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Ethnic Differences in the Relationship between Depressive Symptoms and Health-Related Quality of Life in People with Type 2 Diabetes

Joseph Keawe'aimoku Kaholokula, Stephen N. Haynes, Andrew Grandinetti, and Healani K. Chang

Abstract

Objective—To examine ethnic differences in the relationship between depressive symptoms and specific aspects of health-related quality of life in people with type 2 diabetes.

Design—Cross-sectional data from 190 people with type 2 diabetes of Native Hawaiian (50%), Filipino (16%), Japanese (18%), and mixed-ethnic (16%) ancestries from the rural community of North Kōhala, Hawai'i were examined in this study. Depressive symptoms were measured with the Center for Epidemiological Studies—Depression (CES-D) scale. Health-related quality of life was measured with the Short Form-36 Health Survey (SF-36). Eight health-related quality of life constructs were examined: Physical Functioning, Role-Physical Functioning, Role-Emotional Functioning, Social Functioning, Bodily Pain, Vitality, General Health, and Health Transition.

Results—Hierarchical regression analyses of the interaction between ethnicity and the SF-36 subscales of Physical Functioning, Role-Emotional Functioning, Bodily Pain, Vitality, and General Health indicated statistically significant associations with CES-D scores after controlling for sociodemographic factors, glycemic status, and social support.

Conclusion—Ethnicity moderated the relationship between depressive symptoms and the health-related quality of life aspects of physical and role-emotional functioning, bodily pain, vitality, and general health perception in people with type 2 diabetes. This relationship was strongest for Filipinos followed by Native Hawaiians and people of mixed-ethnic ancestries.

Keywords

Diabetes; Depression; Ethnicity; Native Hawaiian; Filipino; Japanese

Diabetes mellitus is a group of metabolic diseases that is characterized by elevated blood glucose levels resulting from abnormalities in insulin secretion, insulin action, or a combination of both (American Diabetes Association [ADA] 2004). The two most common types of diabetes mellitus are type 1 and type 2 diabetes. Type 1 diabetes involves absolute insulin deficiency caused from β -cell destruction of the pancreas. Type 2 diabetes is believed to be a heterogeneous group of conditions in which insulin secretion is not entirely compromised, but the body may be insulin resistant (e.g. a unit of insulin has less effect in lowering blood glucose) or the pancreas may not secrete enough insulin in response to glucose stimulation. People with diabetes mellitus need to maintain their blood glucose at an optimum level (hemoglobin A1c values [HbA1c] <7%) to reduce the risk of other serious medical complications such as heart, kidney, and eye diseases (ADA 2004).

In the USA, diabetes mellitus is the sixth leading cause of death (Centers for Disease Control and Prevention [CDCP] 2004). It is estimated that 13 million people have a diagnosis of diabetes mellitus and another 5.2 million people are estimated to have undiagnosed diabetes mellitus (CDCP 2004). Of all people with diabetes mellitus, it is estimated that 90% have type 2 diabetes (CDCP 2004). However, type 2 diabetes disproportionately affects people of various US ethnic groups. For example, people of Native Hawaiian, Japanese, and Filipino ancestries are two times more likely, as a group, to have type 2 diabetes compared to Caucasians in the USA (CDCP 2004).

Diabetes Mellitus and Co-morbid Depression

Several studies have observed a significant association between depressive symptoms and diabetes mellitus in the USA (Lustman *et al.* 2000; Anderson *et al.* 2001; Eaton 2002; Kaholokula *et al.* 2003; Nichols & Brown 2003). The prevalence of depressive symptoms in people with diabetes mellitus has been reported to be as high as 31.7% (Anderson *et al.* 2001) compared to an estimated 10% prevalence of depressive symptoms in the general population (Judd *et al.* 1997). Furthermore, people with a diabetes mellitus diagnosis were found to be three times more likely to have major depressive disorder (MDD) than people without a diabetes mellitus diagnosis (Gavard *et al.* 1993).

A significant association between depressive symptoms and diabetes mellitus has also been observed within various ethnic groups. For example, Grandinetti *et al.* 2000 observed that the prevalence of depressive symptoms was significantly higher among Native Hawaiians with type 2 diabetes (26.9%) compared to those with other chronic illnesses (15.2%) and those without a chronic illness (13.1%). Similarly, Black (1999) observed that the prevalence of depressive symptoms was significantly higher in older Mexican-Americans with diabetes mellitus (31.1%) compared to those without diabetes mellitus (24.1%).

Understanding depressive symptoms in people with diabetes mellitus has important implications for the treatment of depression and the prevention of diabetes-related complications (e.g. heart, kidney, and eye diseases) for the following reasons. Studies have indicated that people with diabetes mellitus and co-morbid depression have significantly higher blood glucose levels and are less likely to perform adequate diabetes self-care compared to people with diabetes mellitus in the absence of depression (Black 2002; Harris 2003). As a result, people with co-morbid diabetes and depression are at an increased risk for diabetes-related complications and other health-related problems, such as functional disability, low work productivity, low health service use, and more frequent and lengthier hospital stays (Black & Markides 1999; Black 2002).

