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Original article

Ethnic differences in psychological outcomes among people with diabetes: USA results from the second Diabetes Attitudes, Wishes, and Needs (DAWN2) study

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Abstract

Objective:

To assess differences in psychological outcomes as well as risk and protective factors for these outcomes among several USA ethnic groups and identify correlates of these psychological outcomes among adults with diabetes in the second Diabetes Attitudes, Wishes and Needs (DAWN2*) study.

Research design and methods:

The core USA DAWN2 sample was supplemented by independent samples of specific ethnic minority groups, yielding a total of 447 White non-Hispanics, 241 African Americans, 194 Hispanics, and 173 Chinese Americans ($n=1055$). Multivariate analysis examined ethnic differences in psychological outcomes and risk/protective factors (disease, demographic and socioeconomic factors, health status and healthcare access/utilization, subjective burden of diabetes and social support/burden). Separate analyses were performed on each group to determine whether risk/protective factors differed across ethnic groups.

Main outcome measures:

Psychological outcomes include well-being, quality of life, impact of diabetes on life domains, diabetes distress, and diabetes empowerment.

Clinical trial registration:

NCT01507116.

Results:

Ethnic minorities tended to have better psychological outcomes than White non-Hispanics, although their diabetes distress was higher. Levels of most risk and protective factors differed significantly across ethnic groups; adjustment for these factors reduced ethnic group differences in psychological outcomes. Health status and modifiable diabetes-specific risk/protective factors (healthcare access/utilization, subjective diabetes burden, social support/burden) had strong associations with psychological outcomes, especially diabetes distress and empowerment. Numerous interactions between ethnicity and other correlates of psychological outcomes suggest that ethnic groups are differentially sensitive to various risk/protective factors. Potential limitations are the sample sizes and representativeness.

Conclusions:

Ethnic groups differ in their psychological outcomes. The risk/protective factors for psychological outcomes differ across ethnic groups and different ethnic groups are more/less sensitive to their influence. These findings can aid the development of strategies to overcome the most prominent and influential psychosocial barriers to optimal diabetes care within each ethnic group.

*DAWN2 is a registered trademark of Novo Nordisk

Introduction

The past decade has seen significant improvements in outcomes for people with diabetes; however, outcomes continue to lag behind advances in treatment options, new technologies, and patient-centered approaches to care¹. A recent study reported that up to half of people with diabetes failed to meet targets for HbA_{1C}, blood pressure, and cholesterol levels, and a quarter continued to smoke²; only one in seven participants met targets for all four of these outcomes, and less than half reported having received diabetes education, recommended vaccinations, and eye examinations. These results highlight the importance of understanding the influences on diabetes outcomes.

The original Diabetes, Attitudes, Wishes and Needs (DAWN) study in 2001 was a multinational (13 countries) study of adults with diabetes and diabetes care providers designed to help better understand ongoing issues relating to the management of diabetes³. Findings confirmed that diabetes is associated with multiple psychosocial issues; that these issues are barriers to achieving adequate glycemic control and interfere with self-management; and that current healthcare systems are not fully equipped to provide support for the psychological needs and chronic illness care of adults with diabetes⁴. The DAWN 'Call to Action'⁵ encouraged stakeholders to implement person-centered diabetes care, with support from an interdisciplinary team of healthcare professionals, in an attempt to address the psychosocial needs of adults with diabetes⁶.

In 2011, a second Diabetes Attitudes, Wishes and Needs (DAWN2) study was planned and initiated⁷. This study provides an update on levels of psychosocial needs and the strategies employed to address these needs, as well as examining a number of new topics in an expanded sample involving 17 countries and including adult family members of adults with diabetes. The sample in each country was designed to yield data comparable across countries for the purpose of benchmarking outcomes as well as risk and protective factors⁸. However, the country samples were not large enough to compare outcomes or risk factors (which increase the risk of poor outcomes) and protective factors (which decrease the risk of poor outcomes) within and across specific subgroups within each country. Given the importance of ethnic group disparities in health, the USA sample was expanded to oversample African Americans, Hispanics and Asian Americans in order to facilitate ethnic group analysis.

Research suggests that in the USA there are differences by ethnicity in healthcare access, utilization and outcomes for adults with type 2 diabetes^{9–13}, with poorer outcomes noted for subjects in minority groups. However, some recent research suggests that ethnic health disparities vary by type of outcome, with minorities having better

outcomes for some diabetic complications¹⁴. There are few careful investigations of ethnic disparities in psychological outcomes for the diabetes population, but two recent studies of adults with diabetes have suggested that one or more ethnic minorities have better physical and/or psychological quality of life (QoL) than White non-Hispanics^{15,16}. We do not know whether the pattern of minority ethnic differences in these outcomes is reproduced for other psychological outcomes, nor do we know why disparities exist (or not). Thus, further exploration is needed of possible differences in psychological outcomes among ethnic groups in the DAWN2 USA study population and the explanation of the absence or presence of those differences.

The first research question is whether there are ethnic group differences in psychological outcomes among adults with diabetes. We hypothesize that for general measures of well-being, the pattern will follow that observed for the general population (i.e., minority ethnic groups will have better outcomes). While generalization of this pattern to diabetes-specific outcomes (diabetes-related distress, impact of diabetes on life domains, diabetes self-efficacy or empowerment) is more open to question, we formulate a parallel hypothesis based on the principle of parsimony.

The second research question is whether ethnic differences in psychological outcomes reflect differences in social and cultural factors and whether accounting for these factors will reduce the ethnic disparities observed. Answering this question requires that we conduct analyses to answer two more specific questions:

- (1) Which potential risk and protective factors are associated with the psychological outcomes?
- (2) What are the ethnic group differences in exposure to these risk and protective factors?

We hypothesize that (1) several types of risk/protective factors (disease and demographic factors, socioeconomic factors, physical health status, healthcare access/utilization, subjective burden of diabetes and social support/burden) are associated with psychological outcomes, and (2) these factors differ across ethnic groups.

Finally, following theoretical developments in conceptual models of health disparity¹⁷, we propose a third research question: do the associations of risk and protective factors with psychological outcomes differ by ethnicity? This reflects a *differential vulnerability* hypothesis, i.e., that some risk/protective factors are more important in some ethnic groups than others. While it is not possible to formulate specific hypotheses regarding which risk/protective factors are more/less important in which ethnic groups, we do formulate a general hypothesis that there will be many differences in strength of associations by ethnicity that can be tested by statistical comparison of within-group models for each ethnic group. Differences in vulnerability have clear clinical implications in that they indicate which

factors require more attention in interventions targeted to members of specific ethnic groups.

Patients and methods

Study objectives

The objectives of the DAWN2 study have been described previously⁷. The objectives of the present report are to determine whether there are differences in psychological outcomes for adults with diabetes from several ethnic groups (White non-Hispanic, African American, Hispanic, and Chinese American) in the USA, and to examine the correlates/predictors of these outcomes, with a goal of identifying factors (mediators) associated with identified disparities.

Study design

The overall methodology for the DAWN2 study (UTN No: U1111-1123-7509; NCT01507116) has been described in detail elsewhere⁷. Briefly, participants were residents of the participating country, aged ≥ 18 years, and diagnosed with type 1 or type 2 diabetes (not only during pregnancy) ≥ 12 months prior to study. Participants were excluded if they were unable to understand and comply with written and verbal instructions. Recruitment and interviewing of adults with diabetes utilized internet, telephone, and in-person methods. People with diabetes were selected from panels of consumers who had volunteered to participate in research studies, with quotas for age, gender, education, and type and treatment of diabetes that were used to screen for eligibility to produce comparable samples in each country.

