Published in final edited form as:

Med Care. 2012 August ; 50(8): 692–699. doi:10.1097/MLR.0b013e318254a43c.

Do Diabetic Patients Living in Racially Segregated Neighborhoods Experience Different Access and Quality of Care?

Kitty S. Chan, Ph.D.^{1,2,*}, Darrell J. Gaskin, Ph.D.^{1,2}, Gniesha Y. Dinwiddie, Ph.D.^{2,3}, and Rachael McCleary, BA^{1,2}

¹Department of Health Policy and Management, Johns Hopkins Bloomberg School of Public Health

²Hopkins Center for Health Disparities Solutions, Johns Hopkins Bloomberg School of Public Health

³African American Studies Department, University of Maryland College Park

Abstract

Background—Place of residence, particularly residential segregation, has been implicated in health and health care disparities. However, prior studies have not focused on care for diabetes, a prevalent condition for minority populations.

Objective—To examine the association of residential segregation with a range of access and quality of care outcomes among Black and Hispanic diabetics using a nationally representative U.S. sample.

Research Design—Cross-sectional study using data for 1598 adult diabetics from the 2006 Medical Expenditure Panel Survey (MEPS) linked to residential segregation information for Blacks and Hispanics based on the 2000 census. Relationships of five dimensions of residential segregation (dissimilarity, isolation, clustering, concentration and centralization) with access and quality of care outcomes were examined using linear, logistic and multinomial logistic regression models, controlling for respondent characteristics and community utilization and hospital capacity.

Results—Black and Hispanic diabetics had comparable or better access to providers, but received fewer recommended services. Living in a segregated community was associated with more recommended services received, but also problems with seeing a specialist. The relationship of residential segregation to diabetes care varied depending on type of segregation and race/ethnic group assessed.

*Corresponding Author: Kitty S. Chan, Department of Health Policy and Management, Johns Hopkins Bloomberg School of Public Health, 624 North Broadway, Room #633, Baltimore, MD 21205, Telephone: 410-614-4043; kchan@jhsph.edu.

Author Affiliation and Contact Information

Kitty S. Chan, PhD, Associate Professor, Department of Health Policy and Management, Hopkins Center for Health Disparities Solutions, Health Services Research and Development Center, Johns Hopkins Bloomberg School of Public Health, 624 North Broadway, Room #633, Baltimore, MD 21205, Telephone: 410-614-4043; kchan@jhsph.edu

Darrell J. Gaskin, PhD, Deputy Director and Associate Professor of Health Economics, Hopkins Center for Health Disparities Solutions, Department of Health Policy and Management, Johns Hopkins Bloomberg School of Public Health, 624 North Broadway, Suite 441, Baltimore, MD 21205, Telephone: 443-287-0306; dgaskin@jhsph.edu

Gniesha Y. Dinwiddie, Ph.D., Assistant Professor, African American Studies Department, Faculty Associate, Maryland Population Research Center, University of Maryland College Park, 2169 LeFrak Hall, College Park, MD 20742, gnieshad@umd.edu, Faculty Associate, Hopkins Center for Health Disparities Solutions

Rachael McCleary, BA, Research Assistant, Hopkins Center for Health Disparities Solution, Johns Hopkins Bloomberg School of Public Health, 624 North Broadway, Room #337, Baltimore, MD 21205, Telephone: 443-287-8307; rmccleary@jhsph.edu

Conclusions—Residential segregation influences the care experience of diabetics in the U.S. Our study highlights the importance of investigating how different types of segregation may affect diabetes care received by patients from different race and ethnic groups.

Keywords

Diabetes; Residential Segregation; Access to Care; Quality of Care

INTRODUCTION

Diabetes is a leading cause of death and a major contributor to heart disease, stroke, kidney failure and new cases of blindness in the U.S. (CDC, 2011a). Appropriate care can significantly reduce the risk of complications, but recent reports indicate that the quality of diabetes care in the U.S. has actually worsened, with lower proportion of adult diabetics receiving recommended services in 2007 than 2002 (AHRQ, 2011a). The decreasing quality of diabetes care is particularly concerning for minority groups, who bear a disproportionate share of the burden for this condition, with higher prevalence, poorer care and worse health outcomes (AHRQ, 2011b; CDC, 2010; CDC, 2011b, c).

Place of residence, particularly residential segregation, have been associated with health and health care outcomes. However, its effect has varied across studies. Some studies found poorer health, particularly higher mortality, with greater segregation (Acevedo-Garcia, 2000; Acevedo-Garcia et al., 2003; LaVeist, 2003; Subramanian et al., 2005; Chang, 2006; Do et al., 2008). Others found better health for those living in a neighborhood with greater concentration of residents of similar race (Fang et al., 1998; Inagami et al., 2006; Rodriguez et al., 2007). Studies are also beginning to examine the influence of segregation on health care access and quality (Haas et al., 2004; Baicker et al., 2005; Rodriguez et al., 2007; Smith et al., 2007; Gaskin et al., 2009; Sarrazin et al., 2009a; Sarrazin et al., 2009b). Of these, many have reported that Blacks who live in areas with high proportion of Blacks or that are highly segregated receive care from lower quality hospitals (Sarrazin et al., 2009a; Sarrazin et al., 2009b), nursing homes (Smith et al., 2007) and dialysis centers (Rodriguez et al., 2007). However, two studies using the MEPS (Haas et al., 2004; Gresenz et al., 2009) found that Blacks and Hispanics living in neighborhoods with high percentages of residents of the same race had better access to care based on physician visits, having a usual source of care and perceived difficulty in accessing care.