Depression and Health-Related Quality of Life

Health-related quality of life (i.e. physical, social, and role functioning, and perceived health status) has been found to be an important factor related to depressive symptoms in people with diabetes mellitus (Talbot & Nouwen 2000; Goldney *et al.* 2004). For example, Kaholokula *et al.* 2003 found a significant negative correlation between depressive symptoms and health-related quality of life in a community-based, heterogeneous population of people with type 2 diabetes. Ciechanowski *et al.* 2000 found that the severity of depressive symptoms was significantly correlated with health-related quality of life in people with diabetes mellitus. Furthermore, studies that examined more specific aspects of health-related quality found that the aspects of physical, role, and social functioning, general health perceptions, and bodily pain were significantly poorer in people with diabetes mellitus and co-morbid depression compared to those without co-morbid depression (Hanninen *et al.* 1999; Lustman *et al.* 1999). The elucidation of specific aspects of health-related quality of life in accounting for depressive symptoms in people with diabetes mellitus has important treatment implications, given that

treatments for depression (e.g. cognitive-behavioral therapy) often target presumed causal variables contributing to depression.

The associations between depressive symptoms and aspects of health-related quality of life in people with diabetes mellitus have been found to be similar across different ethnic groups in the USA. Fisher *et al.* 2001 found that Latino-and European-Americans with type 2 diabetes who reported greater functional limitations on personal, work, and social life also reported significantly more depressive symptoms, after controlling for sociodemographic factors and other disease indicators such as glycemic status (i.e. HbA1c), body mass index (BMI), number of co-morbid medical conditions, and years of diagnosis. Black (1999) found that functional disability (i.e. impairment in basic self-care behaviors and instrumental activities of daily living) and poor self-rated health were significantly higher in Mexican-Americans with diabetes mellitus and co-morbid depression compared to those Mexican-Americans without co-morbid depression, after controlling for sex, age, education level, marital status, immigrant status, and living arrangements.

Despite findings of a significant relationship between depressive symptoms and health-related quality of life in people with diabetes mellitus within and across ethnic groups, no published study has specifically examined ethnic differences in this relationship. Ethnic differences in the relationship between depressive symptoms and indices of health-related quality of life are expected because of possible differences in health beliefs and expected health outcomes across ethnic groups. These differences in health beliefs and expected health outcomes are presumed to have differential effects on aspects of health-related quality of life across ethnic groups (Utz *et al.* 2001). Other factors associated with ethnicity are also presumed to affect the relationship between depressive symptoms and health-related quality of life, such as the degree and expectations of family involvement and the extended social network (e.g. friends and community members) and lifestyle differences (e.g. diet, types of physical activities, and religious and spiritual beliefs; Berger 1998).

One study that points to possible ethnic differences in the relationship between depressive symptoms and health-related quality of life in people with diabetes mellitus was a study by Jackson-Triche *et al.* 2000. They examined the relationship between depression and health-related quality of life in an aggregated clinical sample of 2,195 people with chronic medical conditions, including diabetes mellitus, heart disease, and hypertension, controlling for age, gender, clinic site, and income. Among the participants with depression, it was found that African-Americans and non-Hispanic whites had significantly poorer physical functioning, energy/fatigue, and perception of general health compared to Hispanics and Asian-Americans. In contrast, Asian-Americans with depression had significantly poorer role limitations due to emotional health compared to participants with depression from the other three ethnic groups. Lastly, Hispanics with depression had significantly fewer role limitations due to physical health compared to participants with depression from the other three ethnic groups. These findings suggest that the influence of depression on various aspects of health-related quality of life differ across distinct ethnic groups.

In examining the relationship between depression and health-related quality of life in people with diabetes mellitus, several correlates of depression need to be considered. Studies found a significant positive correlation between glycemic levels (e.g. HbA1c values) and depression in people with diabetes mellitus (Lustman *et al.* 2000). Other studies have found that certain sociodemographic factors were associated with depression and diabetes mellitus. Egede and Zheng (2003) found that being under the age of 64, female, having less than a high school degree, and being in a lower socioeconomic status (SES) were associated with major depression in people with diabetes mellitus. Other studies have also reported similar associations between age (Ciechanowski *et al.* 2000), sex (Lloyd *et al.* 2000), and education (Brazier *et al.* 2002) in

the relationship between depressive symptoms and diabetes mellitus. Furthermore, marital status and social support were significantly associated with depression in people with diabetes mellitus in past studies where people with a disrupted marital status (e.g. divorced, separated, and widowed) and people with lower social support were more likely to report depressive symptoms (Littlefield *et al.* 1990; Kaholokula *et al.* 2003). Therefore, any examination of the relationship between depressive symptoms and health-related quality of life in people with diabetes mellitus needs to account for glycemic status and sociodemographic factors.

