

Ethnic disparities in the control of type 2 diabetes risk factors in southwestern American veterans: the Diabetes Outcomes in Veterans Study

Christopher S Wendel¹, Jayendra H Shah^{1,2}, William C Duckworth^{2,3}, Richard M Hoffman^{4,5*}, M Jane Mohler^{1,2}, Glen H Murata^{4,5}

¹Southern Arizona VA Health Care System, Tucson, AZ, 85723, USA

²University of Arizona College of Medicine, Tucson, AZ, 85724, USA

³Carl T. Hayden VA Medical Center, Phoenix, AZ, 85012, USA

⁴New Mexico VA Health Care System, Albuquerque, NM, 87108, USA

⁵University of New Mexico School of Medicine, Albuquerque, NM, 87131, USA

*Corresponding author

Email addresses:

CSW: Christopher.Wendel@med.va.gov

JHS: Jayendra.Shah@med.va.gov

WCD: William.Duckworth@med.va.gov

RMH: Richard.Hoffman2@med.va.gov

MJM: Martha.Mohler@med.va.gov

GHM: Glen.Murata@med.va.gov

Abstract

Background

Type 2 diabetes causes a substantial burden of suffering for minorities. We examined the association between race/ethnicity and control of disease risk factors in a large cohort of insulin-treated veterans with type 2 diabetes.

Methods

We conducted a cross-sectional observational study at Veterans Affairs (VA) Medical Centers in Albuquerque, NM, Phoenix, AZ, and Tucson, AZ, USA. We randomly selected 338 insulin-treated type 2 diabetics on stable medication regimens, 72 (21.3%) Hispanics, 35 (10.4%) African Americans, and 226 (67%) non-Hispanic whites. The main outcome measures were hemoglobin A1c (A1c), glycemic regimen, micro- and macrovascular risk factors, Diabetes Care Profile, Mini-Mental Status Exam, Geriatric Depression Scale, Michigan Diabetes Knowledge Test, and Diabetes Family Checklist.

Results

Mean (SD) entry A1c for non-Hispanic white, Hispanic, and African American were 7.86 (1.4)%, 8.16 (1.6)%, and 8.84 (2.9)%, respectively ($P = 0.05$); units of insulin were 70.6 (48.8), 58.4 (32.6), and 53.1 (36.2) units/day, respectively ($P < 0.01$). Units of insulin in the poorly controlled group ($A1c \geq 8\%$) for non-Hispanic white, Hispanic, and African American were 78.6 (48.3), 57.1 (29.2), and 52.7 (31.5) units/day, respectively ($P < 0.01$). After adjusting for A1c, BMI, age, and oral medications, African American subjects received on average 17.8 units/day less ($P = 0.01$) and Hispanic subjects 10.5 units/day less ($P = 0.04$) than non-Hispanic whites.

No significant between-group differences were found for age, sex, BMI, smoking status, blood pressure, lipids, duration insulin therapy, insulin dosing times, or use of oral agents. Blood lipids and blood pressures were close to the target values recommended by the American Diabetes Association.

Conclusions

Insulin-treated veterans who are minorities may have an increased risk of poor glycemic control and receive lower doses of insulin. African-American patients are the most likely patients to experience this problem, while Hispanics have an intermediate risk. No differences were found in other intermediate outcomes of care. These findings could not be explained by differences in the socioeconomic barriers, attitudes, diabetes knowledge, depression, cognitive dysfunction, or levels of social support measured by study instruments. The insulin treatment disparity could be due to provider behavior and/or patient behavior or preferences.

Background

Type 2 diabetes causes a substantial burden of suffering for minorities. Compared to non-Hispanic whites, all minorities except Alaskan natives have a 2- to 6-fold increased risk of acquiring the disease [1-3], and the prevalence is rising in some groups, including African Americans, Hispanic Americans, and American Indians [4]. Many population studies have shown that minorities do not achieve the same level of glycemic control as non-Hispanic whites [3, 24-27]. Cultural and socioeconomic differences may create barriers to health care [1, 2, 5-7] by making it difficult to adhere to customary self-care recommendations for diet, weight loss, exercise, or blood glucose monitoring. Physiologic differences have been found that amplify the severity of disease such as the distribution of adipose tissue [8-10] and altered glucose and insulin metabolism [11-13]. Finally, minorities have a predisposition to developing micro- or macrovascular complications [1, 14, 15]. An excess risk has been described for nephropathy [3, 16-18], retinopathy [19-21], amputations and foot problems [1, 22], coronary artery disease [3] and stroke [3, 23] compared to non-Hispanic whites. This health care burden makes it imperative to develop appropriate interventions for minority patients.

Evaluating ethnic and racial variations in the intermediate outcomes of diabetes care may be the best way to assess diabetes management. A comprehensive evaluation is essential because socio-cultural barriers may differentially influence various clinical outcomes. Evaluations should encompass weight control, diet, exercise, glycemic control, smoking status, lipid management, and blood pressure control. The American Southwest is an appropriate region in which to evaluate ethnic and racial differences in diabetes care because of the high prevalence of disease, the large minority populations, and substantial disparities in socioeconomic status. The purpose of this study was to examine the association between race

and ethnicity and control of risk factors for diabetes and its complications in a large cohort of insulin-treated veterans with type 2 diabetes.

