Article

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Perceived Discrimination, Retention, and Diabetes Risk Among American Indians and Alaska Natives in a Diabetes Lifestyle Intervention

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Abstract

Objectives: To examine the association of perceived discrimination with participant retention and diabetes risk among American Indians and Alaska Natives. **Methods:** Data were drawn from the Special Diabetes Program for Indians–Diabetes Prevention Demonstration Project (N = 2553). **Results:** Perceived discrimination was significantly and negatively associated with short-term and long-term retention and diabetes risk without adjusting. After controlling for socioeconomic characteristics and clinical outcomes, perceived discrimination was not associated with retention but was significantly associated with less improvement in body mass index (BMI) and high-density lipoprotein (HDL) cholesterol. Every unit increase in the perceived discrimination score was associated with 0.14 kg/m^2 less BMI reduction (95% CI: [0.02, 0.26], p = 0.0183) and 1.06 mg/dl lower HDL at baseline (95% CI: [0.36, 1.76], p = 0.0028). **Discussion:** Among racialized groups, improving retention and health in lifestyle interventions may require investigating perceived discrimination and the broader context of structural racism and colonialism.

Keywords

perceived discrimination, diabetes prevention, retention

Type 2 diabetes is a leading cause of morbidity and mortality among American Indians and Alaska Natives (AI/ANs). Intensive lifestyle interventions that promote moderate weight loss and physical activity have been shown to prevent or delay diabetes onset with AI/ANs (Diabetes Prevention Program [DPP] Research Group, 2002). These interventions have also been shown to facilitate short-term adoption and long-term maintenance of these healthy behaviors (Dunn et al., 1998; Hamman et al., 2006; Jeon et al., 2007; Orchard et al., 2005). Participant retention, which includes engagement with and adherence to intervention protocols and continued follow-up, is critical to the success of such efforts (Manson et al., 2011). For example, the Special Diabetes Program for Indians–Diabetes Prevention (SDPI-DP) Demonstration Project, one of the first large-scale, multisite lifestyle interventions ever conducted to prevent diabetes in a minority population, found that greater intervention attendance was strongly associated with weight loss, decreased blood pressure, and ultimately diabetes risk reduction (Jiang et al., 2013, 2015). Associations such as these have been demonstrated in similar health interventions conducted in non-AI/AN populations (Giordano et al., 2007; Moroshko et al., 2011). Despite successful recruitment and improved health outcomes, retaining participants in the SDPI-DP,

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especially in the long term, was extremely challenging (Jiang et al., 2013, 2015). Given that higher retention in health interventions is associated with greater adoption of healthy lifestyle changes and better health outcomes, maximizing retention rates remains essential in efforts to address racial and ethnic health disparities.

Retention and related barriers are not yet well understood. Of the research available, however, studies among general populations indicate that individual-level factors, such as younger age, lower readiness for change, depression, and anxiety, may be associated with poor retention in health interventions (Jiang et al., 2013; Moroshko et al., 2011; Ná poles & Chadiha, 2011). Intervention delivery factors, including staff sociodemographic characteristics, exert similar influence (Jiang et al., 2015; Manson et al., 2011). Among diverse groups, including AI/ANs, current best practices for enhancing retention and promoting engagement include community engagement and culturally tailoring health interventions (Jiang et al., 2013; Yancey et al., 2006). However, even when health interventions include such multilevel factors in their design (e.g., individual-level risk factors, staff demographics, community involvement, and cultural tailoring), retention continues to be lower among racialized and ethnically underrepresented groups, including AI/ANs (Jernigan et al., 2015; Jiang et al., 2015; Kong et al., 2010; Ná poles & Chadiha, 2011). This body of evidence indicates that improving retention, especially among racialized and ethnic underserved groups, may require investigating the nature of retention through a broader lens that is common in current research.

Inquiry into the nature of retention can be expanded and more fully developed by considering psychosocial stressors that reflect the broader context of oppression among racialized and underserved ethnic groups (Paradies et al., 2015; Walters & Simoni, 2002) (Paradies et al., 2015; Walters & Simoni, 2002). One form of psychosocial stress, particularly relevant in racialized groups, is perceived experiences of racial discrimination (hereinafter "perceived discrimination"), defined as the perception of unfair treatment by social institutions and individuals based on race (Paradies, 2006; Paradies et al., 2015; Institute of Medicine (US) Committee on Understanding and Eliminating Racial and Ethnic Disparities in Health Care, 2003; Williams & Mohammed, 2009). Broadly, studies demonstrate that psychosocial stressors may activate unhealthy behaviors, such as smoking and the consumption of alcohol and high-fat foods (Dallman et al., 2003, 2005; Gonzales, et al., 2018a, 2018b). These unhealthy behaviors are related to poor adoption of lifestyle changes, which in turn may undermine retention in a lifestyle intervention (Kong et al., 2010; omitted for review, 2018). With regard to perceived discrimination, studies document that it adversely impacts health behaviors and health outcomes, including those related to diabetes risk and management (Dawson et al., 2015; Hunte, 2011; Johnson et al., 2012). These patterns have been documented among AI/ANs (Gonzales et al., 2013, 2014, 2018a, 2018b).