Rationale and Goal of the Present Study

The previously reviewed studies highlight the need for a better understanding of the relationship between depressive symptoms and health-related quality of life in people with diabetes mellitus across ethnic groups. First, people with diabetes mellitus and co-morbid depression are at an increased risk for diabetes-related complications, and depression and health-related quality of life are significantly associated in people with diabetes mellitus. Second, no study to date has specifically examined ethnic differences in the relationship between depression and health-related quality of life, especially among ethnic groups with a high risk for type 2 diabetes (e.g. Native Hawaiians and Filipino-Americans). Finally, the confounding effects of glycemic control, age, sex, marital status, education, and social support need to be considered when examining the relationship between depression and health-related quality of life in people with diabetes mellitus. This is especially important when examining between-ethnic group differences because ethnic groups vary in glycemic control, the incidence of diabetes-related complications (Karter *et al.* 2002; Bonds *et al.* 2003), and sociodemographic variables that may be associated with depressive symptoms (Franks *et al.* 2003).

The goal of the present study was to examine the degree to which the correlations between depressive symptoms and aspects of health-related quality of life varied across ethnic groups in a community-based sample of people with type 2 diabetes. The effects of ethnicity were examined while controlling for age, sex, marital status, education level, social support, and glycemic status, factors that have been found to influence the relationship between depressive symptoms and health-related quality of life among people with diabetes mellitus. The US ethnic groups examined in this study were Native Hawaiians, Filipinos, Japanese, and people of mixed-ethnic ancestry. The specific health-related quality of life aspects of interest were physical functioning, role-physical functioning, role-emotional functioning, social functioning, bodily pain, vitality, general health perception, and perceived health transition.

Methods

Participants

Participants were drawn from the Native Hawaiian Health Research (NHHR) Project. The NHHR Project was a community-based, epidemiological study of diabetes and cardiovascular disease risk factors in the North Kōhala district of the island of Hawai'i. The original sample consisted of 1,452 participants, of which 190 (91 males and 99 females) Native Hawaiians ($n=94$; 50%), Filipinos ($n=30$; 16%), Japanese ($n=35$; 18%), and people of mixed-ethnic ancestry ($n=31$; 16%) were identified as having diabetes mellitus, based on World Health Organization (WHO) criteria (fasting blood glucose ≥ 125 mg/dl or two-hour post-challenge blood glucose ≥ 200 mg/dl; Puavilai *et al.* 1999). All 190 participants had type 2 diabetes confirmed by c-peptide traces in their fasting blood samples.

Assessment Instruments

Personal information was gathered using the Personal History Form designed by NHHR, which was interviewer administered. Among the data collected were sex, age, marital status,

education level, and ethnic ancestry. Ethnic ancestry information was based on participants' self-report, which included percentage of blood quantum (i.e. less than 25%, 25–49%, 50–74%, 75–99%, and 100%) for each ethnic ancestry reported. A participant was categorized as Native Hawaiian if he or she reported having any percentage of Native Hawaiian blood quantum. Native Hawaiian was defined as any individual who had ancestors residing in the Hawaiian Islands prior to 1778. A participant was categorized as Japanese if he or she reported having 100% Japanese blood quantum. A participant was categorized as Filipino if he or she reported having 100% Filipino blood quantum. A participant was categorized as having mixed-ethnic ancestry if he or she reported two or more different ethnic ancestries, which did not include Native Hawaiian.

Hemoglobin A1c (HbA1c) was used to measure glycemic status, providing an index of participants' average blood glucose levels over the previous three to four months (ADA 2004). HbA1c was assayed by affinity chromatography using a minicolumn (BioRad, Hercules, CA, USA) from blood samples collected from each participant using standardized protocols (WHO 1985). HbA1c has been accepted as the preferred measure of glycemic control and has been found to predict the risk for the development of diabetes-related complications (ADA 2004). A significant correlation ($r = 0.82$) between HbA1c and mean plasma glucose levels has been found by the Diabetes Control and Complications Trial (Rohlfing *et al.* 2002).

Depressive symptoms were measured using the 20-item Center for Epidemiological Studies—Depression scale (CES-D; Radloff 1977). The CES-D was designed as a self-report measure of depressive symptoms for research use among the general population. It provides an index of cognitive, affective, and behavioral symptoms. Participants were asked to report the frequency or duration with which they had experienced a specific symptom of depression within the preceding week, using a four-point rating scale that ranges from 'rarely to none of the time (less than one day)' (0) to 'most or all of the time (5–7 days)' (3). The range of possible total scores is from 0 to 60, where higher scores indicate greater frequency of depressive symptoms. The use of the CES-D as a measure of depressive symptoms among different ethnic groups has been supported in several previous studies (Hertzog *et al.* 1990; Beekman *et al.* 1997).