Methods

The Diabetes Outcomes in Veterans Study (DOVES) was a prospective, observational study of insulin-treated veterans with type 2 diabetes mellitus, designed to examine the association between clinical, demographic, lifestyle, socioeconomic, and psychological variables and the clinical outcomes of glycemic control and disease management. The DOVES was conducted under the auspices of the Southwestern Group for Outcomes Research in Diabetes (SWORD), a consortium of the largest VA facilities in Veterans Integrated Service Network 18. The protocol for this study was described in detail elsewhere [28]. Briefly, computerized pharmacy records were used to identify insulin-treated patients receiving care at the New Mexico VA Health Care System (Albuquerque, NM), the Carl T. Hayden VA Medical Center (Phoenix, AZ), and the Southern Arizona VA Health Care System (Tucson, AZ). Patients were eligible for this study if they had type 2 diabetes, took at least one injection of a long-acting insulin preparation daily, did not suffer from alcoholism or substance abuse, had living arrangements conducive to self-care, had no co-morbidities affecting glucose homeostasis, and their diabetes medication regimen was “stable” in the preceding 2 months (the dose of all oral agents remained unchanged, no oral agents were added to the treatment regimen, and the total daily insulin dose was increased by no more than 10 units or 15%, whichever was less).

At entry, all subjects underwent an evaluation of their psychological status, socio-cultural barriers, disabilities, dietary habits, exercise patterns and micro- and macrovascular risk factors. Race or ethnicity was determined from a structured category question that asked the patient to describe his or her background. The listed responses included non-Hispanic white, Hispanic,

Native American, African-American and Asian. Subjects also had the option to check an “other” category and write in a response. Subjects then answered questions on their family obligations, living arrangements, means of transportation, occupation, and financial status. Subjects rated their physical ability to do the following activities: work, yard work, household projects, shopping, exercise, cooking or light housekeeping, and personal care. We also collected data about medical treatment, including insulin dose, number of injections, types of preparations, and the dose, type, and frequency of oral medications.

Psychosocial testing was performed in private sessions during the baseline visit and the second visit two weeks later. The research coordinator was present to provide instructions, answer questions, clarify items, or in some cases, read the questions. Psychological instruments were given in random order and included the University of Michigan Diabetes Knowledge Test [29], the Mini-Mental State Examination [30], the Geriatric Depression Scale [31], the Diabetes Family Behavior Check List [32], and the Diabetes Care Profile [33]. We used the Compendium of Physical Activities to rate physical activities [34] and the Fred Hutchinson Cancer Research Center Food Frequency Analysis to assess dietary habits [35]. Physiologic measurements included hemoglobin A1c (A1c), blood pressure, height, weight, smoking status and blood lipids.

Analytical methods

In this report, group differences in continuous variables were analyzed by the unpaired Student’s t-test and one-way analysis of variance in most cases. For the latter procedure, homogeneity of variances was examined by Levene’s test, and the Brown-Forsythe test was used in place of the standard ANOVA F-test if the variances were significantly different (performed on BMDP software). The Mann-Whitney U-test and the Kruskal-Wallis one-way analysis of variance by ranks were used for variables with highly skewed distributions. Group differences in nominal variables were tested by chi-square analysis. The relationship between continuous variables was

examined by simple regression. We used stepwise multiple linear regression analyses to identify factors affecting entry A1c and daily insulin doses. Predictors associated with the dependent variable in univariate analysis ($P < 0.10$) were entered into multivariate model using a forward- and backward-stepping procedure with an $\alpha \leq 0.05$ to enter and an $\alpha > 0.10$ to remove. Continuous variables were expressed as mean \pm standard deviation (S.D.).

Results

We identified over 10,000 insulin-treated patients at the three participating medical centers. We randomly selected approximately 3000 subjects from this list and invited 589 eligible subjects to participate. We enrolled 359 (61%) subjects, but subsequently excluded 21 with incomplete data, leaving a cohort of 338 for the analysis. Their mean age was 65.1 ± 9.7 years, 96% were men, and 59% were married. The cohort was comprised of 226 (67%) non-Hispanic white, 72 (21%) Hispanic, and 35 (10%) African-American subjects. Over two-thirds of the subjects had at least one microvascular complication and an equivalent number had a macrovascular complication. Although average daily insulin doses were substantial (66 units), only one-third of the subjects were concurrently treated with an oral hypoglycemic agent. Most subjects had an elevated baseline A1c value suggesting poor glycemic control, including 99 (29%) with a value between 7.0% and 8.0%, and 148 (44%) with a value $\geq 8.0\%$. The median level of activity was 7 met-hours of activity per day (equivalent to 2.5 hours of light home activities plus 0.5 hour of moderate walking). Sixty-two percent had a BMI ≥ 30 , and 22.2% were current smokers. However, average lipid and blood pressure measurements were close to the target values recommended by the ADA.