The USA cohort was unique in DAWN2 because it included not only the core sample that used the same sampling design as all participating countries, but also an ancillary minority sample. The ancillary study was conducted to reflect the diverse populations of those increasingly affected by diabetes² and to expand our understanding of psychosocial issues among adults with diabetes in the USA. The ancillary study minority samples were obtained using procedures similar to those for the core sample, with screening to ensure ethnic representation and diabetes type/treatment quota groups paralleling those for the core sample. Respondents could complete the interview in English, Spanish or Chinese.

The USA minority ancillary study included 537 adults with diabetes (184 African Americans, 181 Hispanics, and 172 Chinese Americans). Of the 539 participants in the USA core study, 518 were classified into the following ethnic groups: 447 White non-Hispanic, 57 African American, 13 Hispanic, and 1 Chinese American

(21 participants from the USA core study who could not be classified into any of these ethnic groups were excluded from all analyses). The 518 participants from the core study were combined with 537 participants in the minority ancillary study, yielding 447 White non-Hispanics, 241 African Americans, 194 Hispanics, and 173 Chinese Americans ($n = 1055$).

Measures

In addition to questions developed specifically for the DAWN and DAWN2 studies, the questionnaire included validated instruments and questions adapted from validated instruments^{7,8}. The measures reported here fell into seven categories (Table 1): (1) design, disease, and demographic factors (ethnic groups, diabetes type/treatment, diabetes duration, age, gender); (2) socioeconomic factors (income, education); (3) health status (BMI, self-rated health – a health index representing functional capacities as well as pain and anxiety/depression, number of physical diabetes complications, frequency of hypoglycemia, frequency of severe hypoglycemia); (4) healthcare access/utilization (frequency of seeing physicians and other healthcare providers, receipt of diabetes education, barriers to access, receipt of patient-centered care); (5) subjective burden of diabetes (hypoglycemia worry, body weight worry, dietary restrictions, diabetes-related discrimination); (6) social support/burden (size of diabetes support network, diabetes-related family arguments, diabetes support gap); and (7) psychological outcomes (well-being, QoL, impact of diabetes on life domains, diabetes distress, diabetes empowerment)^{8,18–22}. Variables tested for association with the outcomes were chosen based on the literature regarding correlates of psychological outcomes. All measures were scored so that higher scores indicate higher levels of the factor named by the variable. Because one of the health index items assesses depression/anxiety, a sensitivity analysis was conducted based on a simple sum of the other four items; this reduced the coefficients for the health index but we report the original results using the validated measure because there were no substantively meaningful differences in the results.

Ethical considerations

The study was conducted in accordance with the guidelines of the International Chamber of Commerce/European Society for Opinion and Marketing Research²³, the Council of American Survey Research Organizations²⁴, and Good Pharmacoepidemiology Practices²⁵. A central Institutional Review Board approved the protocol and national/regional/local

Table 1. Description of measures.

Measure	Definition/explanation
Disease, demographic and socioeconomic factors	
Diabetes duration	Natural log of the number of years since diagnosis (log taken after adding 1 to the number so that minimum value returned is zero)
Income	1 = less than \$15,000; 2 = \$15,000 to \$24,999; 3 = \$25,000 to \$34,999; 4 = \$35,000 to \$49,999; 5 = \$50,000 to \$74,999; 6 = \$75,000 to \$99,999; 7 = Over \$100,000
Education	1 = less than high school; 2 = high school graduate; 3 = some college; 4 = college graduate; 5 = graduate school
Health status	
BMI	Natural log of calculated BMI
Health index	EuroQoL-5D health utility score ¹⁸
Self-rated health	Visual analog item of the EuroQoL-5D ¹⁸
Complications	Count of the following conditions: 'a stroke; an open wound on your foot that did not heal without medical care; some or all of your foot/leg amputated; your kidneys not working properly; damage to your eyesight; nerve damage; problems with your sexual functioning; heart disease or attack', possible range = 0 to 8
Frequency of hypoglycemia	Hypoglycemia in last 12 months: 0 = none; 20 = less than monthly; 40 = monthly; 60 = several per month; 80 = weekly; 100 = daily
Frequency of severe hypoglycemia	Natural log of the number of times in the last month respondent had 'severely low blood sugar such that you experienced problems with memory, language, thinking, or judgment and were unable to treat yourself and needed help from someone to restore your blood sugar levels' (log taken after adding 1 to the number so that minimum value returned is zero)
Healthcare access/utilization	
See physician	Count of healthcare professionals seen in the past 12 months for diabetes (primary care physician/general practitioner/family practitioner; doctor who specializes in diabetes; other specialist for your diabetes (e.g., eye care/foot care/kidney doctor), possible range = 0 to 3
See other healthcare professional	Count of healthcare professionals seen in the past 12 months for diabetes (a nurse or educator; dietitian/nutritionist; mental health professional; other type of care professional), possible range = 0 to 4
Diabetes education	Count of whether patient has received (a) group or (b) diabetes education in last 12 months and whether patient has received (a) group or (b) diabetes education prior to the last 12 months, possible range = 0 to 4
Access barriers	Count of the number of items that respondent indicated are currently a problem in best managing their diabetes ('it is difficult for you to pay for the diabetes medications you need to best manage your diabetes; the medications you need to best manage your diabetes are not always available where you live; it is difficult for you get the blood sugar testing supplies and devices you need to best manage your diabetes'), possible range = 0 to 3
Patient-centered care	Mean of 12 items from PACIC-DSF scored 0–100 ⁸
Subjective burden of diabetes	
Hypoglycemia worry	'I am very worried about the risk of hypoglycemic (low blood sugar) events' (1 = fully disagree; 2 = mainly disagree; 3 = mainly agree; 4 = fully agree)
Weight worry	'I feel very anxious about my weight' (1 = fully disagree; 2 = mainly disagree; 3 = mainly agree; 4 = fully agree) ¹⁹
Dietary restrictions	'My diabetes restricts my ability to eat the way I want' (1 = fully disagree; 2 = mainly disagree; 3 = mainly agree; 4 = fully agree)
Diabetes-related discrimination	'I have been discriminated against because I have diabetes' (1 = fully disagree; 2 = mainly disagree; 3 = mainly agree; 4 = fully agree) ⁸
Social support/burden	
Diabetes support network	Natural log of the number of people that respondent could talk to about diabetes if s/he needed or wanted to besides the healthcare professionals seen for diabetes (log taken after adding 1 to the number so that minimum value returned is zero)
Diabetes-related family arguments	'My family argues with me about how I choose to take care of my diabetes' (1 = fully disagree; 2 = mainly disagree; 3 = mainly agree; 4 = fully agree)
Diabetes support gap	Count of the number of items to which respondent did not answer 'very supportive'. 'Overall, how supportive have the following people been in helping you manage your diabetes over the past 12 months?: your family; friends or people close to you; people at work or school; healthcare team; other people in your community' (response options = not supportive; somewhat supportive; very supportive; not applicable), possible scores = 0 to 5
Psychological outcome	
Well-being	WHO-5 Wellbeing Index, scored 0–100 ²⁰
Quality of life	WHOQOL-BREF, single item scored 0–100 ²¹
Diabetes distress	PAID 5-item scale, scored 0–100 ²²
Diabetes impact	Mean of six DIDP items (physical health; financial situation; relationship with family, friends, peers; leisure activities; work or studies; emotional well-being), scored 0–100 with higher scores representing more negative impact (response options = very positive impact; positive impact; slightly positive impact; no impact; slightly negative impact; negative impact; very negative impact) ⁸
Diabetes empowerment scale	Mean of five DES-DSF items, scored 0–100 ⁸

BMI, body mass index; DES-DSF, Diabetes Empowerment Scale–DAWN Short Form; DIDP, DAWN Impact of Diabetes Profile; PACIC-DSF, Patient Assessment of Chronic Illness Care–DAWN Short Form; PAID-5, Problem Areas in Diabetes Scale 5; WHO-5, World Health Organization 5-item Well-Being Index; WHOQOL-BREF, World Health Organization Quality of Life (an abbreviated version of the WHOQOL-100).

guidelines were followed, including ethical review and approval as required.