Health-related quality of life indices were measured using the Short Form-36 Health Survey (SF-36; Ware *et al.* 1993). The SF-36 was designed to measure eight different health aspects based on the participants' perceived burden of their illness. The SF-36 subscales were: (1) Physical Functioning, (2) Role-Physical Functioning (e.g. role limitations due to physical health problems), (3) Bodily Pain, (4) General Health, (5) Vitality, (6) Social Functioning, (7) Role-Emotional Functioning (e.g. role limitations due to emotional problems), and (8) Mental Health (e.g. psychological well-being and distress). In addition, a one-item Health Transition subscale was included in the SF-36. The Mental Health subscale was not used in this study because of overlap of items with the CES-D. Higher scores on the SF-36 subscales indicated better health-related quality of life. The use of the SF-36 as a measure of health-related quality of life in people with diabetes mellitus has been supported in previous studies (see Ware *et al.* 1993).

Social support was measured using a six-item subscale of the 10-item Lubben Social Network Scale (LSNS; Lubben 1988). The six-item subscale was designed to measure social support received from family (three items) and friends (three items). Based on a five-point rating scale, participants are asked to report availability of assistance from family and friends for various needs with responses ranging from 'definitely true' (1) to 'definitely false' (5). The possible range of scores is from 6 to 30, where lower scores indicate greater social support. The use of the LSNS as a measure of social support has been supported in past studies (Lubben 1988; Newsom & Schulz 1996).

Procedures

The NHHR Project's procedures were described in detail elsewhere (Mau *et al.* 1997; Grandinetti *et al.* 1998). Briefly, the NHHR Project recruited Native Hawaiian participants who had participated in a previous NHHR diabetes and cardiovascular risk factors study via telephone, mail, or a home visit for re-participation with NHHR. All other participants, both Native Hawaiian and non-Native Hawaiian, were recruited via telephone using a cross-reference directory, local public television announcements, flyers posted at community centers and stores, and presentations given to community organizations. The eligibility criteria for participation in the NHHR Project were as follows: (1) 18 years of age and older, (2) resident of North Kōhala, and (3), if female, not pregnant. Those interested in participating were scheduled for a two-hour clinical examination and interview at the NHHR community clinic. Informed consent was obtained prior to participants' involvement in the study. Each participant underwent a clinical exam, which consisted of fasting and post-OGTT blood draws, vital signs (i.e. temperature and blood pressure), and anthropometric measurements (i.e. weight, height, waist and hip circumference, and sagittal diameter), ECG testing, urine sampling, and pulmonary testing. Upon completion of clinical exams, a series of questionnaires were administered, which included a medical history form, a physical activity form, a dietary form, and a series of psychosocial measures that included the CES-D, SF-36, and LSNS.

Data Reduction and Statistical Methods

Because of missing data on the CES-D, SF-36 subscales, and LSNS, only 179 participants' data were available for analyses. Because 5 of the 179 participants had one or two items unanswered on the CES-D, their missing data were replaced with the average score of the remaining answered items. Sex (1 = male; 2 = female) and education level (0 = non-high school graduate; 1 = high school graduate/GED; 2 = some college, technical, or vocational training; 3 = college graduate) were interval coded for statistical analyses. Marital status was coded using 1 (yes) or 0 (no) for membership in one of three levels of marital status: never married, married, and disrupted marital status (i.e. separated, divorced, or widowed; comparison group). The same coding method was done for ethnic groups.

Descriptive statistics were calculated for the sociodemographic variables, HbA1c values, CES-D, SF-36, and LSNS by ethnicity. Chi-square (χ^2) analyses were done to examine ethnic differences in categorical variables. Analysis of variance (ANOVA), with *post hoc* Tukey, was done to examine ethnic differences in CES-D, SF-36, and LSNS mean scores, age, and HbA1c values. For each ethnic group, Pearson-product moment correlation coefficients were calculated between CES-D scores and the SF-36 subscale scores, LSNS scores, and age, HbA1c, and education level. Logistic fit analysis was used to correlate CES-D scores and marital status. For each ethnic group, Cronbach's alphas were calculated to determine the internal consistency of the CES-D, SF-36, and LSNS. Hierarchical regression analyses were used to examine the degree to which variance in CES-D scores could be accounted for by the interaction between ethnicity and each of the eight SF-36 subscale scores while controlling for their main effects and age, sex, marital status, education level, LSNS scores, and HbA1c values. A regression model that included CES-D scores predicted by scores from a SF-36 subscale, ethnicity, the interaction between the SF-36 subscale scores and ethnicity, age, sex, marital status, education level, LSNS scores, and HbA1c values (full model) was compared to a regression model with the interaction term removed (restricted model). The values of R^2 of the full and restricted model were compared (R_{Δ}^2) for each of the eight SF-36 subscales, separately from the other subscales, to determine the predictive power of the interaction term in accounting for CES-D scores above the effects of the sociodemographic variables, HbA1c values, and LSNS scores. An alpha level of 0.05 ($p \leq 0.05$) was used to determine statistical significance. All statistical analyses were done using JMP Statistical Software for Windows, release 5.0 (SAS Institute 2000).