Clinical and socioeconomic characteristics stratified by race/ethnicity are presented in Table 1. African-American subjects had the highest A1c and were most likely to have poor glycemic control. Fifty-one percent of African Americans had an A1c \geq 8% compared to 49% for Hispanics and 40% for non-Hispanic whites ($P = 0.27$). Mean A1c levels were 7.9 (1.4) % for non-Hispanic whites, 8.2 (1.6) % for Hispanics, and 8.8 (2.9) % for African Americans ($P = 0.05$). We found significant differences in the daily units of insulin, with non-Hispanic whites receiving 70.6 (48.8) units compared to 58.4 (32.6) units for Hispanics and 53.1 (36.2) units for African Americans ($P < 0.01$). However, we found no differences between minorities and non-Hispanic whites in the daily number of insulin injections, the number of different insulin preparations used, or the use of oral agents. Body mass index, amount of exercise, smoking status, lipid levels, and blood pressures were also similar between groups.

We also evaluated potential barriers to care. African-American subjects considered themselves less disabled for work (Table 1). Hispanic subjects had the most dependents, and reported the highest psychosocial barriers with respect to language preference, education, depression, diabetes knowledge or performance on the MMSE (Table 2). African-Americans perceived the fewest problems with glycemic control, had the fewest negative attitudes, and had the highest self-ratings for self-care abilities and dietary adherence. They also tended to have the strongest convictions about the importance of self-care and the fewest perceived barriers to exercise.

We found that higher depression scores ($r = 0.11$, $P = 0.049$), greater work hours per week ($r = 0.17$, $P = 0.002$), greater number of household dependents ($r = 0.13$, $P = 0.023$), being employed ($P = 0.004$), and age ($r = -0.21$, $P = 0.0001$) were significantly associated with a higher baseline A1c. After adjusting for these covariates with a multivariate linear regression analysis,

baseline A1c was significantly higher for African-American subjects (+0.93%, $P = 0.002$), though not Hispanics (+0.25%, $P = 0.29$), compared to non-Hispanic whites.

We stratified daily insulin dose by race/ethnicity and level of glycemic control (Table 3). We found that unadjusted daily insulin units increased monotonically with A1c in non-Hispanic whites, but not in Hispanics or African Americans. We found the most significant racial/ethnic differences in insulin doses among subjects with poorly controlled diabetes ($A1c \geq 8.0\%$), with non-Hispanic whites receiving approximately 22 daily units more than Hispanics and 26 daily units more than African Americans ($P < 0.01$).

We found that race/ethnicity, BMI, baseline A1c, use of metformin (trend), and use of any other oral hypoglycemic were significant predictors of daily insulin units on multivariate linear regression analyses (Table 4). African-Americans received an insulin dose that was an average of 17.8 units less ($P = 0.01$) and Hispanics an average of 10.5 units less ($P = 0.04$) than non-Hispanic whites. No significant interactions were observed. When the adjusted model was limited to those with baseline $A1c \geq 8\%$, African-Americans received an insulin dose that was an average of 26.5 units less ($P = 0.01$) and Hispanics an average of 15.9 units less ($P = 0.03$) than non-Hispanic whites. These differences persisted after adjusting for practice site.

Discussion

We evaluated racial/ethnic differences in glycemic control, medical therapy and control of risk factors in insulin-treated Southwestern veterans with type 2 diabetes. We found that African Americans and Hispanics had poorer glycemic control and received less intensive insulin treatment, particularly African-Americans with $A1c \geq 8.0\%$. Compared to non-Hispanic whites, they received over 25 units of insulin less per day. We found that blood lipids and blood

pressure control were close to ADA target values for all ethnic/racial groups. This finding is consistent with previous findings that failure to intensify insulin treatment contributed to poor glycemic control in urban African-Americans [36]. This under-treatment is an important health problem, as evidence suggests that African Americans respond better to insulin treatment [37].

Disparity in glycemic control among minority groups is consistent with findings of numerous other studies. Several psychosocial factors and barriers to care or self-care varied among the racial/ethnic groups in this study, and could be related to glycemic control. Hispanics were the most disadvantaged group in terms of language preference and education and scored higher on the depression inventory. These factors may explain their performance on the MMSE and Diabetes Knowledge tests – tasks that required comprehension of complex instructions. On the other hand, African-Americans had more favorable responses in several areas rated by the Diabetes Care Profile. We could not readily attribute poorer glycemic control to a negative outlook in this group.

Other investigators [39, 40] have described ethnic differences in attitudes towards type 2 diabetes that might contribute to poor outcomes. Possibly, instruments specifically developed for that purpose might have detected the effects of race/ ethnicity. For example, the Veterans Ecocultural Self Report [41] adaptation measure better explains the effect of minority status on glycemic control than does Hispanic ethnicity. Our inability to identify these factors may also be due to the fact that our instrument did not specifically target insulin therapy. Hunt and associates [42] used an open-ended interviewing technique to examine the attitudes of 44 low-income Mexican Americans towards insulin therapy. Negative aspects were much more frequently discussed than positive aspects and focused on anxiety about pain, proper techniques, disrupting daily activities, low blood sugars, and other complications of therapy. The subjects also expressed concern that prior treatment efforts had failed and that the disease had progressed into

a more serious phase. Our study suggests that integrating an abbreviated interview technique could be considered for future studies of minority subjects with an inadequate response to insulin therapy.

Potential cultural barriers to a more intensive insulin regimen in minorities also include: 1) a greater aversion to parenteral injections or to multiple injections; 2) greater fear of hypoglycemic events; 3) greater aversion to glucose monitoring; and 4) cultural barriers relating to images of wellness, such as a cultural aversion to public display of illness. Future studies should determine if there is a disparity in glycemic control for minorities based upon a much larger number of patients, use a less monitoring intimidating protocol, and a more culturally-sensitive approach to recruitment.