Because AI/ANs experience a high burden of psychosocial stress from historical, intergenerational, and contemporary forms of racism, the association between perceived discrimination in the everyday context and retention in a health intervention may be particularly relevant to this population. Furthermore, best practices used to improve retention, such as community engagement and culturally tailored intervention strategies, may not be enough to counter systemic and structural factors related to perceived experiences of discrimination within one's healthcare experiences and everyday social experiences (Jacob et al., 2015). If perceived discrimination in one's everyday context is negatively associated with retention in health interventions, this may help explain the profound and persistent health disparities experienced by AI/ANs, and it may also need to be more fully considered and accounted for within health interventions.

To our knowledge, no study has considered the association between perceived discrimination and retention in the context of a lifestyle intervention. However, prior research, including those among AI/ANs, indicates that experiences of perceived discrimination are associated with patient healthcare disengagement factors, including less trust of healthcare workers and systems, lower perceived quality of care, less satisfaction with care, and reduced healthcare-seeking behaviors and adherence to medical regimens (Ben et al., 2017). Thus, we sought to examine the association of perceived discrimination with retention and diabetes risk outcomes among AI/ANs enrolled in the SDPI-DP. We hypothesized that higher levels of perceived discrimination in one's everyday context would be associated with lower odds of completing all 16 lifestyle classes within the intervention (short-term retention) and poorer long-term retention (measured as time to loss to follow-up, which was the time between the intervention starting date and the date when the participant became inactive in the project). Additionally, we hypothesized that higher levels of perceived discrimination would be associated with worse baseline diabetes risk factors and less improvements in those risk factors post-intervention.

Methods

Study Population and Data Source

This secondary analysis is based on data collected between January 2006 and July 2008 by the SDPI-DP. Participants (N = 2553) were recruited by 36 different federal, tribal, or urban Indian healthcare facilities across 11 Indian Health Service administrative areas located in 18 states in the United States. The intervention of the SDPI-DP had two phases: an initial intensive phase followed by a maintenance phase (Jiang et al., 2013). During the initial phase (within the first

16–24 weeks of the program), participants were offered the 16-session *Lifestyle Balance Curriculum* drawn from the DPP original intervention (Diabetes Prevention Program Research Group, 2000, 2002). The DPP curriculum was taught in group sessions by a local lifestyle coach, usually a dietitian and/or health educator, to help reach and maintain a goal of 7% weight loss through diet and exercise behavior modifications. In the maintenance phase, monthly one-on-one lifestyle coaching sessions were offered to create individual plans and to address barriers to participation (Jiang et al., 2013). More detailed descriptions of the SDPI-DP protocol and measures are provided elsewhere (Jiang et al., 2013). The SDPI-DP collected psychosocial data, including perceived discrimination as measured by the Everyday Discrimination Scale (EDS; Williams et al., 1997), which has been validated among AI/ANs, as reported in our previous publications (Gonzales et al., 2016). The EDS is a nine-question, self-reported measure intended to assess subjective beliefs of unfair treatment because of race/ethnicity, and SDPI-DP participants were asked to respond "based on being Indian/Native." More detail is provided in the measurement section of this article.

Ethical approval. The SDPI-DP protocol was approved by the Institutional Review Board (IRB) of the University of Colorado Denver and the National Indian Health Service IRB. When required, grantees obtained approval from other entities charged with overseeing research in their programs (e.g., tribal review boards). All participants provided written informed consent and Health Insurance Portability and Accountability Act authorization. These review boards, and the Portland State University IRB, reviewed and approved this secondary data analysis.

Measures

At baseline, within a month of completing the last lifestyle class (usually 4–6 months after baseline, hereafter called the post-curriculum assessment), and annually after baseline, participants underwent a comprehensive clinical assessment to evaluate diabetes risk and incidence. At the same time, each participant completed a questionnaire encompassing sociodemographic information, health-related behaviors, and a range of psychosocial factors.