Results

Participants' Characteristics and Descriptive Statistics

The number and percentages of participants by sex, marital status, and education level across ethnic groups and combined samples are summarized in Table 1. No statistically significant differences in sex, education level, and marital status were observed across ethnic groups. The means and standard deviations of participants by age and HbA1c values across ethnic groups and combined sample are summarized in Table 2. A statistically significant difference between ethnic groups in mean age and mean HbA1c values was observed. The Native Hawaiian participants were significantly younger and had significantly higher HbA1c values compared to participants from the other three ethnic groups. Descriptive statistics for CES-D, LSNS, and the SF-36 subscales by ethnicity and the combined sample are also presented in Table 2. No statistically significant between-ethnic group differences in mean scores were observed for the CES-D, LSNS, and SF-36 subscales based on ANOVA.

Internal Consistency of CES-D, SF-36 subscales, and LSNS

Cronbach's alphas for the CES-D, LSNS, and the SF-36 subscales are presented in Table 3 by ethnic groups and combined sample. Because the Health Transition subscale of the SF-36 consisted of only one item, its internal consistency was not calculated. The results of Cronbach's alpha suggested that all the measures had acceptable internal consistency within each ethnic group and the combined sample, with the exception of the Filipino sample on the LSNS (0.58) and Social Functioning subscale (0.48) and the mixed-ethnic ancestry sample on the Social Functioning subscale (0.42). Within all four ethnic groups and the combined sample, the Social Functioning subscale had the lowest internal consistency coefficients.

CES-D Correlates

For the Native Hawaiian participants, the variables that were significantly correlated with CES-D scores were the SF-36 subscale scores of Physical Functioning (PF; $r = -0.26$), Role-Physical Functioning (RP; $r = -0.32$), Bodily Pain (BP; $r = -0.24$), General Health (GH; $r = -0.36$), Vitality (VT; $r = -0.33$), Social Functioning (SF; $r = -0.43$), and Role-Emotional Functioning (RE; $r = -0.47$). For the Filipino participants, the variables that were significantly correlated with CES-D scores were the SF-36 subscale scores of Physical Functioning (PF; $r = -0.44$), Role-Physical Functioning (RP; $r = -0.58$), Bodily Pain (BP; $r = -0.62$), General Health (GH; $r = -0.64$), Vitality (VT; $r = -0.61$), Social Functioning (SF; $r = -0.44$), Role-Emotional Functioning (RE; $r = -0.65$), Health Transition (HT; $r = 0.39$), and marital status [$\chi^2 = (2, N = 30) = 8.79, p < 0.05$]. For the Japanese participants, none of the sociodemographic variables, HbA1c values, scores from the SF-36 subscales, and LSNS scores were significantly correlated with CES-D scores. For the mixed-ethnic ancestry participants, the variables that were significantly correlated with CES-D scores were the SF-36 subscale scores of Physical Functioning (PF; $r = -0.46$), Social Functioning (SF; $r = -0.38$), and Role-Emotional Functioning (RE; $r = -0.43$).

Hierarchical Regression Analyses of Ethnic Differences

The goal of this set of analyses was to determine the degree to which variance in CES-D scores could be accounted for by the interaction between ethnicity and SF-36 subscale scores while controlling for their main effects, sex, age, education level, marital status, social support, and HbA1c values. Of the eight SF-36 subscales examined, significant variances in CES-D scores were accounted for by the interaction between ethnicity and five of the eight SF-36 subscale scores—Physical Functioning, General Health, Bodily Pain, Vitality, and Role-Emotional Functioning subscales—above the main effects of ethnicity and the SF-36 subscale scores and the effects of age, gender, marital status, education level, HbA1c levels, and LSNS scores. The

results for the significant interactions are depicted in Figures 1–5. No statistically significant variances in CES-D scores were accounted for by the interaction between ethnicity and the SF-36 subscales of Role-Physical Functioning, Social Functioning, and Health Transition.

Specifically, a significant proportion of the variance in CES-D scores was accounted for by the interaction effect of ethnicity and the Physical Functioning subscale [$R_{\Delta}^2 = -0.04$, $p \leq 0.05$; full model $R^2 = 0.21$, $F(14,179) = 3.12$, $p < 0.0001$; restricted model $R^2 = 0.17$, $F(11,179) = 3.17$, $p < 0.0001$]; the interaction effect of ethnicity and the Bodily Pain subscale [$R_{\Delta}^2 = -0.05$, $p \leq 0.05$; full model $R^2 = 0.22$, $F(14,179) = 3.36$, $p < 0.0001$; restricted model $R^2 = 0.17$, $F(11,179) = 3.22$, $p < 0.0001$]; the interaction effect of ethnicity and the General Health subscale [$R_{\Delta}^2 = -0.05$, $p \leq 0.05$; full model $R^2 = 0.25$, $F(14,179) = 3.88$, $p < 0.0001$; restricted model $R^2 = 0.20$, $F(11,179) = 3.84$, $p < 0.0001$]; the interaction effect of ethnicity and the Vitality subscale [$R_{\Delta}^2 = -0.04$, $p \leq 0.05$; full model $R^2 = 0.23$, $F(14,179) = 3.46$, $p < 0.0001$; restricted model $R^2 = 0.19$, $F(11,179) = 3.59$, $p < 0.0001$]; and the interaction effect of ethnicity and the Role-Emotional Functioning subscale [$R_{\Delta}^2 = -0.04$, $p \leq 0.05$; full model $R^2 = 0.29$, $F(14,178) = 4.71$, $p < 0.0001$; restricted model $R^2 = 0.25$, $F(11,178) = 5.09$, $p < 0.0001$].