This study has some potential limitations. We cannot explain why minorities with poor glycemic control did not receive higher insulin doses. One possibility is a selection bias that precluded the enrollment of minorities with more aggressive insulin regimens and better glycemic control. We randomly selected subjects from a sample frame generated from administrative pharmacy files; however, a number of eligible patients refused to participate. Because participation in this study required time, travel, disruption of daily routines, and some discomfort, even minor cultural barriers may have played a role in the loss of more intensively-treated minorities. We were unable to ascertain the race/ethnicity of non-participants. Since provider adjustments to insulin dose are not captured in the administrative pharmacy database, we relied on self-report from patients for current insulin units per day via structured interviews with nurse study coordinators. While this was the best practical source of information, it is possible that systematic under-reporting of dose occurred among minority patients. Finally, because of the population studied, our results may be less generalizable to younger patients, nonveterans, or women.

Insulin treatment may have been less intensive in minorities for clinical reasons. Hypoglycemia is a major deterrent to tight glycemic control. Although age has been identified as a risk factor for drug-induced hypoglycemia [46], the roles of race and ethnicity have not been established. The risk of hypoglycemia could be affected by dietary habits that are influenced by race and culture. Another possibility is racial/ethnic differences in the intensity of glucose monitoring. Because monitoring is used to titrate insulin doses, targets may not have been reached in those who tested less frequently. In 1993, Harris and co-workers [47] reported data from the 1989 National Health Interview Survey on 2,405 diabetic patients ≥ 18 years of age. They found that African-Americans were 60% less likely to test their blood glucose at least once daily compared to non-Hispanic whites and Hispanics. The effect of race/ethnicity was independent of age, insulin use, education, intensity of physician visits, or diabetes education. Unfortunately, we did not obtain information on monitoring practices or the rate of hypoglycemia when patients entered this study.

Finally, it should be noted that the differences among the racial groups were limited to insulin use. We found no racial/ethnic differences in the use of oral hypoglycemic agents or in the control level of 5 other risk factors for diabetes or its complications (weight, exercise, smoking status, lipids, and blood pressure). In contrast, Heisler and co-workers [48] found that black veterans with type 2 diabetes were more likely to have poor lipid and blood pressure control compared to whites, although there was no difference in intensity of treatment for those in poor control (the intensity of glycemic regime was not measured). Our observation does not support the hypothesis that subjects faced access barriers or that their providers were careless or indifferent. Insulin treatment requires more motivation and patient education than other aspects of diabetes treatment. Failure to achieve treatment goals may have been due to a highly focused problem with the patient-provider interaction. One possibility is that the patient was not able to

establish an effective therapeutic relationship with a provider of another race. A second possibility is that the providers were not aware of the specific needs of minorities with diabetes [49]. Providers face competing demands during medical encounters, often presenting barriers to preventive services and optimal disease management [50, 51].

Conclusions

In summary, insulin-treated veterans who are minorities have an increased risk of poor glycemic control and receive lower doses of insulin. African-American patients are the most likely patients to experience this problem, while Hispanics have an intermediate risk. No differences were found in the other intermediate outcomes of care. These findings could not be explained by differences in the socioeconomic barriers, attitudes, level of knowledge, depression, cognitive dysfunction, or level of social support measured by the study instruments. Future investigations should be done to determine if these findings persist in much larger surveys and to elucidate the reasons for this discrepancy.

Competing interests

None (all authors)

Authors' contributions

CSW served as data manager and analyst and drafted the manuscript. JHS participated in study conception, design, management, and interpretation. WCD participated in study conception, design, management, and interpretation. RMH participated in study conception, design, and interpretation, and helped to refine the manuscript. MJM participated in study conception and design, and helped to refine the manuscript. GHM conceived of and designed the study, managed it as PI, lead the statistical analysis, and helped to draft the manuscript. All authors read and approved the final manuscript.

Acknowledgements

Supported by a grant (VCR 99-007) from the Health Services Research & Development Service and Veterans Integrated Service Network 18, Department of Veterans Affairs. We are indebted to our study coordinators, Syed U. Bokhari, M.D., Karen D. Adam, R.N., C.D.E., Cheri Dalton, RN, and Patricia Solvas, R.N., for collection of this data.