Analysis

All analyses were performed using data from the participants who were classified into one of the four ethnic groups. Data were weighted by education, age, and gender using parameters generated for the core sample in each country based on data from United Nations Educational, Scientific and Cultural Organization and the International Diabetes Federation Diabetes Atlas, with parallel weights generated for the USA minority samples using estimates from the National Health Interview Survey. These weights were designed to make the samples more closely representative of the populations from which they were drawn.

Analysis of the relationship between design factors (ethnicity and diabetes type/treatment) was performed using bivariate chi-squared tests, while analysis of ethnic group differences on socioeconomic factors, health status, healthcare access/utilization, subjective burden of diabetes, and social support/burden was performed by ANCOVA with main effects for ethnicity, diabetes type/treatment, diabetes duration, gender, age, income, and education. Two models were estimated for each psychological outcome: estimated marginal means (adjusting for covariates) of psychological outcomes for each ethnic group adjusted for (1) design, disease, demographic, and socioeconomic factors (Model 1), and (2) all risk/protective factors (Model 2). To assess the clinical meaningfulness of ethnic differences in psychological outcomes, we determined whether the difference between the highest and lowest ethnic group scores was greater than 0.5 standard deviation, an effect size (Cohen's *d*) of 0.50²⁶ (0.5 SD is the recommended criterion for a 'minimum detectable difference', which represents the smallest difference that is recognizable by a person, either as a difference between types of situations or as a change over time²⁷).

Analysis of the correlates of psychological outcomes used hierarchical (blockwise) multiple regression analysis. Variables were forced into the regression models in blocks representing their hypothesized causal ordering (i.e., mediators were entered after the variables whose relationships with the outcomes they were hypothesized to mediate): (1) design, disease, demographic, and socioeconomic factors; (2) health status; (3) healthcare access/utilization; (4) subjective burden of diabetes; and (5) social support/burden. Use of causal modeling logic to guide order of entry into the models allows the analysis to determine the size of the total unconfounded association after controlling for potential confounders (i.e., variables already in the model), and then determine the independent unmediated association after controlling for potential

mediators (i.e., variables added after assessing the total association)²⁸. Coefficients reported in the 'beta at entry' column represent the values at the end of the block in which they were entered (i.e., controlling for all potential confounders) and represent the total unconfounded association with the respective outcome. Coefficients reported in the 'final beta' column represent the values after all variables were entered (i.e., controlling for all potential mediators) and represent the independent unmediated association with the respective outcome. The difference between the total unconfounded association and the independent unmediated association is the indirect or mediated association.

Supplementary analyses were performed to test the differential vulnerability hypotheses; these analyses tested whether there were interactions between ethnicity and all measures of risk/protective factors in their relationship to psychological outcomes (i.e., whether strength of association of each risk/protective factor with each psychological outcome was stronger/weaker in different ethnic groups). Measures of risk/protective factors were dichotomized at their median and each tested for the 4 × 2 (ethnicity by predictor) interaction in an ANCOVA controlling for main effects of all factors included in regression Model 2.

Results

Reliability of all scales was adequate ($\alpha > 0.80$; median = 0.90); all scales also had adequate reliability within each of the four ethnic groups ($\alpha > 0.75$; median = 0.90).

There was a statistically significant association between the two study design factors: ethnicity and diabetes type/treatment ($P < 0.001$). Thus, it was important in this analysis to control for diabetes type/treatment (and closely associated factors, such as age and diabetes duration) when assessing ethnic group differences in this sample (Table 2). All analyses also controlled for socioeconomic status (education and income); because weighting did not yield subgroup samples that were representative of the respective populations for socioeconomic status, all analyses were adjusted to eliminate socioeconomic disparities. Thus, all reported differences in risk/protective factors and psychological outcomes were adjusted to be statistically independent of income and educational disparities.

Table 3 reports the distribution of risk/protective factors by ethnic group. After adjustment for diabetes type/treatment, diabetes duration, gender, age and socioeconomic status, there were statistically significant overall ethnic group differences for five of six health status indicators (BMI, self-rated health, health index, frequency of hypoglycemia, frequency of severe hypoglycemia), four of five measures of healthcare access/utilization (frequency

Table 2. Raw data for design-related and weighting factors by ethnicity.

Sample descriptor	White non-Hispanic <i>n</i> = 447	African American <i>n</i> = 241	Hispanic <i>n</i> = 194	Chinese American <i>n</i> = 173
Diabetes type/treatment (<i>n</i>, %)**				
Type 1 diabetes	73, 16.3	34, 14.1	32, 16.5	20, 11.6
Type 2 diabetes (no medication)	88, 19.7	28, 11.6	15, 7.7	17, 9.8
Type 2 diabetes (non-insulin medication)	155, 34.7	103, 42.7	87, 44.8	93, 53.8
Type 2 diabetes (insulin medication)	131, 29.3	76, 31.5	60, 30.9	43, 24.9
Gender (<i>n</i>, %)**				
Male	191, 42.7	105, 43.6	93, 47.9	109, 63.0
Female	256, 57.3	136, 56.4	101, 52.1	64, 37.0
Education (<i>n</i>, %)**				
Less than high school graduate	18, 4.0	25, 10.4	50, 25.8	18, 10.4
High school graduate	243, 54.4	48, 19.9	29, 14.9	18, 10.4
Some college	88, 19.7	87, 36.1	55, 28.4	23, 13.3
College graduate	52, 11.6	43, 17.8	37, 19.1	61, 35.3
Graduate school	46, 10.3	38, 15.8	23, 11.9	53, 30.6
Income (<i>n</i>, %)**				
Less than \$15,000	47, 12.1	44, 19.7	35, 19.0	18, 11.8
\$15,000 to \$24,999	58, 14.9	39, 17.5	30, 16.3	18, 11.8
\$25,000 to \$34,999	57, 14.7	19, 8.5	19, 10.3	14, 9.2
\$35,000 to \$49,999	82, 21.1	46, 20.6	41, 22.3	14, 9.2
\$50,000 to \$74,999	74, 19.0	39, 17.5	29, 15.8	27, 17.6
\$75,000 to \$99,999	35, 9.0	21, 9.4	14, 7.6	29, 19.0
Over \$100,000	36, 9.3	15, 6.7	16, 8.7	33, 21.6
Diabetes duration, years (<i>M</i> ± <i>SD</i>)*	16.3 ± 12.1	14.4 ± 10.6	13.8 ± 11.0	14.5 ± 11.8
Age, years (<i>M</i> ± <i>SD</i>)**	59.0 ± 13.5	56.6 ± 14.6	53.1 ± 17.0	58.3 ± 17.6
Body mass index (<i>M</i> ± <i>SD</i>)**	33.7 ± 9.1	32.6 ± 8.3	32.0 ± 7.8	26.4 ± 5.5

*Overall $P < 0.05$ for ethnicity.**Overall $P < 0.001$ for ethnicity.

M, Mean.

of seeing physician and other healthcare professionals, barriers to access, receipt of patient-centered care), two of four measures of subjective burden of diabetes (hypoglycemia worry, dietary restrictions), and all three measures of social support/burden (diabetes support network, diabetes-related family arguments, diabetes support gap). Significant pairwise differences among the four ethnic groups are also noted in Table 3; in general, the three minority ethnic groups were similar to each other and significantly different from White non-Hispanics. Exceptions were BMI (Chinese Americans lower than all other ethnic groups), self-rated health (African Americans significantly higher than Hispanics and Chinese Americans), the health index (Hispanics significantly lower than all other ethnic groups), seeing a physician (Hispanics significantly lower than African Americans), hypoglycemia worry (Chinese Americans significantly higher than all other ethnic groups), perceived dietary restrictions (Chinese Americans significantly higher than all other ethnic groups), and diabetes support network (Chinese Americans similar to White non-Hispanics and significantly lower than Hispanics).