Short- and long-term retention. Short-term retention in the SDPI-DP was operationalized as a dichotomous measure. The completion of all 16 diabetes prevention lifestyle classes was coded as "1," while missing one or more classes was coded as "0" and considered "not retained" or "did not complete the program" in the short-term (Jiang et al., 2013). Long-term retention was measured by time to loss to follow-up. Participants who converted to diabetes died or became pregnant by 07/31/2009 and who were still active after 07/31/2009 were censored for the long-term retention variable.

Diabetes risk factors. Participants' baseline diabetes risk factors and change of the risk factors from baseline to post-curriculum assessment were examined as continuous outcomes. Diabetes risk factors included fasting blood glucose (FBG), body mass index (BMI), systolic blood pressure (SBP), diastolic blood pressure (DBP), low-density lipoprotein cholesterol (LDL), high-density lipoprotein cholesterol (HDL), and triglycerides (TG). Height was assessed at baseline. At each clinical assessment, body weight was measured with participants wearing light clothing and no shoes; blood pressure was measured by a SDPI-DP program staff member. Laboratory assays of FBG, HDL, LDL, and TG were conducted after 9–12 hours of fasting.

Demographic characteristics. The following demographic characteristics were documented for each participant at baseline via questionnaires: age, gender, household income, and education. Age was operationalized as a categorical variable with the following categories: 18–39, 40–49, 50–59, and 60 or older. Education was coded as a 3-category variable (< high school, high school, and some college or college graduate), as were employment (employed, retired, and unemployed or student) and marital status (married or living together, separated/divorced or widowed, and never married). Finally, household income was included as a categorical variable with the following categories: $0–14,999; $15–29, 999; $30–49,999; and $50,000 or higher.

Perceived discrimination. At baseline, participants provided information about a wide range of behavioral and psychosocial factors that may be related to their program retention and clinical indicators. The factors included in the current study are perceived discrimination as the primary variable of interest, smoking status, problematic alcohol use (assessed via the Alcohol Use Disorders Identification Test, AUDIT), and family support.

Perceived discrimination was assessed using the Everyday Discrimination Scale (EDS; Williams et al., 1997). The EDS is a nine-question, self-reported measure intended to assess perceived experiences of unfair treatment because of race/ethnicity. Participants were asked to respond to all nine items of the measure, based on "being Indian/Native." The items of this measure include the following: (1) Are you treated with less courtesy than other people? (2) Are you treated with less respect than other people? (3) Do you receive poorer service in restaurants or stores? (4) Do people act as if they are better than you? (5) Do people act as if they are afraid of you? (6) Are you called names or insulted? (7) Are you threatened or harassed? (8) Do people act as if you are not smart? (9) Do people act as if you are dishonest? Responses were ordered on a 4-point Likert-type scale where 1 = never, 2 = rarely, 3 = sometimes, and 4 = often. Perceived discrimination was treated as a continuous measure and reflects the combined average of the responses. The EDS scale has demonstrated acceptable psychometric properties in African American communities

(Clark et al., 2004; Shariff-Marco et al., 2011) as well as in a large, diverse sample of AI/ANs (Gonzales et al., 2016).

Health behavior factors

Smoking status. Smoking status was measured as a dichotomous variable. Individuals who reported current smoking were coded as "1" and those who reported never or past smoking were coded as "0."

Alcohol use. Alcohol use patterns were measured via the Alcohol Use Disorders Identification Test score (AUDIT; Reinert & Allen, 2002). This test asks for information on frequency of alcohol consumption and other alcohol-related issues. A full description of the measure is published elsewhere (Babor & Higgins-Biddle, 2001; Gomez et al., 2005; Reinert & Allen, 2002; Rubio Valladolid et al., 1998). Responses were summed and ranged from 0 to 37, with higher values reflecting more problematic alcohol use.

Family support. Family support was measured via the Diabetes Family Behavior Checklist (Lewin et al., 2005; Schafer et al., 1986; Schäffer et al., 2008). Responses to questions such as "How often do your family members praise you for following your diet?" were combined to create an index of positive support ranging from 1–5 (with one reflecting less than once a month to five reflecting once per day).

Statistical Analysis

Bivariate associations between baseline perceived discrimination and participant baseline characteristics were examined using two sample *t*-tests for binary variables (gender) and ANOVA tests for categorical variables with more than two categories (age categories, education status, employment status, marital status, and annual household income). Pearson correlation coefficients were used to assess the bivariate association between baseline perceived discrimination and baseline characteristics measured as continuous variables (diabetes risk factors such as FBG, BMI, etc.), as well as changes in those variables. Spearman correlation coefficients were calculated to quantify the bivariate associations between baseline perceived discrimination and ordinal variables (AUDIT score and positive support) due to their skewed distributions that violate the normality assumption needed for Pearson's correlation.

