Diabetes Control Among Hispanics in the Action to Control Cardiovascular Risk in Diabetes Trial

Asqul Getaneh, MD, MPH¹, Laney S. Light, MS², David J. Brillon, MD³,
Jorge Calles Escandón, MD, MPH⁴, James Felicetta, MD⁵, Gregory W. Evans, MA²,
Carlos R. Lopez-Jimenez, MD, MS¹, Robert Cuddihy, MD⁶, and J. Thomas Bigger, MD⁷

¹Department of Medicine, Columbia University College of Physicians & Surgeons, New York, USA; ²Department of Biostatistical Sciences, Wake Forest University School of Medicine, Winston-Salem, NC, USA; ³Division of Endocrinology, Weill Cornell Medical College of Cornell University, New York, NY, USA; ⁴Section of Endocrinology, Wake Forest University School of Medicine, Winston-Salem, NC, USA; ⁵Department of Medicine, Carl T. Hayden Veteran AMC Phoenix, University of Arizona, Tucson, AZ, USA; ⁶Division of Endocrinology, Department of Medicine, University of Minnesota Medical School, Minneapolis, MN, USA; ⁷Division of Cardiology, Columbia University College of Physicians & Surgeons, New York, NY, USA.

BACKGROUND: Hispanics in the United States represent diverse racial, ethnic, and socioeconomic groups, and manifest heterogeneous cardiovascular risks including diabetes. It is not known if there are residual differences in the control of diabetes among Hispanic groups given uniform access to diabetes care.

OBJECTIVE: To evaluate glucose control differences among Mexicans, Puerto Ricans, and Dominicans receiving substantial diabetes care and support in the Action to Control Cardiovascular Risk in Diabetes (ACCORD) trial.

DESIGN: Secondary analysis of data from a randomized trial comparing two treatment strategies: intensive, targeting glycated hemoglobin below 6.0 %, and standard, targeting glycated hemoglobin between 7.0 % and 7.9 %.

PARTICIPANTS: Seven hundred and sixteen Hispanic and 6066 non-Hispanic white participants were recruited from 77 clinical sites across the United States and Canada. There were 243 Mexicans, 199 Puerto Ricans, and 150 Dominicans; and 135 of these Hispanic groups were born in the United States.

MAIN MEASURE: Glycated hemoglobin

RESULTS: Compared to Puerto Ricans, Mexicans were more likely (HR=1.38, CI:0.90–2.10) and Dominicans as likely (HR=1.01, CI:0.66–1.54) to achieve glycated hemoglobin goal in the intensive arm. Participants born in the United States achieved glycated hemoglobin goal at a higher rate than those born elsewhere (HR=1.57, CI:0.99–2.51 in the intensive arm, HR=1.51, CI:0.95–2.43 in the standard arm). These differences were not statistically significant. In the intensive arm, Puerto Ricans (OR=0.47, CI:0.31–0.71), and Dominicans (OR=0.41, CI:0.26–0.66) were less likely than non-Hispanic whites to achieve glycated

hemoglobin goal, whereas the difference between non-Hispanic whites and Mexicans was not statistically significant, (OR=0.66, CI:0.43–1.02).

CONCLUSIONS: Hispanic groups, given access to comprehensive diabetes care, differed from each other non-significantly and had a variable divergence from non-Hispanic whites in achieving intensive glycated hemoglobin goal. These differences, if confirmed, could be due to such factors as variable acculturation and functional health literacy levels that were not measured in the ACCORD trial, but should be further explored in future studies.

KEY WORDS: type 2 diabetes; hispanic; diabetes control; Action to Control Cardiovascular Risk in Diabetes (ACCORD); glycated hemoglobin.