White non-Hispanics had significantly more positive scores than one or more minority ethnic groups for several risk/protective factors, including self-rated health, the health index, frequency of any and severe hypoglycemia, barriers to healthcare access, hypoglycemia worry,

dietary restrictions, and diabetes-related discrimination. On the other hand, White non-Hispanics had significantly worse scores than one or more minority ethnic groups for several risk/protective factors, including BMI, receipt of patient-centered care, and both indicators of diabetes support. White non-Hispanics were less likely to see healthcare providers and experience family arguments about diabetes, factors associated with both positive and negative psychological outcomes.

Ethnicity was significantly associated with each psychological outcome before controlling for potential mediators (Table 4, Model 1); effect sizes ranged from 0.32 to 0.75 (well-being = 0.32, QoL = 0.43, diabetes impact = 0.45, diabetes distress = 0.54, diabetes empowerment = 0.75), indicating that the ethnic disparities in psychological outcomes approached or exceeded the criterion for clinical meaningfulness. With the exception of QoL (Hispanics lowest, but not significantly different from White non-Hispanics) and diabetes distress (White non-Hispanics lowest), White non-Hispanics had the most negative outcomes. Controlling for the potential mediators reduced ethnic differences (Table 4, Model 2), which indicates that the ethnic differences in the psychological outcomes evaluated were, at least partly, a function of ethnic disparities in these risk/protective factors.

The associations of all factors with the five psychological outcomes from the regression models are shown

Table 3. Health status, healthcare access/utilization, subjective burden of diabetes and social support/burden by ethnicity.

Predictor	White non-Hispanic <i>n</i> = 447 mean (95% CI)	African American <i>n</i> = 241 mean (95% CI)	Hispanic <i>n</i> = 194 mean (95% CI)	Chinese American <i>n</i> = 173 mean (95% CI)
Health status				
BMI (log)***	3.45†‡ (3.34, 3.48)	3.41‡ (3.38, 3.45)	3.41‡ (3.38, 3.45)	3.22†§ (3.18, 3.26)
Self-rated health*	70.83 (68.85, 72.80)	73.04‡ (70.28, 75.81)	67.79† (64.84, 70.75)	68.46† (64.94, 71.99)
Health index*	0.73§ (0.70, 0.76)	0.74§ (0.70, 0.77)	0.67†‡ (0.63, 0.72)	0.76§ (0.72, 0.81)
Complications	1.12 (0.99, 1.24)	1.22 (1.04, 1.39)	1.14 (0.96, 1.33)	1.22 (1.00, 1.44)
Frequency of hypoglycemia***	31.56†§ (28.84, 34.29)	38.33 (34.52, 42.14)	39.53 (35.46, 43.61)	33.77 (28.92, 38.63)
Frequency of severe hypoglycemia (log)***	0.32†‡§ (0.24, 0.40)	0.57 (0.46, 0.68)	0.48 (0.36, 0.59)	0.50 (0.36, 0.64)
Healthcare access/utilization				
See physician**	1.36†‡ (1.29, 1.44)	1.59§ (1.49, 1.69)	1.44† (1.33, 1.56)	1.55 (1.42, 1.68)
See other healthcare professional***	0.37†‡§ (0.28, 0.47)	0.77 (0.64, 0.90)	0.68 (0.54, 0.82)	0.72 (0.55, 0.89)
Diabetes education	1.00 (0.92, 1.09)	1.10 (0.98, 1.22)	1.05 (0.92, 1.17)	0.92 (0.77, 1.07)
Access barriers***	0.40†‡§ (0.33, 0.47)	0.55 (0.45, 0.66)	0.68 (0.58, 0.79)	0.68 (0.55, 0.81)
Patient-centered care***	35.67†‡§ (32.87, 38.48)	55.49 (51.62, 59.35)	52.03 (47.85, 56.20)	52.46 (47.42, 57.51)
Subjective burden of diabetes				
Hypoglycemia worry***	2.22†‡§ (2.12, 2.32)	2.58‡ (2.43, 2.72)	2.62‡ (2.47, 2.77)	2.89†§ (2.71, 3.07)
Weight worry	2.71 (2.60, 2.82)	2.71 (2.56, 2.87)	2.74 (2.58, 2.90)	2.75 (2.55, 2.94)
Dietary restrictions***	2.55†‡§ (2.45, 2.66)	2.92‡ (2.77, 3.07)	3.08 (2.92, 3.24)	3.21† (3.03, 3.40)
Diabetes-related discrimination	1.50†‡ (1.40, 1.59)	1.67 (1.54, 1.81)	1.58 (1.45, 1.72)	1.70 (1.54, 1.86)
Social support/burden				
Diabetes support network***	1.11†§ (1.04, 1.90)	1.43‡ (1.33, 1.54)	1.46‡ (1.34, 1.58)	1.20†§ (1.06, 1.34)
Diabetes-related family arguments***	1.63†‡§ (1.52, 1.74)	1.94‡§ (1.79, 2.09)	2.40† (2.24, 2.56)	2.29† (2.10, 2.48)
Diabetes support gap*	3.26†‡§ (3.11, 3.41)	3.00 (2.79, 3.21)	2.86 (2.64, 3.08)	3.08 (2.82, 3.35)

Metrics for all measures described in Table 1.

*Overall $P < 0.05$ for ethnicity from ANCOVA controlling diabetes type/treatment, diabetes duration, gender, age, income, education.

**Overall $P < 0.01$ for ethnicity from ANCOVA controlling diabetes type/treatment, diabetes duration, gender, age, income, education.

***Overall $P < 0.001$ for ethnicity from ANCOVA controlling diabetes type/treatment, diabetes duration, gender, age, income, education.

†Mean is significantly ($P < 0.05$) different from African American mean.

‡Mean is significantly ($P < 0.05$) different from Chinese American mean.

§Mean is significantly ($P < 0.05$) different from Hispanic mean.

||Mean is significantly ($P < 0.05$) different from White non-Hispanic mean.

in Table 5. With the exception of diabetes duration, every factor examined was significantly associated with one or more of the five psychological outcomes. Again, controlling for potential mediators reduced associations (final beta was decreased from beta at entry), indicating that the initial associations of a variety of risk/protective factors with psychological outcome were, at least partly, a function of other risk/protective factors examined. Diabetes and demographic factors accounted for 6.5% to 15.6% of the variance in psychological outcomes. Health status had the strongest explanatory power for all outcomes except diabetes empowerment (incremental increases in r -squared of 11.7% to 30.9% versus 5.3%); for diabetes empowerment, healthcare access/utilization had the strongest explanatory power (increase in r -squared of 13.3%), mostly due to patient-centered care. Modifiable psychosocial risk/protective factors (healthcare access/utilization, subjective burden, and social support/burden) accounted for 3.2% to 18.4% of incremental variance in psychological outcomes beyond that accounted for by demographic, disease, socioeconomic, and health factors, representing up to half of the models' explanatory power (depending on the outcome examined).

Several risk/protective factors had a complex relationship with psychological outcomes that differed by ethnic group, i.e., there were statistically significant interactions of these factors with ethnicity (Supplementary Tables 1–5). There were no consistent patterns for the interactions across outcomes (e.g., the same interactions were not significant across all outcomes). These results indicate that the models for each ethnic group differ in complex ways that cannot be easily and simply described. However, each statistically significant interaction highlights a factor in need of further research to determine how that factor works differently in different ethnic groups and whether there should be more clinical focus on that factor within a particular ethnic group.