Despite this growing body of research, much remains unknown about how residential segregation affects health. Existing studies generally focused on Black-White mortality differences, with this relationship largely unexplored for Hispanics and Asians (Acevedo-Garcia et al., 2003). Furthermore, the relationship of segregation to health care access and quality has not been examined in a comprehensive way for diabetes, a high priority condition for minorities. Finally, these studies typically focused solely on racial composition (e.g., % Black), dissimilarity, or isolation (Acevedo-Garcia, 2003). Little is known about how other segregation dimensions, such as centralization, which reflects segregation in urban centers and clustering, which indicate whether minority neighborhoods are connected spatially (Massey and Denton, 1988, 1989), relate to health outcomes. As each dimension conceptualizes segregation differently (Massey and Denton, 1988; Massey et al. 1996) and can influence health in distinct ways (Acevedo-Garcia, 2000; Vaughan Sarrazin et al. 2009a), it is important to investigate their unique relationships to diabetes care. Using nationally representative data, this study contributes to the literature by examining both Black-White and Hispanic-White differentials and the less explored segregation concepts of centralization, concentration and clustering,

METHODS

Data Sources and Study Sample

Individual level socio-demographic, health and service use data were obtained from the 2006 MEPS (www.meps.ahrq.gov). Residential segregation data for Blacks, and Hispanics were abstracted at the Metropolitan Statistical Area or Primary Metropolitan Statistical Area (MSA/PMSA) level from the 2000 Census Residential Housing Patterns Dataset (www.census.gov). Data from the Area Resource File (www.arf.hrsa.gov) for 2006 on outpatient visit rate and number of hospital beds per 100 residents were aggregated to the MSA level. These MSA-level measures were linked to each MEPS respondent's zip code.

We identified respondents from MEPS who were 18 years or older, had diabetes as one of their priority conditions and if they responded to the Diabetes Care Supplement. We restricted our analytic sample to Whites non-Hispanics, Blacks non-Hispanics and Hispanics because the sample size for Asians (N=67) and individuals of "other race" (N=38) who met our eligibility criteria were too small for reliable subgroup analysis. We further excluded respondents whom we cannot match to Census MSA-level residential segregation data. Our final study sample size was 1598.

Measures

Dependent Variables

Access to care: As diabetes is mainly managed in the ambulatory setting, access was measured as: 1) having any outpatient or office visit for diabetes in the past year by a provider of any specialty to reflect overall ambulatory care access; and 2) having any outpatient or office visit for diabetes with a family/general practice or internal medicine provider to reflect access to diabetes care in the primary care setting. To indicate general specialist access, we used respondent report of whether they experienced a small or a big problem in seeing a specialist, whether for diabetes or not, among those indicating need for a specialist.

Quality of care: Quality of diabetes care was based on respondent reports that, in the past year, they had: 1) at least one HbA1c test, 2) at least one LDL test, 3) a dilated eye exam, or 4) their foot checked for sores and irritations. These services reflect key recommendations from the American Diabetes Association (ADA, 2011). We also assessed overall quality of diabetes care as indicated by the receipt of all four of these recommended diabetes services. We separately examined the receipt of a flu shot in the past year in our analysis.

Independent Variables

Individual Race: MEPS participants were categorized as: non-Hispanic White, non-Hispanic Black, or Hispanic, based on self-reports.

Residential Segregation: Five segregation dimensions, as defined by Massey and Denton (1989), were calculated for Black and Hispanics relative to Whites. *Dissimilarity* measures evenness or the proportion of minority residents who would have to change census tracts for the population to be evenly distributed. *Isolation* measures exposure or the likelihood that minorities and Whites would come in contact with each other. For both of these measures, higher values indicate greater segregation. *Clustering* measures the degree to which minority areas are contiguous, with higher values reflect greater clustering of minority areas. *Centralization* measures the degree to which minorities live in the urban center. Ranging from -1 to 1, positive values indicate that minorities reside in the urban center and negative values indicate that minorities live outside the urban center. *Concentration* measures the

degree to which minorities are concentrated within a small geographic area within the MSA. Ranging from -1 to 1 , negative values indicate that whites are more concentrated than minorities, while positive values indicate minorities are more concentrated than whites in the MSA. We focused on the influence of high segregation by using 0.60 for clustering and dissimilarity, 0.70 for isolation and concentration, and 0.80 for centralization to dichotomize these indices (Massey & Denton, 1988). However, continuous measures of these indices, multiplied by 100 to facilitate interpretation of incremental differences, were also used in sensitivity analyses.