References

1. Carter JS, Pugh JA, Monterrosa A: **Non-insulin-dependent diabetes in minorities in the United States.** *Ann Intern Med* 1996, **125**:221-32.
2. Haffner SM: **Epidemiology of type 2 diabetes: risk factors.** *Diabetes Care* 1998, **Suppl 3**:C3-6.
3. Ness J, Nassimiha D, Feria MI, Aronow WS: **Diabetes mellitus in older African-Americans, Hispanics, and whites in an academic hospital-based geriatrics practice.** *Coron Artery Dis* 1999, **10**:343-6.
4. Burke JP, Williams K, Gaskill SP, Hazuda HP, Haffner SM, Stern MP: **Rapid rise in the incidence of type 2 diabetes from 1987 to 1996: results from the San Antonio Heart Study.** *Arch Intern Med* 1999, **159**:1450-6.
5. Robbins JM, Vaccarino V, Zhang H, Kasl SV: **Excess type 2 diabetes in African-American women and men aged 40-74 and socioeconomic status: evidence from the Third National Health and Nutrition Examination Survey.** *J Epidemiol Comm Health* 2000, **54**:839-45.
6. Witucki JM, Wallace DC: **Differences in functional status, health status, and community-based service use between black and white diabetic elders.** *J Cult Divers* 1998, **5**:94-100.
7. Karter AJ, Ferrara A, Darbinian JA, Ackerson LM, Selby JV: **Self-monitoring of blood glucose: language and financial barriers in a managed care population with diabetes.** *Diabetes Care* 2000, **23**:477-83.
8. Banerji MA, Chaiken RL, Gordon D, Kral JG, Lebovitz HE: **Does intra-abdominal adipose tissue in black men determine whether NIDDM is insulin-resistant or insulin-sensitive?** *Diabetes* 1995, **44**:141-6.

9. Okosun IS, Chandra KM, Choi S, Christman J, Dever GE, Prewitt TE: **Hypertension and type 2 diabetes comorbidity in adults in the United States: risk of overall and regional adiposity.** *Obesity Res* 2001, **9**:1-9.
10. Okosun IS: **Ethnic differences in the risk of type 2 diabetes attributable to differences in abdominal adiposity in American women.** *J Cardiovasc Risk* 2000, **7**:425-30.
11. Balasubramanyam A, McKay S, Nadkarni P, Rajan AS, Garza A, Pavlik V, Herd JA, Jahoor F, Reeds PJ: **Ethnicity affects the postprandial regulation of glycogenolysis.** *Am J Physiol* 1999, **277(5 Pt 1)**:E905-14.
12. Haffner SM, Miettinen H, Gaskill SP, Stern MP: **Decreased insulin secretion and increased insulin resistance are independently related to the 7-year risk of NIDDM in Mexican-Americans.** *Diabetes* 1995, **44**:1386-91.
13. Haffner SM, Miettinen H, Stern MP: **Insulin secretion and resistance in nondiabetic Mexican Americans and non-Hispanic whites with a parental history of diabetes.** *J Clin Endocrinol Metab* 1996, **81**:1846-51.
14. Hamel HK, Rodriguez-Saidana J, Flaherty JH, Miller DK: **Diabetes mellitus among ethnic seniors: contrasts with diabetes in whites.** *Clin Geriatr Med* 1999, **15**:265-78.
15. Black SA, Ray LA, Markides KS: **The prevalence and health burden of self-reported diabetes in older Mexican Americans: findings from the Hispanic established populations for epidemiologic studies of the elderly.** *Am J Public Health* 1999, **89**:546-52.
16. Garza R, Medina R, Basu S, Pugh JA: **Predictors of the rate of renal function decline in non-insulin-dependent diabetes mellitus.** *Am J Nephrol* 1997, **17**:59-67.

17. Lindeman RD, Romero L, Liang HC, Hundley R, Baumgartner R, Koehler K, Garry P: **Prevalence of proteinuria/ microalbuminuria in an elderly, urban, biethnic community.** *Geriatr Nephrol Urol* 1998, **8**:123-30.
18. Pugh JA, Medina RA, Cornell JC, Basu S: **NIDDM is the major cause of diabetic end-stage renal disease. More evidence from a tri-ethnic community.** *Diabetes* 1995, **44**:1375-80.
19. Harris EL, Sherman SH, Georgopoulos A: **Black-white differences in risk of developing retinopathy among individuals with type 2 diabetes.** *Diabetes Care* 1999, **22**:779-83.
20. Harris MI, Klein R, Cowie CC, Rowland M, Byrd-Holt DD: **Is the risk of diabetic retinopathy greater in non-Hispanic blacks and Mexican Americans than in non-Hispanic whites with type 2 diabetes? A U.S. population study.** *Diabetes Care* 1998, **21**:1230-5.
21. Estacio RO, McFarling E, Biggerstaff S, Jeffers BW, Johnson D, Schrier RW: **Overt albuminuria predicts diabetic retinopathy in Hispanics with NIDDM.** *Am J Kid Dis* 1998, **31**:947-53.
22. Veves A, Sarnow MR, Giurini JM, Rosenblum BI, Lyons TE, Chrzan JS, Habershaw GM: **Differences in joint mobility and foot pressures between black and white diabetic patients.** *Diabetic Med* 1995, **12**:585-9.
23. Chaturvedi N, Fuller JH: **Ethnic differences in mortality for cardiovascular disease in the UK: do they persist in people with diabetes?** *J Epidemiol Comm Health* 1996, **50**:137-9.

