Ethnic and Racial Differences in Adoption of Evidence-based Diabetes Prevention Strategies and Weight Loss Outcomes in a Shared Decision-Making Intervention

Yelba Castellon-Lopez (✉ ycastellon@mednet.ucla.edu)

UCLA <https://orcid.org/0000-0002-4886-7792>

O. Kenrik Duru

UCLA Medical School: University of California Los Angeles David Geffen School of Medicine

Norman Turk

UCLA Medical School: University of California Los Angeles David Geffen School of Medicine

Gerardo Moreno

UCLA Medical School: University of California Los Angeles David Geffen School of Medicine

Keith Norris

UCLA Medical School: University of California Los Angeles David Geffen School of Medicine

Amanda Vu

UCLA Medical School: University of California Los Angeles David Geffen School of Medicine

Rintu Saju

UCLA Medical School: University of California Los Angeles David Geffen School of Medicine

Chi Hong Tseng

UCLA Medical School: University of California Los Angeles David Geffen School of Medicine

Kia Skrine-Jeffers

UCLA School of Nursing

Carol Mangione

UCLA Medical School: University of California Los Angeles David Geffen School of Medicine

Dominick Frosch

Palo Alto Medical Foundation for Health Care Research and Education: Palo Alto Medical Foundation

Tannaz Moin

UCLA Medical School: University of California Los Angeles David Geffen School of Medicine

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Abstract

Background: To promote health equity, interventions should achieve similar clinical outcomes among all subgroups. However, evidence from real-world Diabetes Prevention Program (DPP) translation studies suggests that adoption of diabetes prevention strategies and weight loss outcomes may vary by race and ethnicity.

Methods: In this retrospective analysis, we examined adoption of diabetes prevention strategies and weight change outcomes among participants who received a shared decision making (SDM) intervention as part of the Prediabetes Informed Decisions and Education (PRIDE) study. We compared (1) uptake of DPP and/or metformin and (2) percent weight change at 12 months stratified by race/ethnicity using generalized linear mixed effects models.

Results: SDM participants (n=515) were on average 56 years old (SD=11.0) with HbA1c 6.0% (SD=.20) and BMI of 30.3 (SD=5.2) who self-identified as non-Hispanic White (NHW) (39.2%), non-Hispanic Asian/Pacific Islander (NHAPI) (18.4%), Hispanic (16.7%), or non-Hispanic Black (NHB) (14.4%). There were no significant differences in adoption of DPP and/or metformin between racial/ethnic groups. NHB and Hispanic participants lost significantly less weight at 12 months as compared to NHW participants (-1.0% and -1.2%, respectively, vs. -3.3%, both comparisons $p<.01$).

Conclusion: While adoption of evidence-based options for diabetes prevention did not vary, Hispanics and NHB lost significantly less weight than NHW at 12-months follow-up after SDM. Minority groups have a higher risk of type 2 diabetes and racial/ethnic disparities in weight change outcomes after adoption of diabetes prevention strategies can further compound risk. These findings have important implications for ongoing efforts to augment diabetes prevention and health equity nationally.

Introduction

Recent data demonstrate that the incidence and prevalence of prediabetes is rising among US non-Hispanic Blacks and Hispanics.^{1,2} While not all patients with prediabetes will develop type 2 diabetes, diabetes prevalence is projected to increase almost threefold by 2060, with non-Hispanic Black women having the highest rates of increase.³ Rates of diabetes related complications, including major amputations, are also higher among Hispanic and non-Hispanic Black patients as compared to White patients.^{4,5}

The Diabetes Prevention Program (DPP) trial and other studies have demonstrated that weight loss (> 5% of baseline weight) using structured, year-long intensive lifestyle behavior change interventions or metformin can significantly lower risk of incident type 2 diabetes among high-risk patients with prediabetes.⁶⁻¹⁵ Although 45% of participants in the 2002 DPP trial were from racial and ethnic minority groups who were at higher risk for diabetes, and DPP outcomes did not vary by race/ethnicity. However,

data from some recent DPP translational studies indicate that outcomes in real-world settings may vary by race/ethnicity.^{16–18}

To promote health equity in diabetes prevention, interventions must achieve similar benefits for all patients. Very few real-world studies have examined racial/ethnic differences in the adoption of evidence-based diabetes prevention strategies (lifestyle change and/or metformin) and weight change outcomes at 12-months follow-up. Thus, our goal was to examine whether adoption of DPP and weight change outcomes varied by race/ethnicity after receipt of a shared decision making (SDM) intervention for diabetes prevention. SDM informs patients of the risks and benefits associated with various treatment options, while taking into consideration their preferences and values. The Prediabetes Informed Decisions and Education (PRIDE) was the first cluster-randomized trial to use SDM to engage a diverse cohort of patients with prediabetes in evidence-based prevention strategies.¹⁹ The PRIDE study showed that among patients with prediabetes SDM increased DPP uptake of lifestyle change with or without metformin, lead to greater weight loss compared to usual care.¹⁹ Our goal is to examine whether intervention effectiveness varied by race/ethnicity.