Short-term retention (i.e., completed all 16 DPP classes or not) was used as a dichotomous variable in all data analyses, while long-term retention (i.e., time to loss to follow-up) was analyzed as a time to event variable. To examine the association between perceived discrimination and short-term retention, after adjusting for potential confounders, we fit a generalized estimating equation (GEE) regression model with a logit link function and exchangeable correlation matrix to account for within-site clustering. To assess the multivariate relationship between long-term retention and perceived discrimination, we used a Cox proportional hazard regression model with robust SE estimates. Linear mixed regression models were used to evaluate the association between perceived discrimination and diabetes risk factors. To avoid data loss (~17% of the total sample size) due to missing data in some of the covariates included in the regression models, final regression results were presented using imputed data. The multiple imputation process was performed using IVEware developed by the University of Michigan Survey Methodology Center (Raghunathan et al., 2009). The IVEware is a type of statistical software that can impute data with both continuous and categorical variables. It was chosen because the commonly used multiple imputation procedure available in SAS assumes all the variables are continuous and follows a normal distribution. Twenty imputed datasets were generated. Regression models were fitted in each of the 20 datasets. The results were then combined using SAS MIANALYZE procedure to generate appropriate parameter estimate and SE for each predictor. All analyses were performed using SAS Institute Inc statistical software (version 9.4).

Results

Table 1 presents the characteristics of the SDPI-DP participants included in this analysis. The majority of the sample was female (74.5%), 18–49 years of age (58.9%), had at least some college education (64.8%), employed (74.0%), and were married or living together (58.8%). About a quarter of participants were current smokers (24.2%). The mean perceived discrimination score was 2.04 with a SD of 0.67, corresponding with the value of "sometimes." Perceived discrimination was higher among participants who were younger than 60 years, male, had some college or higher education, unemployed or student, never married, with low annual household income, or current smoker.

Table 2 illustrates the bivariate association of perceived discrimination with retention outcomes and diabetes risk factors. For the short-term retention outcome, the majority of participants (68.2%) completed all 16 classes, compared to 31.8% who did not complete all classes. Those who did not complete all 16 classes reported a slightly but statistically significantly higher average perceived discrimination score than the participants who completed all 16 classes (2.09 vs 2.02, $p = 0.0203$). For long-term retention, those who dropped out from the study by July 31, 2009 (50.5% of all participants) had a relatively higher perceived discrimination score than those who did not drop out (2.09 vs 1.99, $p = 0.0002$). In addition, at baseline, a higher perceived discrimination score was significantly associated with higher DBP ($p = 0.0102$) and significantly lower HDL ($p < 0.0001$). Moreover, at the post-curriculum assessment, a higher perceived discrimination

Table 1. Participant Baseline Characteristics and their Association with Discrimination Score.

	Total (N = 2553)		Discrimination score[a]		
			Total (2.04 ± 0.67)		
Participant characteristic	n	%	M	SD	p value[b]
Baseline age in years					<.0001
18 to <40	731	28.6%	2.05	0.66	
40 to <50	774	30.3%	2.09	0.65	
50 to <60	645	25.3%	2.08	0.7	
60+	403	15.8%	1.85	0.65	
Gender					<.0001
Female	1901	74.5%	1.99	0.66	
Male	652	25.5%	2.17	0.68	
Education status					<.0001
< High School	318	14.1%	2.00	0.69	
High school	477	21.1%	1.92	0.69	
Some college	1024	45.4%	2.08	0.66	
College graduate	438	19.4%	2.09	0.63	
Employment status					<.0001
Employed	1665	74.0%	2.05	0.66	
Retired	168	7.5%	1.74	0.63	
Unemployed or student	416	18.5%	2.12	0.69	
Marital status					0.0060
Married or living together	1189	58.8%	2.02	0.65	
Separated/divorced or widowed	510	25.2%	2.01	0.69	
Never married	323	16.0%	2.15	0.71	
Annual household income					<.0001
0 - $14,999	371	19.4%	2.19	0.71	
$15,000–$29,999	411	21.5%	2.03	0.64	
$30,000–$49,999	569	29.8%	2.07	0.66	
$50,000–> $100,000	558	29.2%	1.97	0.65	
Smoking					<.0001
Noncurrent smoker	1754	75.8%	2.00	0.66	
Current smoker	561	24.2%	2.16	0.69	
	M	SD	r		p value
AUDIT score (range: 0–37)	2.97	5.34	0.0119		ns[d]
Positive support[c] (range: 1–5)	2.21	0.90	−0.0374		ns[e]

Note. M, mean; SD, standard deviation; r, Pearson's correlation coefficient, AUDIT, Alcohol Use Disorders Identification Test score; ns, not significant.
[a]Perceived discrimination score is a scale ranging from 1 to 4, with higher score associated with more perceived discrimination.
[b]p-value for two sample t-tests or ANOVA tests for comparing discrimination score among characteristic categories.
[c]Positive Support = Diabetes Family Behavior Checklist.
[d]p-value for Spearman's correlation coefficient for association of discrimination score and continuous characteristic variables.
[e]p-value for Pearson's correlation coefficient for association of discrimination score and continuous characteristic variables.

score was significantly associated with smaller reduction in BMI ($p = 0.0012$) and a smaller increase in HDL ($p = 0.0445$).