24. Konen JC, Summerson JH, Bell RA, Curtis LG: **Racial differences in symptoms and complications in adults with type 2 diabetes mellitus.** *Ethnicity & Health* 1999, **41**:39-49.
25. Harris MI, Eastman RC, Cowie CC, Flegal KM, Eberhardt MS: **Racial and ethnic differences in glycemic control of adults with type 2 diabetes.** *Diabetes Care* 1999, **22**:403-8.
26. Harris MI: **Racial and ethnic differences in health care access and health outcomes for adults with type 2 diabetes.** *Diabetes Care* 2001, **24**:454-9.
27. Fultz SL, Good CB, Kelley ME, Fine MJ: **Racial differences in diabetic costs and control [abstract].** In *HSR&D Service 20th Annual Meeting Abstracts: 13-15 February 2002, Washington, DC.* Department of Veterans Affairs; 2002:72.
28. Murata GH, Shah JH, Wendel CS, Hoffman RM, Adam KD, Bokhari SU, Solvas PA, Duckworth WC: **Risk factor management in stable, insulin-treated patients with type 2 diabetes: the Diabetes Outcomes in Veterans Study.** *J Diabetes Complications.* 2003, **17**:186-191.
29. Fitzgerald JT, Funnell MM, Hess GE, Barr PA, Anderson RM, Hiss RG, Davis WK: **The reliability and validity of a brief diabetes knowledge test.** *Diabetes Care* 1998, **21**:706-10.
30. Magaziner J, Bassett SS, Hebel JR: **Predicting performance on the Mini-Mental State Examination: use of age- and education-specific equations.** *J Am Geriatr Soc* 1987, **48**:314-8.
31. Yesavage JA, Brink TL, Rose TL, Lum O, Huang V, Adey M, Leirer VO: **Development and validation of a geriatric depression rating scale: a preliminary report.** *J Psychiatr Res* 1982-1983, **17**:37-49.

32. Schafer LC, McCaul KD, Glasgow RE: **Supportive and nonsupportive family behaviors: relationships to adherence and metabolic control in persons with type 1 diabetes.** *Diabetes Care* 1986, **9**:179-85.
33. Fitzgerald JT, Davis WK, Connell CM, Hess GE, Funnell MM, Hiss RG: **Development and validation of the diabetes care profile.** *Eval Health Prof* 1996, **19**:208-30.
34. Ainsworth BE, Haskell WL, Leon AS, Jacobs DR Jr, Montoye HJ, Sallis JF, Paffenbarger RS Jr: **Compendium of physical activities: classification of energy costs of human physical activities.** *Med Sci Sports Exerc* 1993, **25**:71-80.
35. Kristal AR, Abrams BF, Thornquist MD, Disogra L, Croyle RT, Shattuck AL, Henry HJ: **Development and validation of a food use checklist for evaluation of community nutrition interventions.** *Am J Public Health* 1990, **80**:1318-22.
36. Cook CB, Lyles RH, El-Kebbi I, Ziemer DC, Gallina DL, Dunbar VG, Phillips LS: **The potentially poor response to outpatient diabetes care in urban African-Americans.** *Diabetes Care* 2001, **24**:209-15.
37. Agrawal L, Emanuele NV, Abaira C, Henderson WG, Levin SR, Sawin CT, Silbert CK, Nuttall FQ, Comstock JP, Colwell JA: **Ethnic differences in the glycemic response to exogenous insulin treatment in the Veterans Affairs Cooperative Study in Type 2 Diabetes Mellitus (VA CSDM).** *Diabetes Care* 1998, **21**:510-515.
38. Prospective Diabetes Study (UKPDS) Group: **Tight blood pressure control and risk of macrovascular and microvascular complications in type 2 diabetes.** *Br Med J* 1998, **317**:703-713.
39. Bell RA, Summerson JH, Konen JC: **Racial differences in psychosocial variables among adults with non-insulin-dependent diabetes mellitus.** *Behav Med* 1995, **21**:69-73.

40. Fitzgerald JT, Gruppen LD, Anderson RM, Funnell MM, Jacober SJ, Grunberger G, Aman LC: **The influence of treatment modality and ethnicity on attitudes in type 2 diabetes.** *Diabetes Care* 2000, **23**:313-8.
41. Walsh ME, Katz MA, Sechrest L: **Unpacking cultural factors in adaptation to type 2 diabetes mellitus.** *Med Care* 2002, **40**[supplement]:I-129-I-139.
42. Hunt LM, Valenzuela MA, Pugh JA: **NIDDM patients' fears and hopes about insulin therapy. The basis of patient reluctance.** *Diabetes Care* 1997, **20**:292-298.
43. Pareo-Tubbeh SL, Romero LJ, Baumgartner RN, Garry PJ, Lindeman RD, Koehler KM: **Comparison of energy and nutrient sources of elderly Hispanics and non-Hispanic whites in New Mexico.** *J Am Diet Assoc* 1999, **99**:572-582.
44. Alreck PL, Settle RB: *The Survey Research Handbook.* Chicago: Irwin; 1995:99-105.
45. Bell RA, Summerson JH, Konen JC: **Dietary intakes by levels of glycemic control for black and white adults with non-insulin dependent diabetes mellitus (NIDDM).** *J Am Coll Nutr* 1995, **14**:144-51.
46. Seltzer HS: **Drug-induced hypoglycemia: a review of 1418 cases.** *Endocrinol Metab Clin* 1989, **18**:163-83.
47. Harris MI, Cowie CC, Howie LJ: **Self-monitoring of blood glucose by adults with diabetes in the United States Population.** *Diabetes Care* 1993, **16**:1116-1123.
48. Heisler M, Smith DM, Hayward RA, Krein SL, Kerr EA: **Racial disparities in diabetes care processes, outcomes, and treatment intensity.** *Med Care* 2003, **41**:1221-1232.
49. van Ryn M: **Research on the provider contribution to race/ethnicity disparities in medical care.** *Med Care* 2002, **40**[supplement]:I-140-I-151.
50. Jaen CR, Stange KC, Nutting PA: **Competing demands of primary care: a model for the deliver of clinical preventive services.** *J Fam Pract* 1994, **38**:166-171.