Methods

Study Design

Our retrospective longitudinal cohort study uses data from the SDM intervention arm of the PRIDE study. The PRIDE study tested the effectiveness of an SDM for diabetes prevention vs. usual care on several outcomes, including uptake of DPP and/or metformin and weight change.¹⁹ Our analysis examines differences in outcomes by race/ethnicity among the 515 PRIDE participants who received the SDM intervention. This study was approved by the Institutional Review Board at the University of California, Los Angeles (IRB#15–000310).

Study Participants

The PRIDE study was conducted across 20 primary care clinics between 2015–2018. Clinics were randomized to either deliver the SDM intervention (n = 10) or usual care (n = 10). PRIDE participants met the following inclusion criteria: age 18–74, body mass index (BMI) ≥ 24 kg/m² or ≥ 22 kg/m² if Asian and prediabetes (hemoglobin A1C (HbA1c) 5.7–6.4% within the prior three months). Patients with diabetes (i.e., any HbA1c > 6.4%, ICD-10 back-translated to ICD-9 250.xx billing code, use of oral antidiabetic medications and/or insulin), advanced chronic kidney disease (i.e., estimated glomerular filtration rate ≤ 45 ml/min/1.73m²), active eating disorder(s), dementia, congestive heart failure, active cancer diagnosis, polycystic ovary syndrome, or plans to become pregnant in the next year, were excluded. Patients were screened using electronic medical record (EMR) data. We recruited eligible participants via an invitation letter on behalf of their primary care provider (PCP) or through direct provider referrals. Participants who did not opt out of being contacted received follow-up calls to

schedule an in-person SDM visit with a clinical pharmacist in their primary care clinic. All patients who completed the SDM intervention were included in this secondary analysis.

Intervention

During the SDM visit, participants met one-on-one with a clinical pharmacist in a private room to review an online decision aid called “Prediabetes: Which Treatment Should I Use to Prevent Type 2 Diabetes?” The decision aid was created by Healthwise®, a national provider of health information and patient decision support tools for over 35 years.²⁰ The decision aid provides information about prediabetes based on the scientific literature. Specifically, it compares evidence-based options for diabetes prevention (lifestyle change and/or metformin), and summarizes the average relative risk reduction as well as potential side effects of each option alone.

After the SDM visit, participants were asked if they were interested in initiating the DPP lifestyle intervention, metformin, both, or preferred to take no action. A note summarizing the encounter and the patient’s preference was routed to the PCP through the EMR. Participants choosing DPP lifestyle intervention were referred to a local CDC-recognized DPP. If a participant chose, metformin, pharmacists prescribed it after PCP approval was obtained.

Variables

Our outcomes of interest were (1) uptake of a diabetes prevention strategy after SDM and (2) percent weight loss at 12-month follow-up. DPP uptake was defined as attendance of ≥ 9 sessions of the year-long DPP lifestyle change program (which included 22 total sessions) and metformin uptake at 4-months was assessed using documentation of metformin use as assessed by medication reconciliations in the EMR. We stratified intervention participants using self-reported race/ethnicity as either Non-Hispanic White (NHW), non-Hispanic Black (NHB), non-Hispanic Asian/Pacific Islander (NHA/PI), Hispanic, or Other (includes multi-racial, non-Hispanic Native American or Alaska Native). Other patient-level demographics and clinical measures included self-reported annual income and data from EMR including BMI, HbA1c, estimated glomerular filtration rate, insurance coverage (Medicare, private insurance, Medi-Cal, self-pay), number of co-morbidities, frequency of baseline visits, and use of any weight-loss prescription. Co-morbidities included hypertension, hyperlipidemia, coronary artery disease, atrial fibrillation, chronic obstructive pulmonary disease, cerebrovascular accident, peripheral artery disease, osteoarthritis, depression, anxiety, and substance use disorder.