Discussion

Ethnicity

This study assessed the psychological experiences of adults with diabetes in the USA, in particular by comparison among ethnic groups. Ethnic minority groups in the

Table 4. Adjusted means of psychological outcomes for ethnic groups.

Psychological outcome	White non-Hispanic n = 447	African American n = 241	Hispanic n = 194	Chinese American n = 173
Well-being (overall SD = 22.87)				
Model 1*	57.12†	64.36	60.89	59.96
Model 2**	58.81†‡§	66.48	62.95	63.84
Quality of life (overall SD = 23.24)				
Model 1**	65.11†	72.49‡§	62.47†	63.98†
Model 2*	67.25†	72.42‡§	65.95†	69.53
Diabetes impact (overall SD = 18.19)				
Model 1**	57.20†‡§	48.95‡	51.01	53.85†
Model 2**	56.43†‡§	48.31	49.85	52.96
Diabetes distress (overall SD = 26.80)				
Model 1**	22.92†‡§	32.33‡	37.51†	36.98
Model 2	27.13§	28.93	32.04	26.82
Diabetes empowerment (overall SD = 22.52)				
Model 1**	34.34†‡§	51.13‡§	42.43†	45.60†
Model 2**	38.83†	47.58‡§	39.23†	43.14

Model 1 is an ANCOVA controlling diabetes type/treatment, diabetes duration, gender, age, income, education. Model 2 is from ANCOVA controlling all factors reported in Table 5.

*Overall $P < 0.01$ for ethnicity.

**Overall $P < 0.001$ for ethnicity.

†Mean is significantly ($P < 0.05$) different from African American mean.

‡Mean is significantly ($P < 0.05$) different from Chinese American mean.

§Mean is significantly ($P < 0.05$) different from Hispanic mean.

||Mean is significantly ($P < 0.05$) different from White non-Hispanic mean.

USA have been shown to experience more physical health problems²⁹ and are at higher risk for developing some but not all diabetes complications^{9,14}. This study focused on psychological outcomes, however, and found that minority ethnic groups had more positive psychological well-being and better QoL, experienced less negative impact from diabetes, and were more empowered with regard to their diabetes when compared with the White non-Hispanic group. In fact, the only area in which ethnic minority groups reported more negative psychological outcomes was in diabetes distress. However, diabetes-related distress appears to have a major impact on diabetes outcomes³⁰, and it may be one of the most influential outcomes in this study. Moreover, the observed differences in psychological outcomes approached or exceeded the criterion for clinically meaningful differences.

These findings may seem counterintuitive, and some have proposed that apparent advantages in psychological outcomes among members of racial and ethnic minority groups are a result of their being less likely to report mental health symptoms and thus less likely to receive treatment, i.e., minority ethnic group psychological advantages are artifactual³¹. Another possibility is that the findings are valid and reflect ethnic group differences in the exposure and sensitivity to risk and/or protective factors. This interpretation is supported by recent research that has found better QoL among African Americans, Hispanics, and Asian Americans than among White non-

Hispanics^{15,16}. Moreover, other research has demonstrated that in the general population these ethnic minority groups have lower rates of mental health disorders than White non-Hispanics³². Thus, some of the processes at work in our study population are likely to be operative in non-diabetic ethnic populations, e.g., non-diabetes-specific risk and protective factors are associated with non-diabetes-specific psychological outcomes among people with diabetes.

Except for diabetes distress, African Americans reported the best psychological outcomes of the four ethnic groups (and had the lowest diabetes distress of the three minority populations) prior to adjustment for potential mediators. Interestingly, when mediators were controlled, the impact of ethnicity on psychological outcomes was reduced, and African Americans had results better than or not significantly different from the other ethnic groups for all psychological outcomes. The psychological disparities between African Americans and the other ethnic minority groups (i.e., Hispanics, Chinese Americans) may be in part attributable to factors related to recent immigration, acculturation and cultural perception of disease, which were not accounted for in this study³³. Hispanics and Chinese Americans generally have a relatively recent immigration history compared with African Americans and often experience language barriers as well. Individuals who are more assimilated into mainstream culture report less negative effects of diabetes on their QoL³⁴.

Additionally, individuals' experience of health and disease are heavily influenced by cultural and personal beliefs. The complexity of the cultural factors involved is illustrated by the study findings. In particular, there are ethnic disparities for almost all factors examined, and ethnicity interacts with many of these factors, qualifying or moderating their associations with the psychological outcomes studied. While interpreting each of these individual interactions is beyond the scope of this paper, they are reported here so that others can inspect them for additional insight regarding specific factors in the relevant ethnic groups. At a fundamental level, these results suggest that it is inappropriate to generalize the meaning and impact of risk/protective factors from one ethnic group to another. Culturally specific models must be developed for different ethnic groups if we are to be able to adequately understand the impact of various factors within a particular population¹⁶.

Other respondent characteristics

Type/treatment of diabetes had relatively little association with the psychological outcomes, except for diabetes distress, where people using insulin (whether diagnosed with type 1 or type 2 diabetes) reported more distress than those

Table 5. Regression analysis of psychological outcomes.

Predictor	Well-being			Quality of life			Diabetes impact			Diabetes distress			Diabetes empowerment		
	Beta at entry	Final beta		Beta at entry	Final beta		Beta at entry	Final beta		Beta at entry	Final beta		Beta at entry	Final beta	
Disease, demographic and socioeconomic factors															
Diabetes duration	0.020	0.008		0.003	-0.012		-0.016	-0.027		-0.034	-0.039		0.013	0.019	
Type 1 diabetes [¶]	0.018	0.046		-0.066	-0.021		-0.023	-0.007		0.122**	0.015		0.059	-0.071	
Type 2 diabetes	0.050	0.029		0.008	-0.019		-0.043	-0.025		-0.012	-0.005		0.010	0.028	
(oral medication) [¶]															
Type 2 diabetes (insulin medication) [¶]	-0.083	-0.003		-0.085	-0.007		0.021	0.005		0.145***	0.005		0.082	-0.013	
Female	-0.094***	-0.049*		0.011	0.033		0.019	-0.006		0.047	0.044		0.094***	0.108***	
Age	0.247***	0.191***		0.078*	0.005		-0.183***	-0.141***		-0.258***	-0.161*		-0.156***	-0.096**	
Income	0.161***	0.048		0.229***	0.108***		-0.078*	-0.008		-0.079*	0.000		0.077*	0.020	
Education	0.065	0.014		0.074*	0.016		0.040	0.059		-0.107**	-0.039		0.058	0.088**	
Change in <i>r</i> -squared	0.127	0.100		0.100			0.065	0.172					0.156		
Health status															
BMI	-0.022	0.016		-0.017	0.006		0.025	0.011		-0.040	-0.063*		-0.032	-0.028	
Self-rated health	0.335***	0.276***		0.418***	0.374***		-0.312***	-0.271***		-0.208***	-0.130***		0.165***	0.110***	
Health index	0.250***	0.240***		0.191***	0.189***		-0.051	-0.043		-0.179***	-0.158***		-0.049	-0.034	
Complications	-0.034	-0.026		-0.024	-0.030		0.018	0.022		0.125***	0.079**		0.035	0.011	
Frequency of hypoglycemia	-0.052	-0.037		-0.017	0.005		0.069*	0.068*		0.106***	0.025		0.108**	0.062*	
Frequency of severe hypoglycemia	-0.070*	-0.035		-0.123***	-0.095***		-0.036	-0.040		0.079**	0.008		0.131***	0.102***	
Change in <i>r</i> -squared	0.271	0.309		0.309			0.117			0.182			0.053		
Healthcare access/utilization															
See physician	0.056	0.056*		0.098***	0.098***		-0.081*	-0.079*		0.026	0.007		0.043	0.024	
See other healthcare professional	-0.056	-0.070*		-0.002	0.002		-0.029	-0.013		0.054	0.031		0.019	-0.004	
Diabetes education	0.087***	0.080***		0.006	-0.002		0.006	0.010		0.020	0.022		0.099***	0.090***	
Access barriers	0.013	0.029		-0.032	-0.022		0.018	0.001		0.140***	0.089***		0.072**	0.046	
Patient-centered care	0.061*	-0.017		0.048	0.010		-0.063*	-0.010		0.045	0.063*		0.335***	0.248***	
Change in <i>r</i> -squared	0.015	0.013		0.013			0.014			0.026			0.133		
Subjective burden of diabetes															
Hypoglycemia worry	-0.068*	-0.089**		-0.082**	-0.080**		-0.037	-0.015		0.157***	0.150***		0.086**	0.061*	
Weight worry	-0.111**	-0.108***		-0.060*	-0.052		0.020	0.021		0.122***	0.113***		0.061*	0.063*	
Dietary restrictions	-0.080**	-0.082**		-0.011	-0.002		0.092**	0.101**		0.175***	0.158***		0.043	0.036	
Diabetes-related discrimination	0.053*	0.047		0.015	0.027		0.024	0.037		0.067**	0.045		0.074**	0.063*	
Change in <i>r</i> -squared	0.028	0.010		0.010			0.009			0.098			0.023		
Social support/burden															
Diabetes support network	0.076**	0.076**		0.078**	0.078**		-0.040	-0.040		0.017	0.017		0.093***	0.093***	
Diabetes-related family arguments	0.074**	0.074**		-0.046	-0.046		-0.102**	-0.102**		0.118***	0.103***		0.103***	0.103***	
Diabetes support gap	-0.147***	-0.147***		-0.058*	-0.058*		0.108**	0.108**		0.086**	0.086**		-0.139***	-0.139***	
Change in <i>r</i> -squared	0.031	0.011		0.011			0.020			0.014			0.037		
Final <i>r</i>-squared	0.472	0.443		0.443			0.225			0.492			0.402		