Individual Race- Residential Segregation Interactions: Interaction effects were examined using indicator variables that combined the respondents' race/ethnicity with whether the respondent resides in a segregated MSA, based on the segregation dimension examined in the model (e.g., dissimilarity). Using White respondents who are not living in a highly segregated MSA for Blacks or Hispanics as reference, eight other race/ethnicity-place indicator variables were constructed: Whites living in MSAs with high Black segregation, Whites living in MSAs with high Hispanic segregation, Blacks living in MSAs with high Black segregation, Blacks living in MSAs with high Hispanic segregation, Blacks not living in a highly segregated MSA, Hispanics living in MSAs with high Black segregation, Hispanics living in MSAs with high Hispanic segregation, and Hispanics not living in a highly segregated MSA.

Control Variables: In multivariate analyses, we controlled for respondent age, gender, health insurance (public, private, uninsured), education (at least some college or not), and household income ($<200\%$ federal poverty level or better), diabetes severity and the number of reported priority health conditions (asthma, hypertension, high cholesterol, coronary heart disease, angina, heart attack, stroke, other heart disease, emphysema, joint pain, arthritis). Diabetes severity was based on treatment intensity and complications (diet modification only= 1 , oral medications, no insulin or complications= 2 , insulin, no complications= 3 , diabetes complications, eye or kidney= 4). Outpatient visits and hospital beds per 100 residents were included to control for MSA differences in access and utilization.

Analysis

Logistic and multinomial logistic regression models were used to examine the relationship of individual race and segregation status with access and quality of care outcomes. We constructed a base model that estimates the odds of each outcome for Blacks and Hispanics compared to Whites after controlling for respondent socio-demographics, health, and MSA access and utilization characteristics. We then constructed a second set of five models, using a separate model for each segregation dimension. In each of these models, we added two indicators, one reflecting MSAs with high segregation for Blacks and the other reflecting MSAs with high segregation for Hispanics for the specified segregation dimension, to the base model. The final set of models allowed for interactions between individual race-ethnicity and segregation status if statistically significant main effects were observed. In lieu of the four indicators of individual race and MSA segregation status used in the second set of models for each segregation dimension, we used the set of eight individual and residential segregation indicator variables with Whites not living in segregated MSAs as the reference category. These models tested whether the association of residential segregation was uniform across race and ethnic groups.

Survey estimation procedures in STATA[®] 11 were used in all analyses to account for MEPS' complex sampling design.

This study was determined to be Not Human Subjects Research by the Johns Hopkins Bloomberg School of Public Health Institutional Review Board.

RESULTS

Sample Characteristics

Overall, our sample demonstrated good socio-demographic diversity (Table 1). The illness burden in our sample was substantial, with 28% experiencing a diabetes complication, another 13% being insulin-dependent and an average of 4 health conditions per person. Hispanics were generally younger, have lower SES and less access to health insurance than Whites, and had fewer health conditions. Diabetes severity was greater in Blacks and Hispanics, with higher percentages of complications, than Whites.

Residence in Different Types of Segregated Neighborhoods

About half of our overall sample lived in MSAs with high dissimilarity or concentration for Blacks (Table 2). In contrast, only 8.8% lived in MSAs characterized by high isolation for Hispanics and 10.5% in MSAs with strong clustering for Blacks. No MSA demonstrated segregation based on clustering for Hispanics. Within each group, the proportion living in different types of segregated neighborhoods varied substantially. There was also significant difference by race in the proportion living within each type of residential segregation, except for centralization for Blacks.

Access to Care and Quality of Care by Individual Race and Ethnicity

Access to care was moderate to good for the sample, overall. Over 75% had an ambulatory visit for diabetes by a provider of any specialty in the past year and of the 57% who indicated needing a specialist, 76% did not report a problem seeing one (Table 2). Quality of care is generally good, with >80% getting HbA1C and LDL tests. However, rates of eye and foot exams were lower at around 70% and only 42% received all four recommended services.

Minority diabetics were not disadvantaged in terms of care access. There were no significant group differences in having any ambulatory visit for diabetes in the past year and perceived problems with seeing a specialist if needed. In fact, after accounting for respondent and area characteristics, Hispanic diabetics had 90% higher odds of a diabetes-related visit and 65% higher odds of having a primary care visit for diabetes compared with Whites (Table 3).

However, minority diabetics did not receive the same quality of care as their White peers, with Hispanics experiencing the worse care (Table 2). Rates of LDL checks, eye and foot exams among Hispanics were between 12% and 18% lower than Whites and between 11% and 17% lower than Blacks (all $p < 0.05$). Lower proportion of Blacks and Hispanics had flu shots and both groups received fewer recommended services than Whites ($p < 0.05$). Hispanics also had fewer recommended services than Blacks ($p < 0.05$). Across segregation models, Hispanic diabetics had between 40% and 60% lower adjusted odds of having eye exams and getting all recommended services. Both Hispanics and Blacks had approximately 40% lower adjusted odds of getting a flu shot than Whites. Otherwise, the quality of care for Blacks, with a few exceptions, was comparable to Whites.

Community Segregation Characteristics and Care Access and Quality

Residents from segregated communities generally had comparable access to ambulatory care for diabetes. Furthermore, high centralization for Blacks was associated with 42% higher adjusted odds of a diabetes-related primary care visit and high isolation for Hispanics was associated with 82% higher adjusted odds for having any diabetes-related visit. Residents in

segregated communities for Hispanics reported problems accessing specialists. Among diabetics who needed a specialist, those living in MSAs with high dissimilarity or concentration had significantly higher adjusted odds of reporting a small problem accessing specialists. In contrast, residents in MSAs where Blacks are highly concentrated had 46% lower adjusted odds of reporting a small problem in getting specialty care.