Analysis

We calculated descriptive statistics of study variables using mean, standard deviation and frequencies, and used the *t* test and chi-squared test for continuous and categorical bivariate associations between study variables with race/ethnicity. We used two generalized linear mixed effects models to compare (1) DPP lifestyle change and/or metformin uptake at 12 months by race/ethnicity and (2) percent weight change at 12-month follow-up by race/ethnicity. Adjusted estimates of change from baseline weight were generated via repeated measures mixed models that accounted for clinic clustering, baseline weight, age,

income, gender, race/ethnicity, and the number of DPP sessions attended. In addition, for the weight loss outcome we conducted a sensitivity analysis adding a race/ethnicity by DPP attendance interaction term to account for possible differential attendance among racial/ethnic groups.

We used multiple imputation to impute missing race/ethnicity (4.0% missing), income (16.0% missing), and 12-month weight (12.0% missing). The imputation model included all the variables in Table 1 and four-month weight measurements were additionally used to impute missing 12-month weights. Significance level $\alpha = 0.05$ was used for all analyses, which were conducted with SAS, version 9.4 (SAS Institute).

Results

Participants ($n = 515$) were on average 56 years old ($SD = 11$) with mean BMI of 30.3 kg/m^2 ($SD = 5.2$) and A1c 6.0% ($SD = .20$) (Table 1). Over half reported incomes $\geq \$85,000$ (57.9%) and were female (55.7%). Participants self-identified as NHW (39.2%), followed by NHA/PI (18.4%), Hispanic (16.7%), NHB (14.4%), other (7.0%), and missing (4.3%). There were significant baseline differences in age, BMI, and income across racial/ethnic groups.

Adoption of Diabetes Prevention Strategy (i.e., DPP and/or metformin)

Among the 515 study participants who completed the SDM intervention 32.8% of participants adopted either DPP lifestyle change and/or metformin. Our adjusted models showed no significant differences in uptake of a diabetes prevention strategy (DPP lifestyle change and/or metformin) by race/ethnicity ($p = .32$, Table 2).

Percent Weight Loss

At 12-months follow-up, mean percent weight loss was -2.5% ($SD = 5.39$). In our adjusted models percent weight loss differed by race/ethnicity (Table 3). Compared to NHW participants, who lost 3.3% body weight, on average, NHB (-1.0% , $p = .004$) and Hispanic participants (-1.1% , $p = .007$) lost significantly less weight (Table 3). There was no significant difference in percent weight loss between NHW and NHA/PI participants. Although baseline weight and self-reported income did not predict percent weight loss, DPP lifestyle change session attendance was a significant predictor of weight loss ($p < 0.001$). A sensitivity analysis with an interaction between race/ethnicity and DPP lifestyle change attendance did not change the magnitude or significance of the main outcome.

Discussion

Our study found that percent weight loss at 12-months after SDM was lower among Hispanics and non-Hispanic Blacks as compared to non-Hispanic White participants, even though rates of adoption of DPP lifestyle change and/or metformin and DPP lifestyle change attendance were similar between groups. Very few studies to date have examined real-world uptake of diabetes prevention strategies, including

DPP lifestyle change and/or metformin, by race/ethnicity. On average, SDM participants lost – 2.48% of their weight from baseline, which includes patients who chose the lifestyle change, metformin, both or neither. This degree of weight loss is below the recommended 5% threshold but aligns with prior reports of mean weight loss from other real-world DPP translation studies.^{16,21,22} The disparities in weight loss outcomes between Hispanic and non-Hispanic Black participants as compared to their White counterparts is concerning. Even after controlling for factors such as self-reported income and DPP lifestyle change attendance, Hispanics (-1.2%) and non-Hispanic Black (-1.0 %) participants lost less weight than White (-3.3%) participants at 12 months follow-up ($p = .004$ and $p = .007$ respectively) (Table 3).

This differential in percent weight loss by race/ethnicity has important implications for ongoing national diabetes prevention efforts. Weight loss outcomes were similar between racial/ethnic subgroups in the DPP trial,⁷ but real-world adaptations may be falling short. Recent evaluations of the National DPP data indicate that NHB and Hispanics were less likely to achieve the 5% weight loss goal as compared their NHW counterparts.¹⁶ The reasons for this DPP weight loss disparity are likely multifactorial but clearly warrant additional study.¹⁶ For example, future studies should assess the amount of additional activity outside of the DPP as well as the impact of culturally tailored lifestyle programs that promote sustained adoption in minority groups. Environmental factors, including limited access in communities of color to the safe spaces and healthy food alternatives necessary to implement behavior changes that promote weight loss, may also need to be addressed. Differences in environmental resources may be present within communities of similar average income, due to residential segregation and historical disparities in wealth.²³

Since racial/ethnic minorities are disproportionately impacted by diabetes and related complications,^{24–26} it is important to study and address underlying reasons for racial/ethnic disparities in DPP weight loss outcomes. In our study, DPP lifestyle change session attendance was a significant predictor of predictor of weight loss ($p < 0.001$), consistent with existing literature showing higher session attendance leads to greater weight loss.^{7,16,17,21} DPP lifestyle change attendance has also been associated with higher rates of patient activation in those who received SDM.²⁷ Future studies should consider exploring potential barriers to activation and its relationship to structural and socioeconomic factors that may also be contributing to disparities in weight loss experienced by Hispanics and NHB participants.