Cell entries are standardized regression coefficients (except as noted). 'At entry' column reports coefficients for all variables in a block after all variables from that block and preceding blocks were entered into the model (i.e., the total unconfounded association). 'Final' column reports coefficients for all variables in the model with all variables entered into the model (i.e., the unconfounded and unmediated association). *R*-squared is that for the model when preceding variables have been entered. Coefficients not shown for ethnic groups; ethnic group disparities from these models are reported in Table 4.

[¶]Reference group is type 2 diabetes, no diabetes medication.
P* < 0.05; *P* < 0.01; ****P* < 0.001.

not using insulin. In contrast, other demographic and socioeconomic factors were strongly and consistently related to both generic and diabetes-specific psychological outcomes. Older respondents had more positive scores for all five psychological outcomes, although these associations were largely mediated by other factors. Higher income and/or education were associated with improved scores on all outcomes, although again these associations were mediated substantially by the other factors studied here.

Health status

Health status had the strongest explanatory power for all psychological outcomes except diabetes empowerment. Interestingly, perceived health status, especially self-rated health, had the strongest association, while objective health outcomes such as BMI, complications, and frequency of hypoglycemia had weaker associations. This finding is consistent with the published literature showing self-rated health to be a better predictor of long-term health outcomes than objective diagnoses³⁵. These subjective judgments of health status represent the cumulative assessment of how all factors affect health and thus mediate the impact of specific indicators on more global outcomes, especially psychological outcomes. Moreover, illness perceptions can influence patients' health behaviors and other mediators of physical and psychological outcomes³⁶. For example, ethnic minorities in this study had higher rates of symptomatic and severe hypoglycemia, as well as hypoglycemia worry, and controlling for hypoglycemia worry partly or fully mediated the association of hypoglycemia with the psychological outcomes. This suggests that interventions to reduce hypoglycemia worry may improve psychological outcomes, independently of the frequency of hypoglycemia.

Healthcare access and utilization

Overall, increased healthcare access and utilization were associated with improved psychological outcomes. Most associations remained significant when potential mediators were controlled, but there were exceptions: the associations of access barriers with diabetes distress and empowerment were partly mediated by subjective diabetes burden, and the associations of patient-centered care with well-being, diabetes impact, and diabetes empowerment were partly mediated by perceived diabetes support (which includes support from the healthcare team). The strongest association was between receiving patient-centered care and greater diabetes empowerment. Patient-centered care is defined by the Institute of Medicine³⁷ as providing care that is respectful of, and responsive to, individual patient preferences, needs, and values, and

ensuring that patient values guide all clinical decisions, resulting in a rebalancing of power so that adults with diabetes are empowered to take a more active role in their diabetes care³⁸. The current study suggests that patient-centered care was effective in empowering adults with diabetes. Furthermore, the ethnic minority groups reported more patient-centered care than the White non-Hispanic group, suggesting it may be one of the key factors contributing to the positive psychological outcomes observed in the ethnic minority groups.

Perceived burden

There were differences across ethnic groups in terms of hypoglycemia worry, concerns about dietary restrictions, and discrimination (but not worry about weight). For the most part, the three ethnic minority groups reported higher levels of burden compared with the White non-Hispanic group. The perceived burden of diabetes was generally associated with poor psychological outcomes, with the greatest impact on diabetes distress. These findings were expected and consistent with the literature¹⁹. However, the pattern differed for diabetes empowerment. Perceived diabetes discrimination and worrying about weight and hypoglycemia were related to increased empowerment (i.e., the capacity of adults with diabetes to be responsible for their own lives)³⁹. Perhaps these associations reflect the possibility that people facing these burdens take a greater role in dealing with them, resulting in greater empowerment; or perhaps people who are more empowered become more concerned with these aspects of living with diabetes. Our data do not allow us to differentiate these possibilities.

Social support

There were important differences across ethnic groups related to social support. In particular, African Americans and Hispanic Americans reported larger diabetes support networks compared with White non-Hispanics and Chinese Americans. Similarly, the White non-Hispanic group reported the largest gap in perceived diabetes support compared with Hispanics and African Americans. Conversely, all three ethnic minority groups reported more diabetes-related family arguments than White non-Hispanics. This may reflect greater opportunities for argument (more interaction and involvement with family members among minority groups), or it may reflect differences in how support is exchanged or perceived. Other studies have identified differences in dimensions of social support across ethnic groups⁴⁰, underscoring the need for more research to better understand the impact of culture on aspects of social support in adults with diabetes.

Overall, this study found that the better the social support, the better the psychological outcomes. More specifically, of the two aspects of diabetes-related social support examined here (having a larger diabetes support network or feeling that people from different life domains are available for diabetes support), the perception of support received had stronger associations with psychological outcomes than the size of the network. This finding is consistent with the literature indicating that the subjective aspect of potential social support (i.e., what one believes can be received from a support network) is more important than the characteristics of the network⁴¹. Our findings are consistent with a recent meta-analysis that underscored the complexity of support and identified that multiple factors – such as source of the support, the amount of the support, and manner of its delivery – may all contribute to perceptions of support and outcomes⁴⁰, and demonstrate the importance of social support in living and coping with diabetes⁴².

The association between family arguments and psychological outcomes is somewhat counterintuitive. Family arguments about diabetes are associated with greater diabetes distress, as expected, but also with better psychological well-being, less negative diabetes impact, and greater diabetes empowerment. It is possible that arguments are perceived as a form of social support in which family members try to help the person with diabetes. In this respect, family arguments might reflect greater problems with diabetes (higher diabetes distress), but help patients better manage their difficulties (lower diabetes impact), resulting in improved well-being and enhanced self-efficacy (empowerment). An alternative hypothesis is that adults with diabetes who are more empowered and psychologically validated may be more willing to recognize problems and manage the potential impacts of diabetes, even though it involves challenging the views of others. The literature shows that attempted control by family members or friends is related to greater psychological symptoms in adults with diabetes, but may result in improved diabetes self-management⁴³. Clearly, greater attention is needed to better understand the ways in which family dynamics affect different psychological and clinical outcomes in diabetes.