Residents in high segregation MSAs generally had comparable or better quality of diabetes care. With few exceptions, high segregation was not related to the receipt of flu shots, cholesterol checks and HbA1c. However, higher adjusted odds of foot checks and receipt of all recommended services was observed in MSAs with high segregation for both Blacks and Hispanics across multiple dimensions. In addition, highly clustered and centralized MSAs for Blacks were associated with higher adjusted odds of eye exams.

Significant associations with access and quality outcomes were primarily observed for high segregation. However, continuously measured dissimilarity, isolation, and clustering was positively related to difficulty in accessing specialists in segregated Hispanic MSAs. In addition, continuously measured concentration and isolation were significantly associated with receiving several diabetes services. These findings suggest that lower levels of these segregation dimensions could be influential in selected health outcomes.

We observed significant interaction of individual race and MSA segregation status on overall quality of diabetes care (Figure 1). Hispanics generally had lower adjusted odds of getting all recommended diabetes services than Blacks or Whites, but did significantly worse in MSAs with low isolation or clustering. The overall quality of care for Blacks living in non-segregated MSAs was poorer than for Whites living in these MSAs, although this was significant only in MSAs with low concentration. However, Blacks in segregated MSAs for Hispanics appears to receive better care, often comparable to Whites living in these MSAs. White diabetics living in segregated MSAs tended to have better diabetes care overall than Whites not living in segregated MSAs.

DISCUSSION

Respondent race and MSA segregation characteristics both exert notable influences on access to and quality of care for diabetics in the U.S. As expected, race/ethnicity was associated with poorer quality of care. Hispanics had lower odds of receiving eye exam and flu shots. Their overall level of diabetes care was also significantly worse than for Whites. Black diabetics had lower odds of getting flu shots and their overall diabetes care was significantly poorer once high dissimilarity or isolation was accounted for. However, the receipt of other services for Blacks was not significantly different from Whites. Given these results, it was surprising that Hispanics had consistently higher odds of diabetes-related visits. However, access alone does not ensure quality care. While minority populations can access providers, their visits may be of lower quality due to time constraints or communication challenges. Underserved communities may also lack a robust referral network for specialty care that enables patients to easily obtain recommended services such as eye exams that are not offered in primary care setting.

The better diabetes care observed in segregated MSAs may reflect the success of safety net providers in increasing access to underserved neighborhoods (Gusmano et al., 2002; Blewett et al., 2008; Darnell, 2010). In addition, high concentration of patients with similar characteristics may attract ethnically or linguistically concordant providers seeking to serve these populations, increasing local availability of culturally competent providers. The fact that accessing specialists was more problematic in segregated MSAs for Hispanics is not consistent with the better access and quality of diabetes care observed. However, since most

diabetes services can be obtained from primary care providers, difficulties in accessing a specialist more generally may not substantially impact diabetes care quality. The significant interaction findings emphasize the unequal effect segregation can have on different groups. While highly dissimilar MSAs for Hispanics were associated with better overall diabetes care, benefits appear to accrue primarily to Blacks and Whites. Whites from highly segregated MSAs consistently had better quality of care, likely reflecting their advantage in personal and community-level resources in segregated MSAs.

Our findings are generally consistent with earlier studies reporting positive health-related outcomes in segregated communities. Haas et al. (2004), using the 1996 MEPS, found for the general population that blacks and Hispanics living in counties with high prevalence of residents of similar race/ethnicity perceived fewer difficulties in obtaining care. Similarly, Fang et al. (1998) and Inagami et al. (2006) observed positive effects of concentration, or “ethnic density” on mortality for Blacks, Latinos and Whites in New York City. However, one nationally representative study did observe poorer outcomes for body mass index and overweight status in isolated communities (Chang, 2006) emphasizing the diverse pathways through which segregation likely influence different health outcomes.

Prior studies of residential segregation typically focused on either dissimilarity or isolation (Acevedo-Garcia, 2000). The strong correlation observed for dissimilarity, isolation and clustering (Johnston et al., 2007) and the similar pattern of significant associations for these dimensions in our own study lend some support to this practice. However, findings for segregation were not consistent across all dimensions, suggesting that the conceptual distinctions of different dimensions do matter. Specifically, centralization did not demonstrate the significant associations that the other dimensions did for foot checks and overall diabetes care. In addition, the pattern of findings was not exactly the same, even among the highly correlated dimensions of dissimilarity, isolation and clustering. These results, along with a recent study reporting different relationships for dissimilarity and isolation on revascularization after AMI (Vaughan Sarrazin et al., 2009), reinforce the need to examine relationship between segregation and health outcomes for each dimension.