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INTRODUCTION

Hispanics in the United States represent several racial and ethnic groups, over 20 countries of origin, different degrees of acculturation, and live in disparate socioeconomic contexts.¹ This heterogeneity influences disease risk, diagnosis and management^{2,3} and accumulating evidence shows differences among Hispanics in the rising prevalence and severity of cardiometabolic diseases including diabetes.^{4–8}

To date, there is no comparative prospective data on diabetes control among Hispanics. Of the four major prospective trials of type 2 diabetes,^{9–13} only the Action to Control Cardiovascular Risk in Diabetes (ACCORD) trial, and the Veteran Affairs Diabetes Trial (VADT) included Hispanic participants. The ACCORD trial, unlike the VADT^{12,13} recruited both men and women across diverse clinical sites and provided the opportunity to

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evaluate prospective data on glucose control among groups who had uniform access to comprehensive diabetes care.

The ACCORD trial results (online Appendix A, Table 1) have shaped clinical practice in glucose, lipid and blood pressure management in type 2 diabetes. Briefly, compared to standard therapy, intensive therapy to target glycated hemoglobin below 6 % increased all-cause mortality, but reduced nonfatal myocardial infarction and progression of nephropathy and retinopathy.^{12,14–17} Nonetheless, persistently elevated glycated hemoglobin levels rather than low values were associated with increased mortality risk in the intensive arm.¹⁸

Hispanics as a group had greater glycated hemoglobin values compared to non-Hispanic whites in the trial.²⁰ Given the heterogeneity of Hispanics in the United States, we hypothesized that there will be differences in glucose control among Hispanic groups receiving comprehensive diabetes care in the ACCORD trial. These differences will also be reflected in each Hispanic group's glycated hemoglobin achievement rate compared to non-Hispanic whites. This is not captured in the comparison of Hispanics as a homogenous group with non-Hispanic whites. In this paper, we report on glucose control among three distinct Hispanic groups, Mexicans, Puerto Ricans and Dominicans and differences between each of the three Hispanic groups and non-Hispanic white participants in the ACCORD trial.

METHODS

Design. We analyzed data from the ACCORD trial, a double two-by-two factorial, parallel treatment trial that was conducted across 77 clinical sites in the United States and Canada. The trial recruited 40–79 year old individuals who have type 2 diabetes and cardiovascular disease or at least two cardiovascular risk factors.¹⁰ The study protocol was approved by the institutional review board or ethics committee at each study center, and by a review panel at the National Heart, Lung, and Blood Institute. Study design and methods are documented elsewhere in detail.¹⁰ Briefly, all participants who met inclusion and exclusion criteria (online Appendix B), and provided written informed consent were randomized to the intensive or standard treatment arms targeting glycated hemoglobin goals below 6.0 % and between 7.0 %–7.9 %, respectively. There was no recruitment strategy employed specifically for race/ethnic groups. All participants received glucose lowering drugs, glucose monitoring supplies, and language appropriate lifestyle counseling and diabetes education. Adherence to visits and therapy was encouraged at every visit, and glycated hemoglobin values were monitored. Study physicians added or reduced diabetes medicines to ensure participants were within glycated hemoglobin goal of the treatment arm. As a sub-study, weekly caloric expenditure was collected on a randomly selected subset