Our study has some limitations. We conducted this study within one large health system, which limits the generalizability of our findings, although the health system spans a large region of the most populous and one of the most diverse counties in the nation. In addition, income was self-reported and therefore may be understated or overstated. Lastly, we used multiple imputation to impute missing 12-month follow-up weights, however this was for only a small portion of our study participants (4.0%). By contrast, we demonstrated that using SDM a health system can effectively implement the DPP in a diverse cohort of its members with prediabetes.

Diabetes prevention is a public health imperative given the burden of complications, decreased quality of life, and economic costs associated with incident diabetes.^{26,28-30} Importantly, the rising burden of diabetes is greatest in racial/ethnic minority communities that already suffer from inequities in health and health care. Despite similar rates of adoption of diabetes prevention strategies, we found that NHB and Hispanic participants had lower percent weight loss at 12 months, even after controlling for income and DPP lifestyle change attendance. National diabetes prevention initiatives should adopt a racial equity objective to encourage research and care interventions to better understand and address these racial/ethnic gaps in desired outcomes. Future studies should also explore potential causes for this concerning disparity, including literacy, structural environmental factors, and/or cultural barriers.

Declarations

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Consent to participate: Informed consent was obtained from all individual participants included in the study.

Consent for publication: Not applicable.

Availability of data and material: available upon request.

Code availability: available upon request.

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Tables

Table 1
Baseline characteristics by study participants (N = 515)

Baseline Characteristics		NHW N = 202	NHB N = 74	Hispanic N = 86	NHA/PI N = 95	Other N = 36	Missing N = 22	P Value ¹
Mean Age (SD)		58.7 (10.9)	57.4 (11.2)	52.4 (11.3)	50.4 (10.9)	56.6 (10.9)	53.8 (9.7)	< .01
Female		52.5%	64.9%	62.8%	52.6%	58.3%	36.4%	.11
Income ²	< \$45,000	14.2%	27.7%	19.7%	5.1%	12.5%	16.7%	< .01
	\$45,000 - \$84,999	28.4%	26.2%	30.3%	20.2%	34.4%	11.1%	
	\$85,000+	57.4%	46.2%	50.0%	74.7%	53.1%	72.2%	
Mean BMI, kg/m ² (SD)		30.4 (4.8)	31.6 (5.5)	31.5 (5.3)	27.5 (4.3)	31.6 (5.9)	30.3 (4.4)	< .01
HbA1c, % (SD)		5.9 (.20)	6.0 (.21)	6.0 (.19)	6.0 (.17)	6.0 (.22)	5.9 (.17)	.04
eGFR	>89	14.8%	28.4%	37.2%	39.0%	16.7%	36.4%	< .01
	60–89	70.3%	68.9%	58.1%	60.0%	72.2%	63.6%	
	45–69	14.8%	2.7%	4.6%	1.0%	11.1%	0.0%	
Medicaid (Y/N)		2.5%	12.2%	4.6%	0.0%	2.8%	0.0%	< .01
Medicare (Y/N)		30.2%	33.8%	10.5%	9.5%	25.0%	13.6%	< .01
Number of Co-morbidities	0	16.8%	21.6%	38.4%	32.6%	27.8%	50.0%	< .01
	1	29.2%	33.8%	19.8%	36.8%	25.0%	13.4%	
	2	27.2%	12.2%	24.4%	21.0%	38.9%	18.2%	
	3+	26.7%	32.4%	17.4%	9.5%	8.3%	18.2%	
Hypertension		37.6%	46.0%	27.9%	30.5%	52.8%	13.6%	< .01
Hyperlipidemia		55.0%	47.3%	40.7%	43.2%	50.0%	27.3%	.06
CAD		4.0%	0.0%	3.5%	1.0%	0.0%	0.0%	.24
Afib/arrhythmia		7.4%	4.0%	4.6%	6.3%	0.0%	9.1%	.51
COPD		16.8%	16.2%	11.6%	13.7%	11.1%	18.2%	.83
Abbreviations: NHW, non-Hispanic White; NHB, non-Hispanic Black; NHA/PI, non-Hispanic Asian/Pacific Islander; CAD, Coronary artery disease; Afib, atrial fibrillation; COPD, chronic obstructive pulmonary disease; CVA, cerebrovascular accident; PVD, peripheral vascular disease; Rx, prescription; BMI, body mass index; eGFR, estimated glomerular filtration rate; HbA1C, hemoglobin A1C.								
¹ Chi-square tests of significance were used to compare categorical variables and ANOVA was used for comparison of continuous variables.								
² There are N = 79 participants with missing income.								