The influence of individual segregation dimensions varies by outcome and population, suggesting complex relationships between segregation and different health outcomes. For example, while high clustering of minority neighborhoods may attract diabetes intervention programs and safety net providers targeting specific populations to these areas, concentrated disadvantage in these neighborhoods may deter private practice physicians, particularly specialists, from locating there. The fact that segregation findings vary by group was not unexpected given the multiple factors that may influence these relationships. For example, while both segregated Black and Hispanic communities may lack important community resources (Acevedo-Garcia, 2000; Williams and Collins, 2001), the language barriers experienced by Hispanic immigrants can exacerbate access and quality problems. Alternatively, ethnic enclaves can positively influence health and health care experience by bolstering social support, as has been seen with immigrant groups (Gresenz et al., 2009). A thorough examination of these issues is beyond the scope of this paper and the data sources available to us. However, detailed exploration of these issues in future studies could yield valuable insights into the nature of the relationships between segregation and health in different groups.

Our study has several limitations. Residential segregation information came from the 2000 Census while the MEPS data were collected in 2006. However, we used the best data available and prior studies have reported that residential segregation is persistent in urban areas (Massey & Denton, 1989). We did not adjust for multiple comparisons as significant and non-significant associations are of equal interest. However, as this increases the risk of

spurious findings, weaker results which were not consistently observed, such as those for diabetes visits and HbA1c, should be interpreted with caution. Finally, the cross-sectional design and available data limited our ability to explain observed associations. Despite these limitations, our study contributes generalizable evidence on the association between specific dimensions of segregation with care access and quality for two important minority diabetic groups which can guide more detailed testing of alternate causal pathways in future studies.

CONCLUSION

While being Black or Hispanic did not negatively impact access to providers, it did lead to fewer recommended services received. Living in a racially segregated community appeared to improve diabetes care access and quality of selected services, although the relationship varied by segregation type and group. Future investigations should focus on specifying the pathways by which specific segregation dimensions affects the health and health care outcomes of different racial and ethnic groups.

Acknowledgments

This research was supported by grant# 1P60MD00214-07 from the National Institute of Minority Health and Health Disparities (NIMHD) of the National Institutes of Health (NIH). The authors are also grateful for technical assistance provided by Ray F. Kuntz, the CFACT Data Center Coordinator in the Division of Survey Operations Center for Financing, Access and Cost Trends at the Agency for Healthcare Research and Quality Data Center.

References

- Acevedo-Garcia D. Residential segregation and the epidemiology of infectious diseases. *Soc Sci Med*. 2000; 51:1143–1161. [PubMed: 11037206]
- Acevedo-Garcia D, Lochner KA, Osypuk TL, et al. Future directions in residential segregation and health research: A multilevel approach. *Am J Public Health*. 2003; 93:215–221. [PubMed: 12554572]
- Agency for Healthcare Quality and Research. AHRQ Publication No 11–0004. US Department of Health and Human Services; Rockville, MD: Mar. 2011a 2010 National Healthcare Quality Report.
- Agency for Healthcare Quality and Research. AHRQ Publication No 11–0005. US Department of Health and Human Services; Rockville, MD: Mar. 2011b 2010 National Healthcare Disparities Report.
- American Diabetes Association. Standards of Medical Care in Diabetes—2011. *Diabetes Care*. 2011; 34(Suppl 1):S11–S61. [PubMed: 21193625]
- Baicker K, Chandra A, Skinner J. Geographic variation in health care and the problem of measuring racial disparities. *Perspect Biol Med*. 2005; 48(Suppl 1):S42–S53.
- Blewett LA, Ziegenfuss J, Davern ME. Local access to care programs (LACPs): new developments in the access to care for the uninsured. *Milbank Q*. 2008; 86:459–79. [PubMed: 18798886]
- Centers for Disease Control and Prevention. QuickStats: Death Rates for Persons Aged 65 years, with diabetes as the underlying or contributing cause, by race and sex—United States, 1981–2007. *MMWR*. 2010; 59(41):1345.
- Centers for Disease Control and Prevention. National Diabetes Fact Sheet: national estimates and general information on diabetes and prediabetes in the United States, 2011. Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention; 2011a.
- Centers for Disease Control and Prevention. Age-Adjusted Percentage of Civilian, Noninstitutionalized Population with Diagnosed Diabetes, by Race, United States, 1980–2009. U.S. Department of Health and Human Services, Centers for Disease Control and Prevention; 2011b. <http://www.cdc.gov/diabetes/statistics/prev/national/figbyrace.htm>
- Centers for Disease Control and Prevention. Age-Adjusted Percentage of Civilian, Noninstitutionalized Population with Diagnosed Diabetes, Hispanics, United States, 1997–2009. U.S. Department of Health and Human Services, Centers for Disease Control and Prevention; 2011c. <http://www.cdc.gov/diabetes/statistics/prev/national/figbyhispanic.htm>