Table 1. Baseline Characteristics Among Hispanic Groups in the ACCORD Trial

Baseline Characteristics	Mexican (N=243)	Puerto Rican (N=199)	Dominican (N=150)	p-value*
Age, years (mean, SD)	60.5 (7.7)	62.8 (7.3)	60.3 (7.6)	0.002
Gender, female N (%)	119 (49)	81 (41)	87 (58)	0.006
Education, less than high school, N (%)	95 (39)	81 (41)	86 (57)	0.001
high school graduate, N (%)	46 (19)	61 (31)	47 (31)	
some college or higher, N (%)	102 (42)	57 (29)	17 (11)	
Born in the United States, N (%)	115 (48)	18 (10)	2 (1)	0.001
Smoking, never N (%)	144 (59)	86 (43)	87 (58)	0.001
former/current N (%)	99 (41)	112 (57)	63 (42)	
Health insurance, private, N (%)	85 (35)	71 (36)	22 (15)	0.001
public, N (%)	58 (24)	110 (55)	90 (60)	
none, N (%)	96 (40)	18 (9)	37 (25)	
Weekly caloric expenditure (mean, SD) †	2865 (2643)	2452 (2747)	1378 (1250)	0.034
Body mass index kg/m ² , (mean, SD)	31.8 (5.1)	31.5 (5.6)	29.9 (4.8)	0.001
Systolic blood pressure, mmHg (mean, SD)	138 (17)	137 (18)	139 (18)	0.388
Diastolic blood pressure, mmHg (mean, SD)	76 (11)	74 (12)	78 (10)	0.004
High density lipoprotein, mg/dl (mean, SD)	41 (9)	43 (11)	43 (14)	0.018
Low density lipoprotein, mg/dl (mean, SD)	104 (34)	108 (37)	104 (33)	0.449
Self reported peripheral neuropathy, N (%)	34 (14)	40 (21)	26 (17)	0.239
Insulin therapy, N (%)	72 (30)	77 (39)	56 (37)	0.099
Number of oral hypoglycemic medicines, N(%)				
0	35 (14)	37 (19)	24 (16)	0.805
1	94 (39)	73 (37)	54 (36)	
2+	114 (47)	89 (45)	72 (48)	
Glycated hemoglobin %, (mean, SD)	8.6 (1.3)	8.4 (1.0)	8.6 (1.3)	0.056
Duration of diabetes, years (mean, SD)	11.3 (8.3)	12.5 (8.9)	10.6 (7.1)	0.102

*P-value from overall test of association between baseline characteristics and Hispanic group (χ^2 test for categorical variables, analysis of variance for continuous variables)

†Caloric expenditure data was collected on a randomly selected subset of ACCORD participants, among 96 Hispanic participants

of Hispanic participants (n=96). Participants were followed in their respective treatment arms for a median of 3.4 years, after which the intensive arm strategy was discontinued and

participants were followed in the standard treatment strategy.

Hispanic Groups. Of the 10,251 participants, 6066 self-identified as non-Hispanic white and 741 as Spanish/Hispanic/Latino(a). Participants were assigned a Hispanic group as follows. 1) if, at study enrollment, they self-identified as Spanish/Hispanic/Latino(a) and specified a group affiliation as “Puerto Rican”, “Mexican/Chicano/Mexican American”, or “Cuban,” (n=421); 2) if, at study enrollment, they wrote in a specific group affiliation in the race/ethnicity question (n=76); or 3) if study sites were able to gather group affiliation information from the individuals at the end of the study (n=219). Included in this analysis are 592 Hispanic participants who were categorized as Mexicans (n=243), Puerto Ricans (n=199), and Dominicans (n=150). The 149 participants excluded from the analysis were three individuals who selected multiple groups, 34 who self-identified as Hispanic/Spanish/or Latino(a) but whose group affiliation could not be determined, 87 who selected one of the 17 other South-American, Central-American, or Caribbean-American Hispanic groups, including 15 Cubans, each making up less than 5 % of the Hispanic population, and 25 individuals who self-identified as Hispanic/Spanish/Latino and when asked for a specific Hispanic affiliation identified themselves as non-Hispanic,¹⁰ or non-Hispanic white/Caucasian,⁸ German Czech,¹ Jamaican,¹ Irish/Scottish,¹ Filipino,¹ Asian,¹ Black/African American/Canadian,¹ and Trinidadian.¹

Place of Birth. Hispanic participants (n=716) were separated into two groups, born in the United States or Canada, or born elsewhere, based on place of birth information entered in text fields (city, state, and country) on the baseline Contact Form. For the 417 participants who could not be categorized, study sites gathered country of birth information at the end of the study. Of the 701 Hispanic participants whose places of birth were determined, 569 were included in the analysis comprising Mexicans (n=236), Puerto Ricans (n=185), and Dominicans (n=148).