Limitations

The limitations of the larger multinational DAWN2 study have been described in an earlier paper⁷. Although efforts were made to be inclusive, the recruitment procedures could have caused overrepresentation of healthier, higher-functioning respondents with internet access, and recruitment may not have obtained participation of underserved and difficult-to-reach individuals with poorer health; thus means of measures examined here may not

be generalizable to USA national ethnic populations. However, by controlling for socioeconomic disparities in all analyses, the results of ethnic group comparisons are not affected by income and educational non-representativeness. In addition, the current analysis was not powered to assess correlates of outcomes within each ethnic group nor interactions of risk/protective factors with ethnicity. Also, the results are based on self-report and are subject to the known limitations of this approach, particularly social desirability. Furthermore, some of the measures were based on single items that have not been independently validated. Finally, as with all correlational research, causation cannot be determined.

Clinical and future research implications

Potential factors contributing to disparities in healthcare for multicultural populations include greater clinical uncertainties when treating people from different cultures, especially due to lack of recognition of the differences among ethnic groups. Clinician biases based on race or ethnicity can influence diagnostic and treatment decisions, especially when clinicians do not realize that they are being influenced by them⁴⁴. This study has shown that there are numerous differences among ethnic groups in terms of factors such as access to healthcare and receipt of patient-centered care, as well as burden and support; these disparities are not always in the expected direction (e.g., better psychological well-being seen for ethnic minorities, but lower diabetes distress among White non-Hispanics). When addressing psychological outcomes, clinicians should be aware of ethnic differences in perceived burden and support, and should tailor interventions to the specific needs of each group. Clinicians could improve outcomes by becoming more sensitive to cultural diversity through cultural competency training initiatives which recognize that psychosocial and health disparities exist and address them^{44,45}. For example, these findings suggest that incidence of hypoglycemia and worry about hypoglycemia are higher among ethnic minorities and may require special attention, especially in conjunction with health literacy disparities⁴⁶.

Adults with diabetes from ethnic minorities report having more social supporters and greater support for living with diabetes, but they also are involved in more 'arguments' about diabetes with their supporters. This suggests that definitions of what constitutes support may differ by ethnicity, and this possibility should be taken into account. Moreover, diabetes-related arguments are associated with several positive psychological outcomes, including improved well-being, reduced impact of diabetes and more diabetes empowerment. Clearly, there is a need for better understanding of how family members from different ethnic groups can best help adults with diabetes to

live with their disease⁴⁷. Preconceived notions about what type of support is helpful or unhelpful (e.g., 'arguments'), may result in adoption of inappropriate intervention targets. In the case of support behaviors, it is important that clinicians assess what types of support an individual with diabetes would prefer to receive (or not receive) from family members.

The results of our supplementary analyses assessing strength of association between risk/protective factors and psychological outcomes also have clinical and research implications. Our findings suggest that some factors may be more important intervention targets, depending on the ethnic group being treated, i.e., those for which exposure and/or sensitivity are elevated. Moreover, these results suggest that understanding of what role various risk/protective factors play in psychological outcomes among adults with diabetes cannot be generalized from one ethnic group to another. Such factors must be studied in each ethnic group to obtain valid results¹⁶.

The conceptual/analytic approach implemented here provides a model for parallel studies, i.e., comparative analyses of health outcomes in various populations. The key steps are to: (1) identify risk and protective factors, ideally using causal modeling logic to distinguish confounding from mediation; (2) assess differences in exposure to risk/protective factors in the populations being compared; and (3) assess differences in sensitivity to various risk and protective factors among the populations being compared.

Conclusions

Ethnic disparities in psychological outcomes among USA adults with diabetes follow the pattern of physical health outcomes; our results suggest that ethnic minorities may have an advantage in terms of some (but not all) psychological outcomes, especially when socioeconomic disparities are accounted for. Study results indicate that social factors are important correlates of psychological outcomes. In particular, socioeconomic status, social discrimination, participation in the societal system of healthcare, and participation in interpersonal support networks all play a role in psychological outcomes for people with diabetes. Cultural context is also important in that risk and protective factors have different associations with psychological outcomes in different ethnic groups; thus the meaning and consequences of experiences are influenced by their cultural context.

While medicine can and should be personalized at the individual level, social and cultural personalization are important first steps on this path. If this path is to be evidence based, we must do the relevant research and conduct the appropriate analyses to provide that evidence

base. The findings of this study have suggested a number of possible ways that healthcare support might be personalized by taking ethnicity into account, and further work is required to extend and validate this approach.

Transparency

Declaration of funding

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M.P. and L.E.E. researched data and wrote, reviewed, edited and approved the manuscript. M.M.F. and L.M.S. contributed to the introduction and discussion and wrote, reviewed, edited and approved the manuscript. A.J.C., C.C., H.L.S., L.R. and W.C.H. contributed to discussion and wrote, reviewed, edited and approved the manuscript. All statistical analysis and writing was done by the named authors. Authors other than M.P. and L.E.E. are listed in alphabetical order in recognition of their equal participation as authors.

M.P. is the guarantor of this work and, as such, had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

Declaration of financial/other relationships

M.P. and L.E.E. have disclosed that they received funding for statistical analysis work on this paper. M.P. has disclosed that he received funding for his role as Principal Investigator of the DAWN2 study, and has recently received funding for research and/or consulting from: Bristol-Myers Squibb, Calibra, Genentech, Lilly, Novo Nordisk, and Tethys. He has received speaking honoraria and participated in advisory panels for Novo Nordisk. A.J.C., C.C. and W.C.H. have disclosed that they served on the Novo Nordisk Multicultural Advisory Board. A.J.C. has disclosed that he is also a member of a speaker's bureau for Novo Nordisk, Merck, Janssen and Valeritas. C.C. has disclosed that he also serves as an advisory panel member for Eli Lilly, BMS/AZ and Janssen. M.M.F. has disclosed that she serves as an advisory panel member for Animas/Lifescan, Bayer Diagnostics, Bristol-Myers Squibb/AstraZeneca Diabetes, Eli Lilly, GlaxoSmithKline, Halozyne Therapeutics, Hygeia Inc., Johnson & Johnson and Omada Health. L.R. has disclosed that she is a consultant and faculty presenter for Johnson & Johnson Diabetes Institute (JJDI). L.M.S. and H.L.S. have disclosed that they have no significant relationships with or financial interests in any commercial companies related to this study or article.