- Chang V. Racial residential segregation and weight status among U.S. adults. *SocSciMed*. 2006; 63:1289–1303.
- Darnell JS. Free clinics in the United States: A nationwide survey. *Arch Intern Med*. 2010; 170:946–953. [PubMed: 20548006]
- Do DP, Finch BK, Basurto-Davila R, et al. Does place explain racial health disparities? Quantifying the contribution of residential context to the Black/white health gap in the United States. *SocSciMed*. 2008; 67:1258–1268.
- Fang J, Madhavan S, Bosworth W, et al. Residential segregation and mortality in New York City. *SocSciMed*. 47(4):469–476.
- Gaskin DJ, Price A, Brandon DT, et al. Segregation and disparities in health services use. *Med Care Res Rev*. 2009; 66(5):578–589. [PubMed: 19460811]
- Gusmano MK, Fairbrother G, Park H. Exploring the limits of the safety net: Community health centers and care for the uninsured. *Health Aff*. 2002; 21:188–194.
- Haas JS, Phillips KA, Sonneborn D, 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. [PubMed: 15213496]
- Iceland J. Beyond Black and White: Metropolitan residential segregation in multi-ethnic America. *Soc Sci Res*. 2004; 33:248–271.
- Inagami S, Borrell LN, Wong MD, et al. Residential segregation and Latino, Black and White mortality in New York City. *J Urban Health*. 2006; 83(3):406–420. [PubMed: 16739044]
- Johnston R, Poulsen M, Forrest J. Ethnic and racial segregation in U.S. metropolitan areas, 1980–2000. *Urban Affairs Review*. 2007; 42(4):479–504.
- LaVeist LA. Racial segregation and longevity among African Americans: An individual-level analysis. *Health Serv Res*. 2003; 38(6 part II):1719–1734. [PubMed: 14727794]
- Massey DS, Denton NA. Hypersegregation in US Metropolitan Areas: Black and Hispanic segregation along five dimensions. *Demography*. 1989; 26(3):373–391. [PubMed: 2792476]
- Massey DS, Denton NA. The Dimensions of Residential Segregation. *Social Forces*. 1988; 67:281–315.
- Massey DS, White MJ, Phua VC. The dimensions of segregation revisited. *Sociological Methods & Research*. 1996; 25:172–206.
- Rodriguez RA, Sen S, Mehta K, et al. Geography matters: relationship among urban residential segregation, dialysis facilities, and patient outcomes. *Ann Intern Med*. 2007; 146:493–501. [PubMed: 17404351]
- Smith DB, Feng Z, Fennel ML, et al. Separate and unequal: racial segregation and disparities in quality across U.S. nursing homes. *Health Aff*. 2007; 26(5):1448–1458.
- Subramanian SV, Acevedo-Garcia D, Osypuk TL. Racial residential segregation and geographic heterogeneity in black/white disparity in poor self-rated health in the U.S: a multilevel statistical analysis. *Soc Sci Med*. 2005; 60:1667–1679. [PubMed: 15686800]
- Vaughan Sarrazin MS, Campbell ME, Richardson KK, et al. Racial Segregation and Disparities in Health Care Delivery: Conceptual Model and Empirical Assessment. *Health Serv Res*. 2009a; 44:1424–1444.
- Vaughan Sarrazin MS, Campbell ME, Rosenthal GE. Racial differences in hospital use after acute myocardial infarction: Does residential segregation play a role? *Health Aff*. 2009b; 28:w368–w378.
- Williams DR, Collins C. Racial residential segregation: A fundamental cause of racial disparities in health. *Public Health Rep*. 2001; 116:404–416. [PubMed: 12042604]

Figure 1. Receipt of All 4 Recommended Diabetes Service for Black, Hispanic, and White Respondents in High Segregation Compared to Low Segregation MSAs by Segregation Type. High (Black) indicates high segregation between Blacks and Whites for that dimension; High (Hispanic) indicates high segregation between Hispanic and Whites for that dimension; Low indicates low segregation for both Blacks and Hispanics for that dimension. * < p0.05, ** p<0.01.

Table 1
Characteristics and Residence of Diabetes Study Sample, Overall and by Race and Ethnicity

Sample Characteristics	Total Sample N=1598	White N=774	Black N=375	Hispanic N=449	Overall Test of Group Difference p-value
Weighted Population N	13077343	8621753	2224729	2230862	
Age					P=0.0037
Young Adult (18–24)	0.82	0.78	0.96	0.85	
Working Age (25–44)	12.19	9.82	13.74	19.78	
Pre-Retiree (45–64)	49.55	48.02	55.2	49.86	
Elderly (65+)	37.44	41.38	30.1	29.51	
Gender					0.0124
Female	50.81	47.57	57.63	56.51	
Education					<0.001
8 th Grade or Below	11.67	5.67	8.23	38.29	
Some High School	13.37	10.9	19.45	16.92	
High School Diploma or GED	35.62	38.47	36.43	23.8	
Some College	20.83	22.93	21.38	12.21	
Bachelors Degree	11.99	14.11	8.91	6.82	
Advanced Degree	6.51	7.93	5.59	1.96	
Income, Federal Poverty Level (FPL)					<0.001
< 100% FPL	12.80	7.86	22.78	21.93	
100% – 124% FPL	5.83	4.68	7.11	9.02	
125% – 199% FPL	15.74	13.08	20.72	21.08	
200% – 399% FPL	29.38	28.76	28.67	32.5	
>400% FPL	36.24	45.62	20.72	15.46	
Health Insurance					<0.001
Private	61.76	70.81	48.62	39.86	
Public	31.33	25.36	42.44	43.29	
Uninsured	6.92	3.82	8.93	16.85	

Sample Characteristics	Total Sample N=1598	White N=774	Black N=375	Hispanic N=449	Overall Test of Group Difference p-value
Number of Priority Conditions	4.04	4.18	4.00	3.57	0.002
Diabetes Severity					
Diet modification only	9.35	10.51	7.19	7.05	0.0032
Oral meds, no insulin or complications	50.12	51.60	43.25	51.21	
Insulin, no complication	12.97	13.99	13.86	8.23	
Diabetes Complication (eye or kidney)	27.56	23.91	35.70	33.50	