Discussion

The goal of this study was to examine ethnic differences in the relationship between depressive symptoms and different aspects of health-related quality of life in people with type 2 diabetes. The specific aspects of health-related quality of life examined were (1) physical functioning, (2) role-physical functioning, (3) bodily pain, (4) general health perspective, (5) vitality, (6) social functioning, (7) role-emotional functioning, and (8) health transition. The US ethnic groups of interest were Native Hawaiians, Filipinos, Japanese, and people of mixed-ethnic ancestry. The methodological advantages of this study were the examination of a community-based population that included people of unique Asian and Pacific ancestries with confirmed type 2 diabetes.

Among the Native Hawaiian, Filipino, and mixed-ethnic ancestry participants in this study, a significant negative correlation was observed between CES-D-assessed depressive symptoms and the SF-36 subscales of Physical Functioning, Social Functioning, and Role-Emotional Functioning. For Native Hawaiian and Filipino participants, a significant negative correlation was also observed between CES-D-assessed depressive symptoms and the SF-36 subscales of Role-Physical Functioning, Bodily Pain, General Health, and Vitality. In addition, Filipino participants reported a significant negative correlation between CES-D-assessed depressive symptoms and the SF-36 subscale of Health Transition. Interestingly, none of the SF-36 subscales were significantly correlated with CES-D-assessed depressive symptoms among the Japanese participants. Across all four ethnic groups, CES-D mean scores were relatively low. However, Japanese participants reported fewer depressive symptoms compared to the other three ethnic groups and Filipino participants reported the most depressive symptoms, but no statistically significant differences in CES-D mean scores were observed between ethnic groups.

After controlling for the effects of sociodemographic variables, social support, and glycemic status, this study found that ethnicity significantly influenced the relationship between depressive symptoms and certain aspects of health-related quality of life in people with type 2 diabetes. The relationship between CES-D-assessed depressive symptoms and the SF-36 subscales of Physical Functioning, Bodily Pain, General Health, Vitality, and Role-Emotional Functioning were significantly different across ethnic groups. In contrast, the relationship between CES-D-assessed depressive symptoms and the SF-36 subscales of Role-Physical Functioning, Social Functioning, and Health Transition were not significantly different across ethnic groups. However, it is important to note that the magnitude of effects on CES-D scores

were small (4–5% increase in variance accounted for) in this study for the interaction effects of ethnicity and the statistically significant SF-36 subscales. Although statistically significant, the small magnitude of effects observed in this study would suggest that other factors not examined could account for a greater proportion of the variance in CES-D-assessed depressive symptoms in this study's sample of people with type 2 diabetes.

Overall, participants of Filipino, Native Hawaiian, and mixed-ethnic ancestries with type 2 diabetes who reported more depressive symptoms also reported significantly poorer physical functioning, poorer perception of general health and its progression, more severe and extremely limiting bodily pains, less energy, and more emotional problems affecting their work and other daily activities. However, the Filipino participants reported a significantly stronger relationship between depressive symptoms and the health-related quality of life aspects of bodily pain, general health perception, and energy level compared to the Native Hawaiian and mixed-ethnic ancestry participants, after controlling for sociodemographic factors, social support, and glycemic status. The Japanese participants in this study reported no significant correlations between depressive symptoms and the eight aspects of health-related quality of life examined in this study, even after controlling for sociodemographic variables, social support, and glycemic status.

This was the first study to examine the moderating effects of ethnicity on the relationship between depressive symptoms and aspects of health-related quality of life in people with type 2 diabetes. The findings of this study support the idea that the relationship between depressive symptoms and specific aspects of health-related quality of life in people with type 2 diabetes could differ across ethnic groups. Comparison of this study's findings with that of past studies is limited, given the lack of comparable studies. However, these results are consistent with the results of Jackson-Triche *et al.*'s (2000) study in which they found ethnic differences in the relationship between depression and specific aspects of health-related quality of life among an aggregated sample of people with various chronic medical conditions. As presented earlier, their study reported significant ethnic differences between depression and the SF-36 subscales of Physical Functioning, General Health, Vitality, Role-Emotional Functioning, and Role-Physical Functioning after controlling for sociodemographic factors. The Asian-American participants with depression in their study, which consisted of different distinct Asian ethnic groups, reported better physical functioning, more energy and less fatigue, and better perception of general health compared to the African-American and non-Hispanic white participants with depression. Because no mention was made in their study concerning the specific ethnic composition of their aggregated Asian-American sample, which could have included Filipino- and Japanese-Americans, limited comparisons can be made to the findings of the present study.