Main Measures. The ACCORD trial’s main measures, outcomes, and findings are detailed in online [Appendix A](#), Table 1. Glycated hemoglobin goal achievement is the focus of this paper, and it is defined as achieving goal of 7.0 %–7.9 % for the standard arm, and below 6.5 % for the intensive arm. The cut point of 6.5 % for the intensive arm is consistent with the goal recommended by several endocrine experts, including the American Association of Clinical Endocrinologists;¹⁹ and, it is the median goal achieved in the intensive arm of the ACCORD trial.

Statistical Analysis. We analyzed data collected for a median follow up of 3.4 years. Comparisons of baseline characteristics among Hispanic groups were made using analysis of variance for continuous variables and Chi-squared (χ^2) tests for categorical variables.

We compared the following descriptive statistics among Mexicans, Puerto Ricans and Dominicans and/or between participants born in the United States and those born elsewhere stratified by the two treatment arms: (1) N(%) of participants whose glycated hemoglobin was at goal at baseline. We used Fisher’s exact tests in the intensive arm that had smaller numbers and χ^2 tests in the standard arm to compare proportions that had glycated hemoglobin values at goal at baseline. (2) N(%) who achieved their glycated hemoglobin goal at any time during the period covered by this analysis. We used χ^2 tests and unadjusted Cox proportional hazards models to compare these proportions. (3) N(%) of those whose glycated hemoglobin values relapsed. A rise above 6.4 % or 7.9 % for intensive and standard treatment arms, respectively, any time after achievement of goal defined relapse. We used χ^2 tests to compare relapse rates. (4) Median number of days from baseline to first achievement of glycated hemoglobin goals. If baseline glycated hemoglobin values reflected at goal values, then time to goal achievement was “0” days. We used nonparametric median tests to compare time to achievement of glycated hemoglobin goals. (5) Adherence to study visits was calculated as the proportions of scheduled study visits attended by each participant, and the average proportion for each Hispanic group stratified by the two treatment arms. We used analysis of variance models to test differences in adherence to visits among Hispanic groups. (6) We compared glycated hemoglobin achievement and relapse rates between each Hispanic group and non-Hispanic white participants using unadjusted logistic regression models. Data for non-Hispanic white participants was obtained from analyses by Calles et al., with the same cut points for glycated hemoglobin goals and definition of relapse as in our analyses.²⁰

We used Cox proportional hazard models for multivariate modeling of time to first achievement of glycated hemoglobin. Because Puerto Ricans had one of the lowest achievement rates of glycated hemoglobin goal in the intensive arm and were the second largest group, they were selected as the reference group for this analysis. We created two models, one for each treatment arm, to compare Hispanic groups and those born in the United States with those born elsewhere. Both models controlled for the following pre-specified baseline continuous covariates: age, duration of diabetes, systolic and diastolic blood pressure, high and low density lipoprotein, body mass index (BMI), and categorical covariates: education (less than high school, high school graduate, some college or higher) a history of neuropathy (yes/no), insulin therapy (yes/no), and number of oral hypoglycemic drugs (0, 1, 2 +). Additionally, we used multiple logistic regression models to

compare glycated hemoglobin goal achievement and relapse rates between each Hispanic group and non-Hispanic white participants.

RESULTS

There were some differences in baseline characteristics among the three Hispanic groups. Puerto Ricans were older (62.8 years), Dominicans were predominantly women (58 %), fewer Dominicans (11 %) had higher education, and fewer Mexicans (59 %) had health insurance. Mean weekly caloric expenditure ($p=0.034$), BMI ($p=0.001$), diastolic blood pressure ($p=0.004$) and high density lipoprotein ($p=0.018$) values differed significantly among Hispanic groups. There was no statistically significant difference in baseline systolic blood pressure levels ($p=0.388$), low density lipoprotein values ($p=0.449$), history of neuropathy ($p=0.239$), and use of insulin ($p=0.099$) or oral hypoglycemic medicines ($p=0.805$). (Table 1)