Table 2
Segregation Status, and Diabetes Care Access and Quality Overall, by Race and Ethnicity

	Total Sample N=1598	White N=774	Black N=375	Hispanic N=449	Overall Test of Group Difference p-value
High Residential Segregation Measures					
Dissimilarity Index Black (%)	50.81	47.72	65.96	47.65	0.002 ^{ac}
Dissimilarity Index Hispanic (%)	17.28	13.50	24.31	24.93	0.005 ^{ab}
Isolation Index Black (%)	14.02	11.18	23.97	15.09	<0.001 ^{ac}
Isolation Index Hispanic (%)	8.83	2.51	10.24	31.83	<0.001 ^{abc}
Clustering (Spatial) Index Black (%)	10.45	9.95	15.76	7.10	0.0183 ^{ac}
Clustering (Spatial) Index Hispanic (%)	NA	NA	NA	NA	NA
Absolute Centralization Index Black (%)	36.48	38.86	29.92	33.82	0.1896
Absolute Centralization Index Hispanic (%)	16.96	14.70	17.55	25.10	0.0182 ^b
Relative Concentration Index Black (%)	50.65	53.47	54.71	35.73	0.0012 ^{bc}
Relative Concentration Index Hispanic (%)	21.66	17.69	30.19	28.49	0.0024 ^{ab}
Access to Care					
Any office-based or outpatient visit for diabetes, any specialty	77.23	76.29	77.44	80.67	0.4048
Any office-based or outpatient visit for diabetes, primary care only	63.65	61.55	65.69	69.7	0.069 ^b
Needed to see specialist	56.69	60.84	54.11	42.86	0.002 ^{bc}
Problem seeing specialist					
Big Problem	7.12	5.67	9.67	11.71	0.2896
Small Problem	16.87	17.03	17.31	15.4	
Not a Problem	76.01	77.3	73.02	72.88	

	Total Sample N=1598	White N=774	Black N=375	Hispanic N=449	Overall Test of Group Difference p-value
<i>Quality of Care</i>					
A1c checked	89.81	91.06	86.95	87.21	0.1567
Eye exam	70.45	74.37	69.2	56.51	<0.001 ^{bc}
Foot checked	71.54	72.77	77.76	60.69	<0.001 ^{bc}
LDL cholesterol checked	88.14	90.4	88.95	78.41	<0.001 ^{bc}
Flu shot	60.08	66.72	49.79	43.95	<0.001^{ab}
Number of Recommended Diabetes Services Received					
0	3.98	3.56	2.13	7.43	<0.001 ^{abc}
1	6.33	5.36	8.43	8.00	
2	17.02	12.74	2.05	30.15	
3	30.67	31.35	32.58	26.17	
4	42.00	47.00	36.38	28.26	

^a -black/white significance (white reference),

^b -white/Hispanic significance (white reference),

^c -black/Hispanic significance (Hispanic reference), significance indicated p<0.05.

Table 3

The Relationship of Individual and Community Level Race and Ethnicity Characteristics on Access to Care Among Diabetes Patients

	Individual Race Models Adjusted OR	Community Race Models Adjusted OR											
Access to Care Outcomes			Dissimilarity		Isolation		Clustering		Absolute Centralization		Relative Concentration		
			Dichot	Cont	Dichot	Cont	Dichot	Cont	Dichot	Cont	Dichot	Cont	
Any office-based or outpatient visit for diabetes, any specialty	Black	0.94	0.89	0.88	0.90	0.92	0.94	0.91	0.94	0.94	0.92	0.92	
	Hispanic	1.90**	1.84*	1.90*	1.63*	1.92*	1.90**	1.89*	1.87*	1.91*	2.00**	1.99**	
	CommBl		1.14	1.01	0.93	1.00	0.92	1.00	1.29	1.01	1.40	1.01	
	CommHis		1.23	1.00	1.82*	1.00	NA	1.00	1.19	1.00	1.04	1.00	
Any office-based or outpatient visit for diabetes, primary care only	Black	1.09	1.10	1.08	1.11	1.12	1.11	1.12	1.09	1.10	1.10	1.08	
	Hispanic	1.65*	1.68*	1.76*	1.62*	1.90**	1.64*	1.82**	1.62*	1.69*	1.77**	1.69*	
	CommBl		1.08	1.01	0.82	1.00	0.79	1.00	1.42*	1.02	1.32	1.00	
	CommHis		0.83	0.99	1.13	1.00	NA	0.99	1.40	1.00	0.84	1.00	
Problem seeing Specialist Big Problem (Ref: Not a Problem)	Black	1.12	0.97	1.03	0.98	0.93	0.99	0.89	1.08	1.12	1.06	1.08	
	Hispanic	1.96	1.84	1.79	1.63	1.20	1.98	1.21	1.94	1.60	1.85	1.72	
	CommBl		1.34	1.01	1.67	1.00	2.44	1.00	1.13	0.98	0.87	0.99	
	CommHis		1.64	1.01	1.91	1.02	NA	1.04	0.72	1.03	1.69	1.01	
Problem seeing Specialist Small Problem (Ref: Not a Problem)	Black	0.60	0.59	0.65	0.60	0.61	0.61	0.60	0.63	0.60	0.56	0.62	
	Hispanic	0.86	0.82	0.71	0.79	0.58	0.86	0.63	0.85	0.78	0.74	0.78	
	CommBl		0.71	0.98	0.88	0.99	1.03	0.99	0.66	0.99	0.54*	0.99	
	CommHis		1.86*	1.02*	1.36	1.01*	NA	1.03*	1.85	1.01	1.99*	1.00	