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References

- Inzucchi SE, Bergenstal RM, Buse JB, et al. Management of hyperglycemia in type 2 diabetes: a patient-centered approach. Position statement of the American Diabetes Association (ADA) and the European Association for the Study of Diabetes (EASD). *Diabetes Care* 2012;35:1364-79
- Ali MK, Bullard KM, Saaddine JB, et al. Achievement of goals in US diabetes care, 1999–2010. *N Engl J Med* 2013;368:1613-24
- Peyrot M, Rubin RR, Lauritzen T, et al. Psychosocial problems and barriers to improved diabetes management: results of the cross-national Diabetes Attitudes, Wishes and Needs (DAWN) study. *Diabet Med* 2005;22:1379-85
- Skovlund SE, Peyrot M, on behalf of the DAWN International Advisory Panel. The Diabetes Attitudes, Wishes, and Needs (DAWN) program: a new approach to improving outcomes in diabetes care. *Diabetes Spectrum* 2005;18:136-42
- Conference Report: 2nd International DAWN Summit: a call-to-action to improve psychosocial care for people with diabetes. *Pract Diabetes Int* 2004;21:201-8
- Barnard KD, Peyrot M, Holt RI. Psychosocial support for people with diabetes: past, present and future. *Diabet Med* 2012;29:1358-60
- Peyrot M, Kovacs Burns K, Davies M, et al. Diabetes Attitudes Wishes and Needs 2 (DAWN2): a multinational, multi-stakeholder study of psychosocial issues in diabetes and person-centred diabetes care. *Diabetes Res Clin Pract* 2013;99:174-84
- Nicolucci A, Kovacs Burns K, Holt RI, et al.; DAWN2 Study Group. Diabetes Attitudes, Wishes and Needs second study (DAWN2TM): cross-national benchmarking of diabetes-related psychosocial outcomes for people with diabetes. *Diabet Med* 2013;30:767-77
- Harris MI. Racial and ethnic differences in health care access and health outcomes for adults with type 2 diabetes. *Diabetes Care* 2001;24:454-59
- Egede LE, Gebregziabher M, Hunt KJ, et al. Regional, geographic, and racial/ethnic variation in glycemic control in a national sample of veterans with diabetes. *Diabetes Care* 2011;34:938-43
- Gavin JR, Fox KM, Grandy S. Race/ethnicity and gender differences in health intentions and behaviors regarding exercise and diet for adults with type 2 diabetes: a cross-sectional analysis. *BMC Public Health* 2011;11:533
- Campbell JA, Walker RJ, Smalls BL, et al. Glucose control in diabetes: the impact of racial differences on monitoring and outcomes. *Endocrine* 2012;42:471-82
- Brown-Guion SY, Youngerman SM, Hernandez-Tejada MA, et al. Racial/ethnic, regional, and rural/urban differences in receipt of diabetes education. *Diabetes Educ* 2013;39:327-34
- Karter AJ, Ferrara A, Liu JY, et al. Ethnic disparities in diabetic complications in an insured population. *JAMA* 2002;287:2519-27
- Laiterapong N, Karter T, John PM, et al. Ethnic differences in quality of life in insured older adults with diabetes mellitus in an integrated delivery system. *J Am Geriatr Soc* 2013;61:1103-10
- Zhang L, Fergusin TF, Simonsen N, et al. Racial/ethnic disparities in health related quality of life among participants with self-reported diabetes from NHANES. *Diabetes Educ* 2014;40:496-506
- McLeod JD, Kessler RC. Socioeconomic status differences in vulnerability to undesirable life events. *J Health Social Behavior* 1990;31:162-72
- Szende A, Oppe M, Devlin N, eds. EQ-5D value sets: Inventory, Comparative Review and User Guide. EuroQol Group Monographs. Dordrecht, the Netherlands: Springer, 2007
- Peyrot M, Skovlund S, Landgraf R. Epidemiology and correlates of weight worry in the multi-national Diabetes Attitudes, Wishes and Needs (DAWN) study. *Curr Med Res Opin* 2009;25:1985-93
- Bech P, Gudex C, Johansen, KS. The WHO (Ten) Well-Being Index: validation in diabetes. *Psychother Psychosom* 1996;65:183-90
- The WHOQOL Group. Development of the World Health Organization WHOQOL-BREF quality of life assessment. *Psychol Med* 1998;28:551-8
- McGuire BE, Morrison TG, Hermanns N, et al. Short-form measures of diabetes-related emotional distress: the Problem Areas in Diabetes Scale (PAID)-5 and PAID-1. *Diabetologia* 2010;53:66-9
- International Chamber of Commerce/European Society for Opinion and Marketing Research (ICC/ESOMAR) international code on market and social research. December 2007. Available at: <http://ethics.iit.edu/ecodes/node/5178> [Last accessed 10 May 2014]
- Council of American Survey Research Organizations (CASRO) code of standards and ethics for survey research. 2008. Available at: <http://smari.com/images/uploads/CASRO-Code-of-Ethics.pdf> [Last accessed 10 May 2014]
- International Society for Pharmacoepidemiology Guidelines for Good Pharmacoepidemiology Practices. 2007. Available at: http://www.pharmacoepi.org/resources/guidelines_08027.cfm [Last accessed 28 March 2014]
- Cohen J. Statistical Power Analysis for the Behavioral Sciences. New York: Academic Press, 1969
- Norman GR, Sloan JA, Wywich KW. Interpretation of changes in health-related quality of life: the remarkable universality of half a standard deviation. *Med Care* 2003;41:582-92
- Peyrot M. Causal modeling: theory and applications. *J Ped Psychol* 1996;21:3-24
- National Institutes of Health. Fact sheet – health disparities. October 2010. Available at: <http://report.nih.gov/nihfactsheets/Pdfs/HealthDisparities%28NIMHD%29.pdf> [Last accessed 28 March 2014]
- Fisher L, Mullan JT, Areal P, et al. Diabetes distress but not clinical depression or depressive symptoms is associated with glycemic control in both cross-sectional and longitudinal analyses. *Diabetes Care* 2010;33:23-8
- Wagner J, Tsimikas J, Abbott G, et al. Ethnic and racial differences in diabetic patient-reported depression symptoms, diagnosis, and treatment. *Diabetes Res Clin Pract* 2007;75:119-22
- McGuire TG, Miranda J. New evidence regarding racial and ethnic disparities in mental health: policy implications. *Health Affairs* 2008;27:393-403
- Tseng J, Halperin L, Ritholz MD, et al. Perceptions and management of psychosocial factors affecting type 2 diabetes mellitus in Chinese Americans. *J Diabetes Complications* 2013;27:383-90
- Fisher L, Chesla CA, Chun KM, et al. Patient-appraised couple emotion management and disease management among Chinese American patients with type 2 diabetes. *J Fam Psychol* 2004;18:302-10
- Mossey JM, Shapiro E. Self-rated health: a predictor of mortality among the elderly. *Am J Public Health* 1982;72:800-8
- Cooper AF. Whose illness is it anyway? Why patient perceptions matter. *Int J Clin Pract* 1998;52:551-6
- Institute of Medicine. Crossing the quality chasm: a new health system for the 21st century. March 2001. Available at: <http://www.iom.edu/~media/Files/Report%20Files/2001/Crossing-the-Quality-Chasm/Quality%20Chasm%202001%20%20report%20brief.pdf> [Last accessed 28 March 2014]
- White RD. Patient empowerment and optimal glycemic control. *Curr Med Res Opin* 2012;28:979-89
- Funnell, MM, Anderson, RM, Arnold MS, et al. Empowerment: an idea whose time has come in diabetes education. *Diabetes Educ* 1991;17:37-41
- Strom JL, Egede LE. The impact of social support on outcomes in adult patients with type 2 diabetes: a systematic review. *Curr Diab Rep* 2012;12:769-81
- Schaefer C, Coyne JC, Lazarus RS. The health-related functions of social support. *J Behav Med* 1981;4:381-406

42. Mayberry LS, Osborn CY. Family support, medication adherence, and glycemic control among adults with type 2 diabetes. *Diabetes Care* 2012;35:1239-45
43. Grzywacz JG, Arcury TA, Saldana S, et al. Social control in older adults' diabetes self-management and well-being. *Behav Med* 2012;38:115-20
44. Smedley BD, Stith AY, Nelson AR, eds. *Unequal treatment: confronting racial and ethnic disparities in health care*. Washington, DC: National Academies Press, 2003
45. Campos C. Addressing cultural barriers to the successful use of insulin in Hispanics with type 2 diabetes. *South Med J* 2007;100:812-20
46. Sarkar U, Karter AJ, Liu JY, et al. Hypoglycemia is more common among type 2 diabetes patients with limited health literacy: the Diabetes Study of Northern California (DISTANCE). *J Gen Intern Med* 2010;25:962-8
47. Fisher L, Chesla CA, Skaff MM, et al. The family and disease management in Hispanic and European-American patients with type 2 diabetes. *Diabetes Care* 2000;23:267-72