51. Jaen CR, McIlvain H, Pol L, Phillips RL, Flocke S, Crabtree BF: **Tailoring tobacco counseling to the competing demands in the clinical encounter.** *J Fam Pract* 2001, **50**:859-863.

Table 1 - Socio-demographic and clinical features by race and ethnicity

	Non-Hispanic White (n = 226)	Hispanic (n = 72)	African-American (n = 35)	P-value
Demographics				
Age (years)	65.5 ± 9.4	64.9 ± 10.1	63.3 ± 10.8	NS
Proportion of women	5.3%	1.4%	0%	NS
Married	56.6%	66.7%	62.9%	NS
Disease history				
Diabetes duration (years)	14.1 ± 9.5	15.4 ± 10.5	15.5 ± 10.6	NS
Duration of medical treatment (years)	12.3 ± 9.0	14.1 ± 10.5	12.6 ± 10.0	NS
Duration of insulin treatment (years)	8.0 ± 7.7	7.8 ± 8.1	8.6 ± 8.2	NS
Complications				
Neuropathy	59.7%	63.9%	51.4%	NS
Peripheral vascular disease	35.8%	41.7%	28.6%	NS
Angina or chest pain	35.0%	23.6%	40.0%	NS
Myocardial infarction	33.6%	26.4%	17.1%	NS
Retinopathy	31.9%	21.4%	34.3%	NS
Stroke	13.7%	13.9%	11.4%	NS
Extremity amputation	6.6%	8.3%	14.3%	NS
Chronic renal disease	3.5%	0%	2.9%	NS
Blindness	1.3%	1.4%	0%	NS
Any microvascular complication	67.7%	69.4%	71.4%	NS
Any macrovascular complication	66.4%	61.1%	57.1%	NS
Disabilities				
Work	55.8%	55.6%	31.4%	0.03
Household projects	56.6%	47.2%	45.7%	NS
Yard work	40.3%	33.3%	25.7%	NS
Exercise	28.4%	19.4%	25.7%	NS
Cooking	11.1%	9.7%	5.7%	NS
Shopping	9.7%	12.5%	11.4%	NS
Self-care	4.0%	5.6%	2.9%	NS
Any of the above	72.1%	73.6%	54.3%	0.08
Another person:				
Measures blood sugars	1.3%	0%	5.7%	NS
Administers insulin	4.0%	0%	5.7%	NS
Family circumstances				
Head of household	89.3%	97.2%	94.3%	NS
Size of household	1.96 ± 1.16	2.35 ± 1.60	2.03 ± 0.92	0.04*
Number of dependents	0.57 ± 0.90	0.83 ± 0.90	0.69 ± 0.80	0.02*
Family member with alcoholism	6.6%	2.8%	8.6%	NS

Table 1 (cont) - Socio-demographic and clinical features by race and ethnicity

Family circumstances				
Family member with disability	50.9%	41.7%	45.7%	NS
Caregiver to another person	39.4%	30.6%	37.1%	NS
Occupational history				
Employed \geq 8 hours/ week	24.3%	25.0%	37.1%	NS
Work hours from 5:00 pm to 8:00 am	9.3%	9.7%	14.3%	NS
Variable job site	7.5%	9.7%	14.3%	NS
Eligibility				
Service connected	44.0%	48.6%	65.7%	0.06
Percentage disability rating (%)	50.9 \pm 33.3	39.1 \pm 32.4	47.0 \pm 36.3	NS
For diabetes	19.3%	8.7%	37.5%	0.01
Either benefit	25.2%	18.1%	34.3%	NS
Geographic barriers				
Distance to hospital (miles)	20.3 \pm 28.3	21.1 \pm 30.3	11.3 \pm 7.3	0.07*
Drives automobile	88.1%	93.1%	85.7%	NS
Medical treatment				
Insulin				
Units per day	70.6 \pm 48.8	58.4 \pm 32.6	53.1 \pm 36.2	<0.01 [†]
Number of injections per day	2.09 \pm 0.66	2.11 \pm 0.52	1.91 \pm 0.45	NS
Number of preparations	1.43 \pm 0.54	1.43 \pm 0.50	1.29 \pm 0.46	NS
Oral Anti-hyperglycemics				
% subjects using	33.2%	34.7%	31.4%	NS
Number of dosing times	0.65 \pm 1.00	0.72 \pm 1.00	0.66 \pm 1.00	NS
BMI (kg/m²)	32.3 \pm 6.2	30.9 \pm 5.7	31.1 \pm 4.5	NS
Exercise (met-hours per week)	64.1 \pm 63.9	74.3 \pm 77.7	72.7 \pm 48.8	NS
Current smoker	19.9%	25.0%	22.9%	NS
Entry A1c (%)	7.86 \pm 1.41	8.16 \pm 1.61	8.84 \pm 2.87	0.05 [†]
Blood lipids				
Cholesterol (mg/dL)	189 \pm 46	192 \pm 57	196 \pm 35	NS
Triglycerides (mg/dL)	229 \pm 190	225 \pm 159	164 \pm 96	0.08 [†]
HDL (mg/dL)	39.5 \pm 11.6	40.0 \pm 11.5	44.0 \pm 13.4	NS
LDL (mg/dL)	109 \pm 42	105 \pm 38	121 \pm 36	NS
Blood pressure				
Systolic (mm Hg)	138 \pm 18	138 \pm 17	133 \pm 20	NS
Diastolic (mm Hg)	74 \pm 10	75 \pm 10	77 \pm 10	NS