The strong relationship observed in this study between CES-D scores and that of the SF-36 subscale scores of Bodily Pain, General Health, and Vitality among the Filipino participants may be related to Filipino cultural health beliefs and expressions of distress. Ponce (1980) has suggested that Filipinos in Hawai'i express emotional distress primarily through physical complaints, which is supported by the findings of past studies (e.g. Lin *et al.* 1985). The strong association of depressive symptoms with bodily pain, energy level, and general health perspective among the Filipino participants in this study is consistent with the idea that Filipinos could express psychological distress primarily through somatic complaints.

It is important to note that the social support measure used in this study (LSNS) and the SF-36 Social Functioning subscale did not have adequate internal reliability coefficients for the Filipino participants as assessed by Cronbach's alpha. A possible explanation for the lack of internal reliability in the LSNS and Social Functioning subscale among the Filipino participants could be related to their notion of social support and social functioning. Ponce (1980) suggested

that Filipinos' views of social support and social functioning are directly tied to their interdependence on financial and other economic resources (e.g. goods and services) within and between households in the Filipino community. However, items on the SF-36 Social Functioning subscale focused on the extent to which health problems interfered with social activities and items on the LSNS focused on people who the participant could talk to for advice and emotional support. These types of social support (e.g. confidant and emotional social reinforcement) may not have been as important among the Filipino participants in this study compared to other types of social support (e.g. exchange of goods and reliance on economic assistance). Therefore, social support might not have been adequately controlled for in this study. More studies are needed to elucidate the types of social support that are important in moderating the relationship between depression and health-related quality of life in Filipinos with type 2 diabetes.

The Japanese participants in this study consisted mostly of descendents of second (*Nisei*) and third generation (*Sansei*) immigrants to Hawai'i. Therefore, a great majority of the Japanese participants in this study were born and raised in Hawai'i. One plausible explanation for the lack of statistically significant correlations between depression and aspects of health-related quality of life among the Japanese participants may be related to a notable health belief within the older Japanese community in Hawai'i. Rogers and Izutsu (1980) noted that mental illness has a strong social stigma among Japanese in Hawai'i and, therefore, it is viewed as shameful and not openly discussed. If this was a salient health belief with the Japanese participants in this study, it could have affected their response to items on the CES-D and SF-36 subscales in which they were more likely to underreport symptoms of depression and problems with health-related quality of life. However, there were no statistically significant differences in the mean scores of the CES-D and the SF-36 subscales between ethnic groups in this study. Given no differences in mean scores, it is unlikely that the Japanese participants in this study were underreporting on measures relating to mental health. Other plausible explanations to the findings among the Japanese participants are that depression and the eight quality of life aspects examined in this study are unrelated factors or because we did not measure aspects of health-related quality of life that are important to Japanese-Americans.

Finally, another plausible explanation is that the sample size of Japanese participants may not have been large enough to detect the effects of depression on health-related quality of life. However, the sample size for Filipino ($n = 30$) and the mixed-ancestry ($n=31$) participants were smaller than that of the Japanese participants ($n=35$), but yet statistically significant differences were detected for these ethnic groups. This suggests that the findings are robust and that a lack of statistical power may not be responsible for the lack of significant correlations between depression and aspects of health-related quality of life measured among the Japanese participants. The effect sizes of the health-related quality of life constructs were large enough to detect differences among the Filipino and mixed-ethnic ancestry groups and, therefore, should have been large enough to detect differences among Japanese participants as well (see Kraemer & Thiemann 1987). Before confidence can be placed on this study's results on Japanese participants, more studies are needed to elucidate the relationship between depression and health-related quality of life in Japanese-Americans.

Although we did not examine factors that mediate ethnic differences, ethnicity is assumed to be a marker of factors, such as customs, beliefs, and practices, that influence health behaviors and their relationship to psychological well-being (US Department of Health and Human Services 2001). Future research is needed to elucidate these factors related to ethnicity. In addition, more studies are needed to examine other aspects of health-related quality of life that are important in better understating the relationship between depressive symptoms and type 2 diabetes across specific ethnic groups. Again, the lack of a statistical significance between depression and the examined aspects of health-related quality of life among Japanese

participants in this study could be because they are unrelated factors or because we did not capture important aspects of health-related quality of life to Japanese-Americans. This could hold true for the other ethnic groups in this study as well.

Implications

The findings of this study have several important implications. First, the between-ethnic group differences observed in this study concerning the relationship between depressive symptoms and health-related quality of life supports the idea that sociocultural factors (e.g. health beliefs and expectations of social network) could play an important role in this relationship. Second, the differences found between the Filipino and Japanese participants highlight the need for more specific ethnic classification in health behavior research rather than aggregating people of Asian-Pacific ancestries together in research studies. Finally, the finding of this study can help clinicians in better assessing factors associated with depressive symptoms in people with type 2 diabetes. Such assessments often involve the identification and specification of important modifiable factors that are believed to either cause or maintain depressive symptoms. The findings of this study suggest that multiple health-related constructs (e.g. perceived health status and physical and role-emotional functioning) are related to depressive symptoms in people with type 2 diabetes, and that the relative influence of these factors differ by ethnicity.