Note: Segregation modeled as dichotomous (high segregation vs. low segregation) and continuous variable. All models controlled for age, gender, education, poverty, insurance, # priority conditions, diabetes severity, outpatient visits per 100 residents, hospital beds per 100 residents; White served as reference group for individual race variables;

* 0.05,

** 0.01

Table 4
The Relationship of Individual and Community Level Race and Ethnicity Characteristics on Quality of Care Among Diabetes Patients

Individual Race Models Adjusted OR		Community Race Models Adjusted OR											
		Dissimilarity		Isolation		Clustering		Absolute Centralization		Relative Concentration			
		Dichot	Cont	Dichot	Cont	Dichot	Cont	Dichot	Cont	Dichot	Cont		
HbA1c	Black	0.96	0.88	0.85	0.91	0.93	0.89	0.99	0.96	0.89	0.94		
	Hispanic	1.49	1.30	1.33	1.18	1.52	1.17	1.55	1.59	1.46	1.63		
	CommBl		1.01	2.03	1.00	3.35	1.00	1.26	1.01	1.41	1.01 [*]		
	CommHis		1.02	1.34	1.01	NA	1.02	0.71	0.99	1.79	1.00		
Eye Checked	Black	0.91	0.89	0.85	0.89	0.87	0.85	0.94	0.91	0.89	0.91		
	Hispanic	0.57 ^{**}	0.52 ^{**}	0.49 ^{**}	0.46 ^{**}	0.57 ^{**}	0.48 ^{**}	0.58 ^{**}	0.56 ^{**}	0.57 ^{**}	0.60 ^{**}		
	CommBl		1.01	1.70 [*]	1.00	1.96 [*]	1.01	1.19	1.01	1.58 [*]	1.01 [*]		
	CommHis		1.01	1.46	1.00	NA	1.01	0.98	1.00	1.86 ^{**}	1.00		
Foot Checked	Black	1.36	1.24	1.24	1.28	1.31	1.24	1.37	1.37	1.26	1.33		
	Hispanic	0.78	0.72	0.68	0.73	0.78	0.70	0.78	0.79	0.76	0.82		
	CommBl		1.01	1.70 [*]	1.00	1.96 [*]	1.01	1.19	1.01	1.58 [*]	1.01 [*]		
	CommHis		1.01	1.46	1.00	NA	1.01	0.98	1.00	1.86 ^{**}	1.00		
Cholesterol checked within 1 year	Black	1.21	1.14	1.16	1.19	1.18	1.18	1.23	1.22	1.16	1.22		
	Hispanic	0.74	0.67	0.69	0.61	0.74	0.68	0.77	0.82	0.72	0.84		
	CommBl		1.01	1.15	1.00	1.60	1.00	0.91	1.01	1.18	1.01 [*]		
	CommHis		1.01	1.22	1.01	NA	1.01	0.74	0.98	1.33	0.99 [*]		
Had flu shot within 1 year	Black	0.61 ^{**}	0.63 ^{**}	0.63 ^{**}	0.67 [*]	0.62 ^{**}	0.64 [*]	0.61 ^{**}	0.61 ^{**}	0.61 ^{**}	0.61 ^{**}		
	Hispanic	0.62 [*]	0.58 [*]	0.61 [*]	0.64	0.62 [*]	0.62 [*]	0.62 [*]	0.64 [*]	0.61 [*]	0.64 [*]		
	CommBl		0.99	0.72	0.99	0.84	1.00	1.00	1.00	0.93	1.00		
	CommHis		1.01	1.13	1.00	NA	1.00	0.91	0.99	0.98	1.00		

Quality of Care	Individual Race Models Adjusted OR		Community Race Models Adjusted OR														
Received all 4 Recommended Diabetes Services	Black	0.74	Black	0.66 *	0.69	0.65 *	0.67	0.70	0.66	0.75	0.74	0.69	0.73				
	Hispanic	0.52 **	Hispanic	0.46 **	0.47 **	0.42 **	0.40 **	0.53 **	0.43 **	0.52 **	0.51 **	0.49 **	0.53 **				
			CommBl	1.21	1.01	1.69 **	1.00	2.05 **	1.00	1.01	0.99	1.14	1.00				
			CommHis	2.09 **	1.01	1.78 *	1.01 *	NA	1.01	0.93	1.00	1.72 **	1.00				

Note: Segregation modeled as dichotomous (high segregation vs. low segregation) and continuous variable. All models controlled for age, gender, education, poverty, insurance, # priority conditions, diabetes severity, outpatient visits per 100 residents, hospital beds per 100 residents; White served as reference group for individual race variables;

* 0.05,

** 0.01