Almost three-quarters (74 %) of Mexicans, and two-thirds of Puerto Ricans (66 %) and Dominicans (64 %) achieved glycated hemoglobin goal in the intensive arm. Fewer Mexicans (65 %) experienced relapse in their glycated hemoglobin values, and Dominicans had the highest (84 %) relapse rate in the intensive arm. In the standard arm Dominicans had the lowest goal achievement rate (83 %), whereas 90 % of Puerto Ricans and 91 % of Mexicans achieved glycated hemoglobin goal. The relapse rate in the standard arm was the same (68 %) for the groups. The median time to goal achievement among Hispanic groups in the intensive arm ranged from 232 to 265 days; Dominicans took the longest and Mexicans the shortest median time. In the standard arm, Mexicans had the longest (120 days) and Puerto Ricans (115 days) and Dominicans (116 days) had similar median times for achieving goal. Hispanic groups attended over 90 % of their scheduled clinic visits and there was no statistically significant difference in either treatment arm. (Table 2)

A greater proportion of United States-born participants achieved glycated hemoglobin goals compared to those born elsewhere, (77 % vs. 65 %, $p=0.10$ in the intensive, and 95 % vs. 87 %, $p=0.07$ in the standard arm). These associations were not statistically significant. There was no significant difference in relapse rates in the intensive arm (67 % vs. 76 %, $p=0.23$), or in the standard arm (75 % vs. 65 %, $p=0.12$). In the intensive arm only, the median time to achieving glycated goal was shorter for those born in the United States compared to those born elsewhere (231 vs. 251 days, $p=0.01$). (Table 3)

In the unadjusted Cox proportion analysis (data not shown), in the intensive arm, Dominicans were less likely than Puerto Ricans ($HR=0.55$, $CI: 0.41-0.73$), or Mexicans

Table 2. Comparisons of Glycated Hemoglobin Goal* Achievement Among Hispanic Groups by Treatment Arms

Intensive Arm	Mexican N=110	Puerto Rican N=105	Dominican N=77	P value
N (%) at goal at baseline	3 (3)	2 (2)	1 (1)	0.88
N (%) ever achieved goal	81 (74)	69 (66)	49 (64)	0.30
N (%) relapsed from goal†	53 (65)	54 (78)	41 (84)	0.05
Median time to achievement of goal, days‡	232	250	265	0.22
Adherence to study visits (%) §	93	92	90	0.25
Standard Arm	Mexican N=131	Puerto Rican N=93	Dominican N=71	p-value
N (%) at goal at baseline	32 (24)	32 (34)	22 (31)	0.25
N (%) ever achieved goal	119 (91)	84 (90)	59 (83)	0.21
N (%) relapsed from goal†	81 (68)	57 (68)	40 (68)	0.99
Median time to achievement of goal, days‡	120	115	116	0.50
Adherence to study visits (%) §	97	96	95	0.15

*Glycated hemoglobin goal is <6.5 for the intensive and 7–7.9 inclusive, for the standard treatment arms

†Ever had a measured glycated hemoglobin $\geq 6.5/\geq 7.9$ among those who achieved glycated hemoglobin goals in their respective treatment arms

‡Time to first glycated hemoglobin goal achievement, if value $<6.5/7-7.9$ inclusive at baseline time to achievement = 0 days.