The final multivariate regression models assessing the association of perceived discrimination and retention outcomes are shown in Table 3. Younger age, male, low household income, and a higher AUDIT score were significantly associated with higher risk for both short-term and long-term retention failure after adjusting for other factors. Perceived discrimination did not exhibit a significant association with either short-term or long-term retention after controlling for these variables.

Among the diabetes risk factors examined in Table 2, baseline DBP and HDL, as well as changes in BMI and HDL, were significantly associated with perceived discrimination in the bivariate analysis. Therefore, we further fit multivariate linear mixed models for clinical health indicator outcomes including baseline BMI, DBP, and HDL and their changes from baseline to post-curriculum assessment (Table 4). The parameter estimates of those models revealed that higher perceived discrimination was significantly associated with lower baseline HDL and smaller improvements in BMI at the post-curriculum assessment. Specifically, every unit

Table 2. Distribution of Retention and Diabetes Risk Factor Outcomes and their Association with Discrimination Score.

	Total (*N* = 2553)		Discrimination score[a]		
			Total (2.04 ± 0.67)		
Outcome	*N*	%	M	SD	p value[b]
Short-term retention					0.0203
Not completed 16 DPP classes	813	31.8%	2.09	0.66	
Completed 16 DPP classes	1740	68.2%	2.02	0.67	
Long-term retention					0.0002
Dropped out	1288	50.5%	2.09	0.65	
Have not dropped out	1265	49.5%	1.99	0.68	
	M	SD	r		*p* value[c]
Baseline FBG (mg/dl)	104.6	9.2	0.011		ns
Baseline BMI (kg/m2)	35.8	7.3	0.040		0.0582
Baseline SBP(mmhg)	126.6	15.0	−0.027		ns
Baseline DBP (mmhg)	78.8	10.1	0.054		0.0102
Baseline LDL (mg/dl)	111.7	31.3	0.001		ns
Baseline HDL (mg/dl)	45.0	12.1	−0.104		<.0001
Baseline TG (mg/dl)	163.3	98.1	0.021		ns
Change of FBG (follow-up-baseline)	−3.6	10.5	0.018		ns
Change of BMI (follow-up-baseline)	−1.4	1.7	0.078		0.0012
Change of SBP (follow-up-baseline)	−1.9	15.6	0.015		ns
Change of DBP (follow-up-baseline)	−1.5	10.6	0.011		ns
Change of LDL (follow-up-baseline)	−3.3	23.6	−0.017		ns
Change of HDL (follow-up-baseline)	0.3	8.0	0.049		0.0445
Change of TG (follow-up-baseline)	−13.5	81.0	−0.006		ns

Note. M = mean; SD = standard deviation; r = Pearson's correlation coefficient; FBG = fasting blood glucose; BMI = body mass index; SBP = systolic blood pressure; DBP = diastolic blood pressure; LDL = low-density lipoprotein cholesterol; HDL = high-density lipoprotein cholesterol; TG = triglycerides; ns = not significant.
[a]Perceived discrimination score is a scale ranging from 1 to 4, with higher score associated with more perceived discrimination.
[b]*p*-value for two sample t-tests for comparing discrimination score between characteristic categories.
[c]*p*-value for Pearson's correlation coefficient for association of discrimination and continuous variables.

Table 3. Multivariate Models for Retention Outcomes Using Imputed Data.

	Retention Outcome	
	Short-term retention failure[a]	Long-term retention failure[b]
Independent variables	<I>OR</I> (95% CI)	HR (95% CI)
Baseline age (10 years)	0.86 (0.80, 0.93)***	0.86 (0.80, 0.93)***
Female	0.78 (0.64, 0.96)*	0.90 (0.78, 1.03)
Annual household income		
0–$14,999	1.66 (1.26, 2.20)***	1.48 (1.20, 1.82)***
$15,000–$29,999	1.32 (1.00, 1.75)*	1.24 (1.03, 1.50)*
$30,000–$49,999	1.10 (0.85, 1.42)	1.07 (0.91, 1.27)
$50,000–$100,000+	Ref	Ref
AUDIT score (standardized)	1.11 (1.02, 1.21)*	1.05 (1.00, 1.10)*
Perceived discrimination score[c]	1.01 (0.88, 1.16)	1.09 (0.99, 1.20)^

