African-American Women Have Higher Initial HbA_{1c} Levels in Diabetic Pregnancy

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OBJECTIVE — African-American women with diabetes are at greater risk for poor glycemic control outside of pregnancy. We evaluated the effect of race on glycemic control in a racially mixed population of women with diabetes entering prenatal care.

RESEARCH DESIGN AND METHODS — HbA_{1c} levels along with demographic data were collected at the first prenatal visit from a group of 234 women with preexisting diabetes. We applied logistic multivariate analysis to identify factors associated with HbA_{1c} levels above the median for the group.

RESULTS — The median HbA_{1c} level for the group was 8%. HbA_{1c} levels were 8.7 ± 2.0% in African-Americans and 7.7 ± 1.5% in Caucasians ($P < 0.001$). African-American racial designation was significantly and independently associated with high HbA_{1c} when controlled for maternal age, parity, White classification, diabetes type, education, marital status, obesity, insurance type, and first trimester entry into care. The effect of race was confined to the nonobese patients, for whom the adjusted odds ratio for African-American race as a predictor of high HbA_{1c} was 8.15 with a 95% CI of 2.41–27.58 ($P = 0.001$).

CONCLUSIONS — We found a clear racial disparity in glycemic control among women entering prenatal care with preexisting diabetes. This study demonstrates that there generally is need for better glycemic control among reproductive-age women with diabetes, but especially among those who are African-American.

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Although good glucose control around the time of conception has been shown to prevent early pregnancy loss and major malformations in infants of diabetic mothers, many diabetic women appear for prenatal care with evidence of longstanding hyperglycemia (1). Epidemiologic risk factors for poor glycemic control have been studied in nonpregnant diabetic patients but not during pregnancy (2–6). Greater understanding of risk factors for poor glycemic control is a step toward developing strategies to allow more women to enter pregnancy with well-controlled diabetes.

Outside of pregnancy, African-American and Hispanic individuals are at greater risk than Caucasians for poor glycemic control and for diabetic complications (2–6). The relationship between race and glycemic control has not been studied specifically in pregnancy. In a predominantly mixed African-American/Caucasian population, we evaluated the effect of race on glycemic control among patients with preexisting diabetes entering prenatal care.

RESEARCH DESIGN AND METHODS

— A total of 234 women with preexisting diabetes from the St. Louis metropolitan area and surrounding rural communities were enrolled for prenatal care in a university-based specialty clinic. Demographic and clinical data for these women were collected from a self-report questionnaire, as well as a complete medical history and physical examination. Patients selected their race from among the following categories: African-American, Caucasian, Asian, and other. The physicians providing care classified type 1 or 2 diabetes based on age at onset of disease, continuous insulin use since diagnosis, and/or occurrence of ketoacidosis. BMI was computed using the first documented body weight during the pregnancy rather than recollected prepregnancy weight. Data were stored in a computerized database. HbA_{1c} level was measured at entry into prenatal care using a DCA 2000 System (Miles, Elkhart, IN). This system uses a monoclonal antibody specific for glucose associated with certain amino acid sequences on the hemoglobin β chain. Results using this method are well correlated with the "gold standard" high-performance liquid chromatography (7,8).

Univariate analysis incorporated Student's *t* test for normally distributed variables, the Mann-Whitney *U* test for variables with non-normal distributions, and Fisher's exact test for categorical variables. Initial HbA_{1c} levels above the median for the study group were defined as high, and those at or below the median were considered low, thus creating a dichotomous dependent variable for multivariate logistic regression analysis. Independent demographic and clinical variables that could plausibly influence the level of glucose control were selected for the logistic model. Finally, we systematically investigated interactions among independent variables in the model. A stringent standard for significance ($P < 0.01$) was used because of the number of statistical tests performed. Stata (StataCorp, College Station, TX) was used for analysis.

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Abbreviations: OR, odds ratio.

A table elsewhere in this issue shows conventional and Système International (SI) units and conversion factors for many substances.

Table 1—*Characteristics of the patients by racial group*

	African-American	Caucasian	*P*
n	115	118	
Maternal age	27.9 ± 6.5	27.7 ± 5.9	0.838
Gravida	2.9 ± 1.7	2.3 ± 1.5	0.001
Para	1.2 ± 1.4	0.7 ± 0.9	<0.001
White classification			0.006
B	63 (54.8)	45 (38.1)	
C	33 (28.7)	30 (25.4)	
D	14 (12.2)	29 (24.6)	
F/R	5 (4.4)	14 (11.9)	
Diabetes type			<0.001
1	45 (39.1)	77 (65.3)	
2	70 (60.9)	41 (34.8)	
Gestational weeks at entry	13.2 ± 7.6	10.9 ± 6.7	0.010
Education			<0.001
Did not complete high school	19 (16.5)	27 (22.9)	
Completed high school	39 (33.9)	28 (23.7)	
Completed some college or trade	47 (40.9)	29 (24.6)	
Completed college	10 (8.7)	34 (28.8)	
Marital status			<0.001
Single	75 (65.2)	33 (28.0)	
Married	32 (27.8)	74 (62.7)	
Divorced or separated	8 (7.0)	11 (9.3)	
Insurance status			0.006
Private	46 (40.0)	69 (56.5)	
Public	69 (60.0)	49 (41.5)	
BMI	35.8 ± 10.3	29.0 ± 6.7	<0.001
BMI >29	77 (67.0)	52 (44.1)	0.001
HbA_{1c} at entry	8.7 ± 2.0	7.7 ± 1.5	
Median (range)	8.6 (4.4–14.8)	7.6 (5.0–12.3)	<0.001
HbA_{1c} (both groups)	8.0 (4.4–14.8)		

Data are *n*, means ± SD, *n* (%), or median (range). Comparisons between racial groups are considered significant if $P < 0.01$.