§Proportions of scheduled visits that participants attended

|| Denominator includes all scheduled clinic visits up to the last recorded glycated hemoglobin measurement during the trial

($HR=0.86$, $CI: 0.68-1.07$) to achieve glycated hemoglobin goal during the trial. In the multivariate Cox proportional models, Mexicans were more likely than ($HR=1.38$, $CI: 0.90-2.10$), and Dominicans as likely as ($HR=1.01$, $CI: 0.66-1.54$) Puerto Ricans to achieve glycated hemoglobin goal in the intensive arm. There was no difference among Hispanic groups in the standard arm. (Table 3) Of the baseline characteristics, only duration of diabetes ($HR=0.97$, $CI: 0.95-0.99$) and insulin therapy ($HR=0.56$, $CI: 0.38-0.83$) in the intensive arm, and insulin therapy only ($HR=0.62$, $CI: 0.42-0.92$) in the standard arm were associated with rates of glycated hemoglobin goal achievement. (Table 4)

In the multivariate Cox model although statistically not significant, United States born individuals had a greater likelihood of reaching goal ($HR=1.57$, $CI: 0.99-2.51$) in the intensive arm and in the standard arm ($HR=1.51$, $CI: 0.95-2.43$). (Table 4)

Compared to non-Hispanic white participants, Puerto Ricans ($OR=0.47$, $CI: 0.31-0.71$) and Dominicans ($OR=0.41$, $CI: 0.26-0.66$) were significantly less likely to achieve glycated hemoglobin goal in the intensive arm of the trial.

Table 3. Comparisons of Glycated Hemoglobin Goal* Achievement Rates by Place of Birth, United States vs. Elsewhere, in the ACCORD Trial

	Intensive arm			Standard arm		
	United States born (N=60)	Elsewhere Born (N=225)	p-value	United States born (N=73)	Elsewhere Born (N=211)	p-value
N (%) at goal at baseline	1 (2)	4 (2)	1.00	21 (29)	60 (28)	0.96
N (%) ever achieved goal†	46 (77)	147 (65)	0.10	69 (95)	183 (87)	0.07
N (%) relapsed from goal‡	31 (67)	112 (76)	0.23	52 (75)	119 (65)	0.12
Median time to achievement of goal, days‡	231	251	0.01	119	118	0.64

*Glycated hemoglobin goal refers to <6.5 for the intensive arm and 7–7.9, inclusive, for the standard arm † Ever had a measured hemoglobin of $\geq 6.5/\geq 7.9$ among those who first achieved goal in their respective treatment arms

‡ Time to first glycated hemoglobin goal achievement; if <6.5/<7.9 at baseline, time to achievement = 0 days

But, the difference between Mexicans and non-Hispanic whites (OR=0.66, CI:0.43-1.02) was not statistically significant. In the standard arm, all Hispanic groups were less likely to achieve glycated hemoglobin goal compared to non-Hispanic whites (OR=0.45, CI: 0.25-0.84 for Mexicans, OR=0.43, CI: 0.20-0.87 for Puerto Ricans and OR=0.23, CI: 0.12-0.43 for Dominicans). (Table 5)

Table 4. Adjusted Cox Proportional Hazards Models for Time to Achievement of Glycated Hemoglobin Goal* in the ACCORD Trial

Variables	Model 1: Intensive arm	Model 2: Standard arm
Hispanic groups		
Puerto Rican	Reference	Reference
Mexican	1.38 (0.90–2.10)	0.90 (0.58–1.39)
Dominican	1.01 (0.66–1.54)	0.98 (0.61–1.58)
Born in the United States (yes vs. no)†	1.57 (0.99 – 2.51)	1.51 (0.95–2.43)
Age	1.03 (1.00–1.05)	1.03 (1.00–1.05)
Gender (Female vs. Male)†	1.22 (0.86 – 1.71)	1.14 (0.80 – 1.61)
Education		
Less than high school	Reference	Reference
High school graduate	1.06 (0.72–1.56)	0.99 (0.64–1.53)
Some college	0.86 (0.53–1.40)	1.18 (0.72–1.93)
College degree or higher	0.79 (0.45–1.40)	0.93 (0.50–1.72)
Duration of diabetes, years	0.97 (0.95–0.99)	0.99 (0.96–1.02)
Systolic blood pressure, mmHg	1.00 (0.99–1.01)	1.00 (0.99–1.02)
Diastolic blood pressure, mmHg	1.00 (0.98–1.02)	1.00 (0.98–1.02)
High density lipoprotein, mg/dl	0.99 (0.98–1.01)	1.01 (0.99–1.03)
Low density lipoprotein, mg/dl	1.00 (1.00–1.00)	1.00 (1.00–1.01)
Body mass index, kg/m ²	1.03 (0.99–1.05)	0.99 (0.96–1.02)
Self-reported history of neuropathy (yes vs. no)†	1.15 (0.72–1.83)	1.35 (0.86–2.10)
Insulin therapy (yes vs. no)†	0.56 (0.38–0.83)	0.62 (0.42–0.92)
Number of oral diabetes medications		
0	Reference	Reference
1	1.26 (0.76–2.10)	0.78 (0.49–1.24)
2+	0.97 (0.58–1.60)	0.77 (0.47–1.25)