Abbreviations:

BMI = Body Mass Index

A1c = Glycosylated hemoglobin

* Kruskal-Wallis one-way analysis of variance by ranks

[†] Brown-Forsythe test

Table 2 - Psychological features by race and ethnicity

	Non-Hispanic White (n = 226)	Hispanic (n = 72)	African-American (n = 35)	P-value
Preference for English	98.7%	83.3%	100%	<0.001
Education (years)	13.7 ± 2.8	11.9 ± 4.0	12.9 ± 2.0	<0.001*
Cognitive Deficit‡	28.3 ± 2.0	26.4 ± 3.5	27.7 ± 1.8	<0.001
Family Behavior Checklist score§	6.16 ± 6.92	6.33 ± 6.88	8.26 ± 5.92	NS
Diabetes Knowledge score□	67.4 ± 13.9	56.3 ± 17.0	62.1 ± 16.8	<0.001
Depression score¶	7.60 ± 6.58	9.42 ± 7.14	6.03 ± 5.63	0.03†
Diabetes Care Profile scores**				
Problems with glycemic control	3.98 ± 0.66	3.93 ± 0.56	4.27 ± 0.58	0.02†
Social and personal impact	3.47 ± 0.82	3.39 ± 0.84	3.73 ± 0.72	NS
Positive attitudes	3.10 ± 0.72	2.99 ± 0.72	3.12 ± 0.94	NS
Negative attitudes	3.53 ± 0.80	3.24 ± 0.90	3.80 ± 0.83	0.008†
Perceived ability to do self-care	3.00 ± 0.74	3.00 ± 0.87	3.53 ± 0.74	0.001†
Importance of self-care	4.24 ± 0.58	4.29 ± 0.62	4.45 ± 0.66	0.06†
Adherence to self-care	3.49 ± 0.74	3.51 ± 0.77	3.80 ± 0.79	NS
Adherence to diet	2.65 ± 0.94	2.65 ± 0.96	3.08 ± 0.81	0.04†
Barriers to taking medications	4.57 ± 0.45	4.55 ± 0.56	4.59 ± 0.52	NS
Barriers to exercise	4.04 ± 0.80	4.04 ± 0.80	4.37 ± 0.64	0.06†
Barriers to monitoring	4.63 ± 0.46	4.50 ± 0.60	4.38 ± 0.83	NS
Understanding of objectives	3.44 ± 0.81	3.22 ± 0.81	3.57 ± 0.83	NS
Perception of long-term benefits	4.38 ± 0.68	4.29 ± 0.86	4.15 ± 0.96	NS
Social support	3.82 ± 0.60	3.87 ± 0.63	3.94 ± 0.63	NS

* Brown-Forsythe test

† Kruskal-Wallis one-way analysis of variance by ranks

‡ Mini-Mental State Examination: 30-point scale, higher score more favorable

§ Scale ranging from -44 to 38, higher score more favorable

□ University of Michigan Diabetes Knowledge Test: percentage correct, higher score more favorable

¶ Geriatric Depression Scale: 30-point scale, lower score more favorable

** Scale ranging from 1 to 5, higher score more favorable

Table 3 - Daily insulin units by baseline A1c and race/ethnicity

A1c category	Non-Hispanic White		Hispanic		African American		All subjects	
	Mean daily units \pm SD	N	Mean daily units \pm SD	N	Mean daily units \pm SD	N	Mean daily units \pm SD	N
< 7.0%	62 \pm 52	66	54 \pm 39	14	56 \pm 50	11	60 \pm 49	91
7.0% to 7.9%	68 \pm 46	69	63 \pm 34	23	50 \pm 22	6	66 \pm 42	98
\geq 8.0%	79 \pm 48	91	57 \pm 29	35	53 \pm 31	18	70 \pm 44	144

Table 4 - Regression model predicting daily insulin units

Predictor	Coefficient	Standard Error	T value	P value	95% Confidence Interval
Hispanic*	-10.5	5.1	-2.06	0.04	-20.6, -.46
African American*	-17.8	6.9	-2.59	0.01	-31.4, -4.3
BMI† (kg/m ²)	3.4	.37	9.16	< 0.001	2.7, 4.2
Baseline A1c‡ (%)	3.0	1.3	2.36	0.02	.50, 5.5
Age (years)	-0.36	.23	-1.56	0.12	-.81, .094
Metformin	-9.1	5.6	-1.63	0.10	-20.1, 1.9
Other OAH§	-32.0	5.3	-6.02	< 0.001	-42.4, -21.5
Constant	-30.6	25.5	-1.2	0.23	-80.7, 19.5

Number of observations = 327, $R^2 = 0.336$ ($P < 0.0001$)

* Effect in reference to non-Hispanic whites

† Body Mass Index

‡ Glycosylated hemoglobin

§ Oral anti-hyperglycemic