Note. AUDIT = Alcohol Use Disorders Identification Test score; *OR* = odds ratio; HR = hazard ratio; Est = parameter estimate; CI = confidence interval.
^ $p < 0.10$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.
[a]Parameter estimate from Generalized estimation equation (GEE) model, with binary outcome variable = 1 if participants did not complete all 16 classes.
[b]Parameter estimate from Cox regression model based in robust (sandwich) standard errors, where long-term retention outcome is defined as time to loss to follow-up.
[c]Perceived discrimination score is a scale ranging from 1 to 4, with higher score associated with more perceived discrimination.

Table 4. Multivariate Models for Diabetes Risk Factors Using Imputed Data.

	Diabetes risk factor outcome					
	Baseline BMI[a]	Change of BMI[a]	Baseline DBP[a]	Change of DBP[a]	Baseline HDL[a]	Change of HDL[a]
Independent variables	β (95% CI)	β (95% CI)	β (95% CI)	β (95% CI)	β (95% CI)	β (95% CI)
Baseline age (10 years)	−1.49 (−1.72, −1.25)***	−0.08 (−0.15, −0.02)*	−0.52 (−0.85, −0.19)**	−0.43 (−0.85, −0.01)*	2.29 (1.92, 2.67)***	−0.04 (−0.36, 0.28)
Female	0.63 (−0.03, 1.30)^	0.29 (0.11, 0.47)**	−2.63 (−3.55, −1.72)***	0.81 (−0.35, 1.97)	6.77 (5.73, 7.81)***	−0.72 (−1.60, 0.17)
0–$14,999	0.20 (−0.69, 1.09)	0.31 (0.07, 0.56)*	−0.58 (−1.87, 0.72)	0.00 (−1.65, 1.65)	−0.39 (−1.88, 1.09)	−0.55 (−1.77, 0.68)
$15,000–$29,999	0.51 (−0.37, 1.39)	0.22 (−0.01, 0.44)^	−0.61 (−1.76, 0.55)	0.01 (−1.44, 1.45)	0.06 (−1.30, 1.43)	0.11 (−1.07, 1.29)
$30,000–$49,999	0.21 (−0.64, 1.05)	0.17 (−0.04, 0.37)	−0.21 (−1.29, 0.87)	0.55 (−0.79, 1.89)	0.57 (−0.69, 1.82)	0.37 (−0.71, 1.44)
$50,000–$100,000+	Ref	Ref	Ref	Ref	Ref	Ref
AUDIT score (standardized)	0.08 (−0.23, 0.38)	−0.02 (−0.10, 0.07)	0.84 (0.43, 1.26)***	0.02 (−0.52, 0.56)	1.51 (1.04, 1.97)***	0.27 (−0.14, 0.69)
Perceived discrimination score[b]	0.34 (−0.11, 0.78)	0.14 (0.02, 0.26)*	0.57 (−0.04, 1.18)^	0.04 (−0.74, 0.81)	−1.06 (−1.76, −0.36)**	0.47 (−0.12, 1.06)

Note. AUDIT = Alcohol Use Disorders Identification Test score; DBP = diastolic blood pressure; HD =, high-density lipoprotein; Est = parameter estimate; CI = confidence interval.
^ $p < 0.10$; * $p < 0.05$; ** $p < 0.01$; ***$p < 0.001$.
[a]Parameter estimate from mixed regression model.
[b]Perceived discrimination score is a scale ranging from 1 to 4, with higher score associated with more perceived discrimination.

increase of perceived discrimination was associated with 0.14 less BMI reduction (95% CI: [0.02, 0.26], $p = 0.0183$) and 1.06 mg/dl lower HDL at baseline (95% CI: [0.36, 1.76], $p = 0.0028$).

Discussion

Achieving racial and ethnic health equity requires interventions that are effective not only in scope and delivery but also in their ability to retain participants throughout the entirety of the program offered. Using data drawn from the SDPI-DP, a large-scale, multisite diabetes intervention to prevent diabetes among AI/ANs, we examined associations between perceived discrimination and both short-term and long-term retention. Perceived discrimination was assessed using the Everyday Discrimination Scale to assess subjective experiences of perceived discrimination. We also explored the impact of perceived discrimination on diabetes risk by examining the association of perceived discrimination with baseline levels and changes in diabetes risk factors post-intervention.