Baseline Characteristics		NHW N = 202	NHB N = 74	Hispanic N = 86	NHA/PI N = 95	Other N = 36	Missing N = 22	P Value ¹
CVA		3.5%	1.4%	5.8%	2.1%	0.0%	0.0%	.37
PVD		1.5%	0.0%	0.0%	0.0%	0.0%	0.0%	.46
Osteoarthritis		12.4%	18.9%	7.0%	4.2%	13.9%	9.1%	.04
Depression		20.3%	16.2%	10.5%	4.2%	0.0%	18.2%	< .01
Anxiety		16.8%	10.8%	11.6%	2.1%	2.8%	4.6%	< .01
Substance Abuse		4.5%	5.4%	4.6%	1.0%	0.0%	9.1%	.32
Frequency baseline visits	0–1	8.4%	14.9%	11.6%	24.2%	25.0%	45.4%	< .01
	2	12.9%	14.9%	14.0%	13.7%	8.3%	9.1%	
	3	11.4%	12.2%	11.6%	19.0%	19.4%	9.1%	
	4+	67.3%	58.1%	62.8%	43.2%	47.2%	36.4%	
Use Weight Loss Rx		5.4%	5.4%	2.3%	1.0%	2.8%	4.6%	.48
Abbreviations: NHW, non-Hispanic White; NHB, non-Hispanic Black; NHA/PI, non-Hispanic Asian/Pacific Islander; CAD, Coronary artery disease; Afib, atrial fibrillation; COPD, chronic obstructive pulmonary disease; CVA, cerebrovascular accident; PVD, peripheral vascular disease; Rx, prescription; BMI, body mass index; eGFR, estimated glomerular filtration rate; HbA1C, hemoglobin A1C.								
¹ Chi-square tests of significance were used to compare categorical variables and ANOVA was used for comparison of continuous variables.								
² There are N = 79 participants with missing income.								

Table 2

Adjusted percent uptake of diabetes prevention strategy (DPP lifestyle change and/or metformin) by race/ethnicity¹

Race/ethnicity	% Uptake²
NHW (N = 202)	33.4 (25.5, 41.4)
NHB (N = 74)	30.2 (18.9, 41.6)
Hispanic (N = 86)	39.4 (27.8, 51.1)
NHA/PI (N = 95)	29.0 (17.7, 40.4)
Other (N = 36)	24.2 (9.7, 38.7)
Abbreviations: NHW, non-Hispanic White; NHB, non-Hispanic Black; NHA/PI, non-Hispanic Asian/Pacific Islander; NA, not applicable.	
¹ Analysis controlled for clinic, age, sex, and income. Race/ethnicity and income were imputed where missing.	
² There were no significant differences in percent uptake between NHW and any other race/ethnic category ($\alpha = .05$) when examining pair-wise t-tests.	

Table 3

Adjusted percentage of baseline weight change over 12 months¹

Race/ethnicity	Baseline Weight (lbs) (95% Confidence Interval)	% Weight Change (95% Confidence Interval)	p-value²
NHW (N = 202)	197.8 (192.6, 203.0)	-3.3 (-4.08, -2.42)	
NHB (N = 74)	207.2 (199.4, 215.0)	-1.0 (-2.38, 0.35)	.004
Hispanic (N = 86)	192.3 (185.0, 199.6)	-1.2 (-2.44%, 0.14)	.007
NHA/PI (N = 95)	166.1 (157.8, 174.3)	-2.5 (-3.69, -1.22)	.28
Other (N = 36)	198.3 (187.2, 209)	-1.9 (-3.64, -0.13)	.17
Abbreviations: NHW, non-Hispanic White; NHB, non-Hispanic Black; NHA/PI, non-Hispanic Asian/Pacific Islander.			
¹ Analysis controlled for clinic, age, sex, income, baseline weight, and number of DPP sessions attended. Race/ethnicity, income, and 12-month weight were imputed where missing.			
² NHW is the reference category for % weight loss pairwise t-test comparisons.			