*Ever had glycated hemoglobin level at goal, <6.5 for the intensive arm and 7–7.9 inclusive, for the standard arm; Time to glycated hemoglobin goal achievement is calculated using the first date that the individual had levels at goal

†The reference group is the second factor listed

All Hispanic groups had higher relapse rates than non-Hispanic white participants in the intensive arm. These differences were statistically significant for Puerto Ricans (OR=2.11, CI: 1.18-3.76) and Dominicans (OR=3.00, CI: 1.40-6.44); whereas, the difference between Mexicans and non-Hispanic whites (OR=1.11, CI: 0.70–1.77) was not statistically significant. None of the difference in relapse rates in the standard arm was statistically significant. (Table 5)

DISCUSSION

To our knowledge, this is the first comparative report from a prospective trial on differences in glucose control among Hispanic groups. The main findings are: 1) There are some residual differences in glucose control among Hispanic groups in a consistent direction, despite uniform access to care. Mexicans were 38 % more likely, and Dominicans equally likely as Puerto Ricans to achieve glycated hemoglobin goal in the intensive arm of the ACCORD trial. Mexicans were also more likely to maintain their achieved glycated hemoglobin goals than Puerto Ricans or Dominicans. However, the differences in glycated hemoglobin goal achievement rates were not statistically significant. 2) All Hispanic groups had lower rates of glycated hemoglobin achievement compared to non-Hispanic whites. The differences were statistically significant for only Puerto Ricans and Dominicans. 3) Hispanics born in the United States compared to those born elsewhere were about 50 % more likely to achieve glycated hemoglobin goal, but these differences did not reach statistical significance.

The small but residual difference that set Mexicans apart from Puerto Ricans and Dominicans, and the variable divergence from non-Hispanic white participants in achieving glucose control is consistent with accumulating evidence that the Hispanic population in the United States is heterogeneous in cardiovascular risks,⁵ in levels of glycated hemoglobin values,^{21,22} and health behavior.⁸ Insulin therapy at baseline reflecting a progressive decline of beta cell function,²³ was significantly linked with poorer

Table 5. Comparison of Glycated Hemoglobin Goal Achievement and Relapse rates Between Each Hispanic Group and White Participants in Each Treatment Arm of the ACCORD Trial

	N (%) ever achieved goal*				N (%) relapsed from goal†			
	Intensive arm		Standard arm		Intensive arm		Standard arm	
Ethnicity	N (%)	OR (95 % CI)	N (%)	OR (95 % CI)	N (%)	OR (95 % CI)	N (%)	OR (95%CI)
Mexicans	81 (74 %)	0.66 (0.43-1.02)	119 (91 %)	0.45 (0.25-0.84)	53 (65 %)	1.11 (0.70-1.77)	81 (68 %)	0.87 (0.59-1.29)
Puerto Ricans	69 (66 %)	0.47 (0.31-0.71)	84 (90 %)	0.43 (0.21-0.87)	54 (78 %)	2.11 (1.18-3.76)	57 (68 %)	0.86 (0.54-1.37)
Dominicans	49 (64 %)	0.41 (0.26-0.66)	59 (83 %)	0.23 (0.12-0.43)	41 (84 %)	3.00 (1.40-6.44)	40 (68 %)	0.86 (0.49-1.49)
Whites	2581 (81 %)	Reference	3054 (96 %)	Reference	1627 (63 %)	Reference	2169 (71 %)	Reference