We observed a stronger association between perceived discrimination and long-term retention than between perceived discrimination and short-term retention, but both retention outcomes in bivariate analysis were significantly associated with perceived discrimination. Participants not completing all 16 classes had a higher average perceived discrimination score than those who completed all classes (2.09 vs 2.02). A similar association was found with regard to long-term retention, where those who dropped out of the intervention by July 31, 2009 had relatively greater perceived discrimination scores than those retained. Although these findings were not strong, they are in keeping with prior findings in the literature, in patient engagement in healthcare processes and not specific to health interventions, that document greater disengagement from health care among those reporting perceived discrimination (Ben et al., 2017; Peek et al., 2007; Trivedi & Ayanian, 2006). For example, two of our previous studies—using another set of data than used in this particular article, comprised 200 adult American Indian women with confirmed type 2 diabetes—demonstrated that individuals reporting the subjective perception of discrimination on the basis of being Native American was evidenced within the clinical encounter and was associated with lower completion rates for several nationally recommended diabetes management services, including annual foot exam, eye exam, and immunizations, and was also associated with unmet need for cervical cancer screening (Gonzales et al., 2013, 2014). Furthermore, one of these investigations showed that among the 133 participants who reported perceived discrimination, indicators of healthcare disengagement increased with higher mean levels of perceived discrimination (Gonzales et al., 2013).

In the current study, participants with the lowest perceived discrimination scores may have had poor health, but had slightly better HDL and DPB at baseline. Inconsistent with our hypothesis, we found that changes in HDL from baseline to post-intervention were not significantly associated with perceived discrimination in the final multivariate model. Prior studies of these issues in general populations, including those that focus more broadly on cardiovascular risk, have produced mixed results (Everage et al., 2012; Krieger et al., 2013; Mwendwa et al., 2011; Vadiveloo & Mattei, 2016). As cited by Krieger et al. (2013), with regard to a review of several articles on the relationship of perceived discrimination and cardiovascular risk in particular, for which HDL is a risk factor, perceived discrimination was evidenced as a predictor of poor health outcomes, but the pathways through which it operates were unclear. With regard to these findings cited by Krieger et al. (2013), they may be explained by methodological limitations including small sample size, inconsistency in acute versus chronic forms of stress, and variation across studies with regard to the measurement of perceived discrimination used in respective studies (Brondolo et al., 2003; Krieger et al., 2013). However, by the end of the SDPI-DP intervention, our investigation shows that participants with the lowest perceived discrimination scores lost more weight, a finding that remained significant after adjusting for potential confounders. This is a particularly important observation because the primary behavioral target of the DPP and SDPI-DP lifestyle intervention is weight loss. Although associations between perceived discrimination and obesity are mixed (Gee et al., 2008; Johnson et al., 2012), studies are beginning to show that obesity may be a pathway through which discrimination exposure is related to diabetes risk. For example, among 315 African American adolescents, BMI mediated the relationship between perceived discrimination and insulin resistance over time (Brody et al., 2018).

Limitations and Recommendations

In light of our findings, the following limitations should be considered. The EDS used to measure perceived discrimination may be limited to capture socially constructed meanings of race and the values placed on racialized populations within political time and space. For example, some individuals may feel more discrimination because they "look Native," while others who appear less phenotypically AI/AN may feel like they are treated as separate from the group they identify with. Thus, future work may benefit from exploring the ways in which white colonial logics are embedded within health interventions intended to support the health of Native people.

Additionally, the full delivery of the EDS measure includes additional questions to understand the basis for the experiences of race, socioeconomic status, and gender, allowing for differentiation between racial and socioeconomic perceived discrimination. However, in our study, we used a shorter, nine-item version of the EDS, preventing our ability to consider these additional distinctions. Understanding this information is relevant, however, as in the United States, race

is a marker of socioeconomic status, and it is likely that some component of racial discrimination is based on poverty and stereotyping related to assumed lower education levels, less ability to pay bills, and higher crime rate (Bird & Bogart, 2001; Kawachi et al., 2005). This issue may have important implications for projects that implement the DPP lifestyle intervention among people from stigmatized and racialized communities but who live in predominantly white populated areas, where perceived discrimination could be about socioeconomic status or the combination of socioeconomic status and race, not "race" alone. People with multiple stigmatized identities (e.g., race, ethnic identity, and socioeconomic status) that face multiple sources of psychosocial stress from perceived discrimination may also be more challenged to complete programs such as DPP. Future research may benefit from making a distinction between racial and socioeconomic discrimination, as well as the intersectional nature of participant identity, and thus we suggest the use of the complete EDS measure in such inquiries.

