest Grade Comp.	0.01	0.03	1.01	0.96-1.07
Continuity				
No Continuity	0.00	0.00	1.00	1.00-1.00
Usual Source	-0.01	0.31	0.99	0.53-1.84
Usual Provider	0.04	0.23	1.05	0.66-1.66
Number Times Saw MD Past 12 Months	-0.02	0.01	0.98	0.96-1.01

REFERENCES

Ayanian JZ, Weissman JS, Schneider EC, Ginsburg JA, Zaslavsky AM. Unmet health needs of uninsured adults in the United States. *JAMA* 2000;284:2061-9.

Baldwin L, Rosenblatt RA, Schneeweiss R, Lishner DM, Hart LG. Rural and urban physicians: do their Medicare practices differ? *J Rural Health* 1999;15:240-251.

Bolen JC, Rhodes L, Powell-Griner EE, Bland SD, Holtzman D. State-specific prevalence of selected health behaviors, by race and ethnicity--Behavioral Risk Factor Surveillance System, 1997. *Mor Mortal Wkly Rep* 2000; 49(2):1-60.

Burt VL, Whelton P, Roccella EJ, Brown C, Cutler JA, Higgins M, et al. Prevalence of hypertension in the US adult population. Results from the Third National Health and Nutrition Examination Survey, 1988-1991. *Hypertension* 1995;25:305-13.

Dansky KH, Dirani R. The use of health care services by people with diabetes in rural areas. *J Rural Health* 1998;14:129-137.

Eastman RC, Javitt JC, Herman WH, et al. Model of complications of NIDDM II. Analysis of the health benefits and cost-effectiveness of treating NIDDM with the goal of normoglycemia. *Diabetes Care* 1997;20:735-44.

Gillanders WR, Buss TF. Access to medical care among the elderly in rural northeastern Ohio. *J Fam Pract* 1993;37:349-355.

Harris MI. Diabetes in America: epidemiology and scope of the problem. *Diabetes Care* 1998: 21(Suppl 3):C11-4.

Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure. The sixth report of the Joint National Committee on prevention, detection, evaluation, and treatment of high blood pressure. *Arch Intern Med* 1997;157:2413-2446.

Kletke PR, Marder WD, Willke RJ. A projection of the primary care physician population in metropolitan and nonmetropolitan areas. *Primary Care Research: Theory and Methods.* AHCPR conference proceedings, Washington DC: Agency for Health Care Policy and Research 1991:261-269.

Lackland DT, Keil JE. Epidemiology of hypertension in African Americans. *Seminars in Nephrology* 1996;16(2):63-70.

Mainous AG III, Kohrs FP. A comparison of health status between rural and urban adults. *J Comm Health* 1995;20:423-431.

Mainous AG III, Gill JM. The lack of screening for diabetic nephropathy: evidence from a privately insured population. *Fam Med* 2001;33:115-119.

Mancini MC, Cush EM, Sweatman K, Dansby J. Coronary artery bypass surgery: are outcomes influenced by demographics or ability to pay? *Ann Surg* 2001; 233:617-622.

National Center for Health Statistics. Plan and operation of the Third National Health and Nutrition Examination Survey, 1988-94. Vital Health Stat 1. 1994;32:1-407.

Office of Program Development. *Study of Models to Meet Rural Health Care Needs.* Rockville, MD: Health Resources and Service Administration 1992. Publication No. HRS 240-89-0037.

Office of Technology Assessment. *Health Care in Rural America.* Washington DC: U.S. Government Printing Office 1990.

Rubin RJ, Altman WM, Mendelson DN. Health care expenditures for people with diabetes mellitus, 1992. *J Clin Endocrinol Metab.* 1994;78:809A-809F.

Sanchez-Thorin JC. The epidemiology of diabetes mellitus and diabetic retinopathy. *International Ophthalmology Clinics* 1998; 38(2):11-8.

Van Nostrand JF, ed. Common beliefs about the rural elderly: what do national data tell us? *Vital Health Stat* 3, 1993.

Wilson PW. Diabetes mellitus and coronary heart disease. *Am J Kidney Dis* 1998;32(5 Suppl 3):S89-100.

Zoorob RJ, Mainous AG III. Compliance of rural family physicians with the American Diabetes Association standards of care. *J Comm Health* 1996;21:175-182.