* Ever had a measured hemoglobin of ≤ 6.5 –7.9 among those who first achieved goal Glycated hemoglobin goal refers to <6.5 for the intensive arm and 7–7.9, inclusive for the standard arm

† Ever had a measured glycated hemoglobin ≥ 6.5 / >7.9 among those who had achieved glycated hemoglobin goals in their treatment arms

glycated hemoglobin achievement, but did not differ among Hispanic groups. Other potential influences of glycated hemoglobin goal achievement such as culture and acculturation,⁶ family and environmental support, health literacy²⁴ and cultural competence beyond language-consonance between clinical staff and study participants^{8,25} were not the focus of the ACCORD trial and detailed measures were not collected. These factors could influence self-care such as glucose self-monitoring,²⁶ life style²⁷ and willingness to have therapy intensified. The importance of self-care in diabetes management is consistent with our observation that the differences in achieving glycated hemoglobin goal were more magnified in the intensive treatment arm compared to the standard arm of the ACCORD trial. The intensive treatment strategy required greater degree of self-monitoring and therapy intensification.

Other investigators have shown that providing culturally competent clinical care can reduce glycated hemoglobin values, and that individuals who have high health literacy are more likely to have better diabetes management.^{24,25} Although the ACCORD trial did not directly measure health literacy or acculturation, Puerto Ricans and Dominicans, who were less likely to achieve glycated hemoglobin goal, had lower levels of education compared to Mexicans and over 90 % were born elsewhere, compared to 48 % of Mexicans. However, the association of neither education nor birthplace with rates of glycated hemoglobin goal achievement reached statistical significance. This might highlight the notion that the influence of functional health literacy and acculturation in the context of access to uniform care is poorly captured by such broad measures as level of education and birthplace.²⁸ Directly assessing functional health literacy and delivering clinical care tailored to unique acculturation and contextual influences could reduce the residual disparity observed, after providing access to language-appropriate comprehensive diabetes care.

The main limitation of our study is that our findings are drawn from sub-analyses of the ACCORD trial and are

exploratory. The trial was not designed to evaluate differences among sub-groups in glucose control; therefore, the analyses risk spurious results. However, the differences detected among the Hispanic groups are in a consistent direction, the groups were identified at baseline, and we provide tests of significant interactions with pre-specified covariates to limit unwarranted conclusions.

We conclude that, among Hispanic groups receiving language-appropriate and substantial diabetes care and support, the disparity in glycated hemoglobin goal achievement rates was narrow. There was a small but notable residual difference between Mexicans and Puerto Ricans, while Dominicans and Puerto Ricans had similar rates of glycated hemoglobin goal achievement; and there was a distinction between Mexicans and Puerto Ricans or Dominicans in the contribution to the overall Hispanic rate of glucose control. Given the somewhat persistent and variable disparity in glucose control between Hispanic groups and non-Hispanic whites, despite uniform access to care, we recommend clinical vigilance to identify such potential influences of diabetes self-care as low level of health literacy and understand health beliefs that are shaped by unique cultures and degree of acculturation among distinct Hispanic groups. Future studies should confirm and further evaluate if the differences in glucose control lead to variable morbidity and mortality outcomes among Hispanic groups. Additionally, data from national surveys and clinical trials that do not differentiate among Hispanic groups should be generalized only with caution to all groups.

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Corresponding Author: Asqual Getaneh, MD, MPH; New York Presbyterian Hospital, 575 West 181st Street, New York, NY 10033, USA (e-mail: ag665@columbia.edu).

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