Second, perceived discrimination was measured subjectively and related to experiences in one's general everyday life. This may have introduced measurement issues that compromised our ability to detect a direct association between perceived discrimination and retention, and to understand the sources of the perceived discrimination. For example, it is possible that some participants perceived discrimination as part of their participation in the SDPI-DP, where they may have encountered condescension, paternalism, and/or judgmental attitudes from certain SDPI-DP staff (Buchanan, 2008; Came & Griffith, 2017; Jacob et al., 2020; Rahill et al., 2018). Future research may benefit from investigating this distinction further.

Additionally, our sample is comprised mostly of AI/AN women, and this composition may limit our understanding about AI/AN men' experiences of perceived discrimination and its interplay with retention and health outcomes. Recent research into the SDPI-DP implemented specifically among a sample of Native American men, offers compelling evidence to further consider psychosocial stressors and health, as well as intervention engagement and retention, that may be influenced by ideas of what it means to be a strong and healthy man within constructs of masculinity shaped by Western hegemony, settler colonialism, structural racism, white supremacy, and capitalism (Sinclair et al., 2020). Future research should consider these issues from the perspectives and experiences of AI/AN men. Such information is needed to address the profound health disparities experienced by AI/AN men, including those related to diabetes and the low participation of AI/AN men in available diabetes prevention programs, and to overcome the lack of empirical data available to inform interventions to prevent diabetes in AI/AN men (Jiang et al., 2013).

Implications

This study suggests that psychosocial stress resulting from perceived discrimination, whether experienced within or outside of the healthcare setting, may affect patients' decisions and engagement, as well as their subsequent overall health. Indeed, previous studies demonstrated that perceived discrimination occurring outside of the context of health care has been associated with patient healthcare behaviors including lower engagement (Cobbinah & Lewis, 2018; Moffet et al., 2008; Lewis et al., 2015). Thus, to address important gaps in our understanding and to achieve health equity, future research is needed to explore how AI/AN patients and their providers recognize and assign meaning to perceived discrimination, both within a healthcare setting and outside of such settings.

Our findings contribute new information about the impact of perceived discrimination on participant retention and diabetes risk. These findings raise important questions about the limitations of current definitions and parameters of cultural responsiveness within healthcare and health interventions. An important next step in disentangling questions around perceived discrimination and retention in health interventions will be to explore more deeply the lived, contextual experiences of participants who take part in programs such as SDPI-DP (Gonzales et al., 2015; Jacob et al., 2015). We call for future work that can contextualize these findings and report the lived experiences behind the numbers.

Among AI/ANs, engagement and subsequent health behaviors exist in the context of the specific historical, intergenerational, and contemporary experiences of trauma, violence, and settler colonialism experienced by this population (Evans-Campbell, 2008; Gonzales, et al., 2018a, 2018b; Jacob et al., 2020; Paradies, 2016). Systems of care that fail to identify and address these sources of systemic inequities may unknowingly offer health programs that contribute to poor retention and engagement, with consequent failure to achieve desired health outcomes.

The findings presented here contribute to a growing body of work that centers AI/AN health within historical, political, social, and cultural frameworks that help to explain the health inequities experienced by marginalized populations, including AI/ANs by considering perceived experiences of racism as a primary determinant among an oppressed but resilient population (Brave Heart, 2000; Evans-Campbell, 2008; Gonzales, et al., 2018a, 2018b; Jacob, 2010; Johansson et al., 2006; Palacios & Portillo, 2009; Paradies, 2016; Soto et al., 2015; Walters & Simoni, 2002). Enhancing retention in health interventions in these marginalized populations, thus, becomes a public health priority and a social justice issue, as all people should share the benefits of health education and its promised health outcomes, such as diabetes prevention. We suggest that more work is needed to understand the mechanisms that contribute to differential participation and retention among groups that experience oppression and persistent health inequities.

Conclusion

Our study is the first to consider and document the association of perceived discrimination with retention and diabetes risk,

drawing from a sample of AI/AN participants in a large-scale, national health intervention. Our findings contribute new evidence that bolsters prior assertions that BMI is a possible pathway through which perceived discrimination limits positive changes in health outcomes for diabetes prevention. Efforts to improve retention of AI/ANs in health interventions should consider the role of perceived discrimination, even within programs that are community based and culturally tailored. Thus, further replication of this investigation is warranted, as well as further exploration of structural factors in which racism, colonialism, and oppression embed and emerge as factors that shape health intervention design and individual-level engagement. Such consideration may be particularly important within higher education curriculum and applied experiences used to train health researchers. More broadly, further development of this line of research may elucidate new insights about the complex nature of AI/AN health and the design of health interventions reflective of the lasting impacts of colonialism and Indigenous racism and implications with regard to advance Indigenous health equity.

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