RESULTS — Among the 234 women, only one designated her race as other than African-American or Caucasian. Because there were sufficient data only in the two dominant racial categories, this one case was deleted from analysis. Characteristics of the 233 women studied are in Table 1. The median initial HbA_{1c} value was 8% with a wide range (4.4–14.8%). Univariate analysis testing differences in HbA_{1c} level for the specified demographic and clinical variables is indicated in Table 2. HbA_{1c} levels for African-Americans are significantly higher than those for Caucasians. However, as is apparent from Table 1, there are potentially confounding associations with race among these women. To assess the independent effects on HbA_{1c} level, the same variables in Table 2 were incorporated into a logistic regression model. The only variable independently associated with high HbA_{1c} at the $P < 0.01$ level was African-American racial designation. The odds ratio (OR) for African-Americans compared with Caucasians was 2.49 with a 95% CI of 1.33–4.68 ($P = 0.004$) when not considering interactions among the variables.

Interaction terms among the independent variables were then evaluated in turn. The only statistically significant interaction was between African-American racial designation and BMI >29. Indeed, it was confirmed by subgroup analysis that the significant association between race and HbA_{1c} level was present only among women with a BMI ≤29. Among the 104 nonobese patients, elevated HbA_{1c} was strongly related to being African-American ($P < 0.001$); however, among the 129 obese patients, there was no significant relationship ($P = 0.289$). Interestingly, the interaction between race and diabetes type (1 or 2) was not statistically significant ($P = 0.164$).

Because an interaction between race and obesity existed, we constructed separate logistic models for the nonobese and obese to estimate the OR associated with race in prediction of HbA_{1c} elevation (9). The results appear in Table 3. Goodness-of-fit for both models was satisfactory (Pearson $\chi^2 = 57.94$ and 84.31, $P = 0.37$ and 0.44, respectively; Hosmer-Lemeshow $\chi^2 = 3.54$ and 3.80, $P = 0.90$ and 0.87, respectively). This multivariate analysis confirms a relationship between African-American race and high initial HbA_{1c} that is confined to the nonobese group. The adjusted OR is 8.15 with a 95% CI of 2.41–27.58. Similar results were obtained if maternal age, BMI, and gestational age at entry were coded as continuous, rather than dichotomous, variables (not shown).

CONCLUSIONS — Others have found an association between African-American racial designation and evidence of higher glucose levels among those with diabetes. However, no previous study has focused on racial differences in glucose control in early pregnancy. Among nonpregnant adolescents with type 1 diabetes, African-American girls had significantly higher HbA_{1c} levels than Caucasian girls and boys of both races (2). Measured psychosocial variables did not explain the difference in this study. In another study by Auslander et al. (5), diabetic youths <18 years of age showed a racial difference in diabetes control; African-Americans averaged 1.5 percentage units higher than Caucasians in their HbA_{1c} levels. Delamater et al. (10) also found that African-American youths (<22 years of age) were more likely to have poor glycemic control than Caucasians (OR = 3.9) (10). Summerson et al. (4) investigated patients with type 1 and type 2 diabetes in a community-based study. African-American patients with type 2 diabetes had significantly higher HbA_{1c} levels than Caucasian patients. Among those with type 1 diabetes, African-American women had higher levels than African-American men, Caucasian men, or Caucasian women (4). Recent analysis of data from the Third National Health and Nutrition Examination Survey revealed that poor glycemic control (HbA_{1c}>8%) was more common in non-Hispanic African-American women than in other groups (3). Given the higher glucose levels among African-Americans, it is no surprise that this group also experiences more severe complications of diabetes (6,11–15).

The poorer glycemic control among African-Americans that we found in early pregnancy is in accord with the results of

Table 2—*Univariate analysis of effects of the study variables on the initial HbA_{1c} level expressed as a percentage of total hemoglobin*

	HbA_{1c} at entry (%)		
	If present	If absent	*P*
Maternal age >30 years	8.3 ± 2.1	8.2 ± 1.6	0.920
Parity ≥1	8.5 ± 1.9	7.9 ± 1.7	0.017
White class D or more	8.3 ± 1.8	8.2 ± 1.8	0.933
Type 2 diabetes	8.5 ± 2.0	8.0 ± 1.6	0.124
African-American	8.7 ± 2.0	7.7 ± 1.5	<0.001
Beyond high school education	8.2 ± 1.9	8.2 ± 1.7	0.549
Married	8.0 ± 1.9	8.4 ± 1.7	0.030
BMI >29	8.3 ± 1.9	8.1 ± 1.7	0.354
Privately insured	8.1 ± 1.8	8.3 ± 1.8	0.297
Gestational age ≤13 weeks at entry	8.4 ± 1.9	7.8 ± 1.5	0.041

Data are means ± SD.

investigators who have looked at other populations. Our findings are particularly significant, though, in that hyperglycemia in pregnancy may affect the fetus adversely as well as the mother. Because we did not have complete information about the pregnancy outcomes for all the women in our cohort, we confined our conclusions to early pregnancy glycemic control. However, we are currently looking at factors affecting control throughout the remainder of pregnancy and at pregnancy outcomes.

The unexpected finding of an interaction with obesity deserves comment. No other investigators studying the association between race and glycemic control have identified this interaction to our knowledge. It does not appear to be explained simply by the association between obesity and type 2 diabetes. There was no significant interaction between race and diabetes type when predicting elevated HbA_{1c}. Sparcity of data limited further analysis of these relationships in our data set. There were only 19 nonobese patients with type 2 diabetes. The interrelationships among obesity, race, and glycemic control should be explored in other populations.

Our study can address the reasons for elevated HbA_{1c} levels in African-Americans only by exclusion. None of the demographic, anthropometric, or socioeconomic variables for which we controlled explained the association. There is always the possibility of an unmeasured confounding variable. For instance, we did not have information about family income. In a nationwide study of patients with type 2 diabetes, there was no relationship between family income and the frequency of high HbA_{1c} values (3). Other investigators also have noted a lack of association between socioeconomic status and glycemic control in diabetic patients (16,17). Kaufman et al. (18) discussed the difficulty of fully controlling for socioeconomic status while studying racial differences. They warn against invoking poorly supported "genetic" differences.

In their study involving diabetic youths, Auslander et al. (5) found that lower adherence to diet and glucose testing and being in a single-parent household only partly explained the higher HbA_{1c} levels in African-Americans. In a nationwide survey of patients with type 2 diabetes, African-Americans were much less likely to be on multiple daily insulin injections and daily self-monitoring of blood glucose than non-Hispanic Caucasians (19). Recently, Brownson et al. (20) reported racial differences in the physical activity of women that could affect glycemic control. We had no information about physical activity for our patients and only limited information about their glucose control practices before they arrived at our facility.

There are a number of potential barriers to better diabetes care for African-Americans, including racism, lack of knowledge, misinformation about diabetes, lack of access to care, poverty, and cultural values (21). Racial difference between the physician and the patient has been associated with less participatory decision-making and partnering in the patient–physician relationship (22). The finding that the lower survival rate for African-American patients with early lung cancer, compared with Caucasians, is largely a result of a lower surgical resection rate suggests that racial bias may occur in the selection of some treatments (23). Culturally sensitive programs with active involvement of the community can be effective in improving glycemic control among African-Americans with diabetes (24–26). Further research and effort is needed to make these benefits more widespread (27).

Recently, some have raised concerns about the use of racial categories in health research, pointing to the arbitrary and unscientific basis for these classifications (28,29). In our study, racial classification was self-assigned and, therefore, not subject to the bias of the investigators. We readily grant the limitations of racial categories and their potential for misuse. However, so long as there remain clear disparities in health status between groups, we think it imprudent to abandon a means to identify, study, monitor, and, we hope,

Table 3—*Adjusted OR estimates (with 95% CI) for variables predicting an HbA_{1c} level above the median for the groups with BMI ≤29 and >29*

	Model for patients with BMI ≤29		Model for patients with BMI >29	
	OR (95% CI)	*P*	OR (95% CI)	*P*
Maternal age >30 years	0.22 (0.57–0.81)	0.023	0.95 (0.40–2.24)	0.906
Parity ≥1	4.19 (1.30–13.46)	0.016	1.47 (0.63–3.46)	0.374
White class D or more	2.18 (0.74–6.38)	0.156	1.77 (0.67–4.67)	0.251
Type 2 diabetes	1.67 (0.38–7.41)	0.499	1.21 (0.49–2.99)	0.675
African-American	8.15 (2.41–27.58)	0.001	1.22 (0.55–2.70)	0.628
Beyond high school education	1.05 (0.36–3.06)	0.935	0.94 (0.44–2.02)	0.872
Married	0.51 (0.15–1.81)	0.299	0.48 (0.20–1.15)	0.100
Privately insured	1.76 (0.55–5.61)	0.336	1.12 (0.49–2.59)	0.783
Gestational age ≤13 weeks at entry	1.50 (0.94–4.52)	0.476	2.75 (1.28–6.03)	0.011

The term for BMI >29 and the interaction term (African-American × BMI >29) were dropped from these models because of collinearity. See RESEARCH DESIGN AND METHODS regarding the rationale for separate analysis of nonobese and obese patients.

correct these disparities. There is a need for more effective strategies to improve glucose control among reproductive-age women generally, but especially among those who are African-American.

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