Methodological Considerations

Several methodological issues may affect confidence in the inferences that can be drawn from this study. First, this study examined only some aspects of health-related quality of life found to be associated with depressive symptoms in people with chronic illnesses. Although the eight aspects of health-related quality of life examined in this study are common, other aspects of health-related quality of life (e.g. environmental conditions, intimacy, and sexual functioning) could also account for the relationship between depressive symptoms and type 2 diabetes across ethnic groups.

Second, this study used only one measure for each construct of interest. The use of multiple measures (e.g. other self-report measurement strategies) to assess each construct would have reduced the likelihood of measurement error (an aspect of the measure that was not measuring the construct of interest) from occurring in this study and, thereby, increasing confidence in the results (see Haynes & O'Brian 1999). However, the feasibility of using multiple measures of the same construct in large community-based studies is questionable, especially when multiple constructs are involved.

Last, this study used a cross-sectional design to examine nomothetic data for the relationship between depressive symptoms and aspects of health-related quality of life. The use of a cross-sectional design makes it more difficult to examine causal relations. Therefore, this study could only examine the relative strengths of correlations between variables of interest. In addition, the nomothetic data of this study were based on group averages. Important individual differences (e.g. responses to environmental stressors, social reinforcements, and coping styles) that could have influenced the relationship between depressive symptoms and aspects of health-related quality of life were not considered.

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References

- American Diabetes Association. 'Standards of medical care in diabetes'. *Diabetes Care* 2004;27(suppl 1):S15–S35. [PubMed: 14693923]
- Anderson RJ, Freedland KE, Clouse RE, Lustman PJ. 'The prevalence of comorbid depression in adults with diabetes: a meta-analysis'. *Diabetes Care* 2001;24:1069–1078. [PubMed: 11375373]
- Beekman AT, Deeg DJ, Van Limbeek J, Braam AW, De Vries MZ, Van Tilburg W. 'Criterion validity of the Center for Epidemiologic Studies Depression scale (CES-D): results from a community-based sample of older subjects in The Netherlands'. *Psychological Medicine* 1997;27:231–235. [PubMed: 9122304]
- Berger JT. 'Culture and ethnicity in clinical care'. *Archives of Internal Medicine* 1998;158:2085–2090. [PubMed: 9801174]
- Black SA. 'Diabetes, diversity, and disparity: what do we do with the evidence?'. *American Journal of Public Health* 2002;92:543–548. [PubMed: 11919048]
- Black SA, Markides KS. 'Depressive symptoms and mortality in older Mexican Americans'. *Annals of Epidemiology* 1999;9:45–52. [PubMed: 9915608]
- Black SA, Jakobi PL, Rush RD, DiNuzzo AR, Garcia D. 'Ethnic variation in the health burden of self-reported diabetes in adults aged 75 and older'. *Ethnicity & Disease* 1999;9:22–32. [PubMed: 10355472]
- Bonds DE, Zaccaro DI, Karter AJ, Selby JV, Saad M, Goff DC. 'Ethnic and racial differences in diabetes care'. *Diabetes Care* 2003;26:1040–1046. [PubMed: 12663570]
- Brazier JE, Harper R, Jones NMB, O'Cathain A, Thomas KJ, Usherwood T, Westlake L. 'Validating the SF-36 Health Survey Questionnaire: new outcome measure for primary care'. *British Medical Journal* 1992;305:160–164. [PubMed: 1285753]
- Centers for Disease Control and Prevention (2004) *National Diabetes Fact Sheet: General Information and National Estimates on Diabetes in the United States, 2003*, rev. edn, US Department of Health and Human Services, Centers for Disease Control and Prevention, Atlanta, GA.
- Ciechanowski PS, Katon WJ, Russo JE. 'Depression and diabetes: impact of depressive symptoms on adherence, function, and costs'. *Archives of Internal Medicine* 2000;160:3278–3285. [PubMed: 11088090]
- Eaton WW. 'Epidemiologic evidence on the comorbidity of depression and diabetes'. *Journal of Psychosomatic Research* 2002;53:903–906. [PubMed: 12377301]
- Egede LE, Zheng D. 'Independent factors associated with major depressive disorder in a national sample of individuals with diabetes'. *Diabetes Care* 2003;26:104–111. [PubMed: 12502665]
- Fisher L, Chesla CA, Mullan JT, Skaff MM, Ranter RA. 'Contributors to depression in Latino and European-American patients with type 2 diabetes'. *Diabetes Care* 2001;24:1751–1757. [PubMed: 11574437]
- Franks P, Gold MR, Fiscella K. 'Sociodemographics, self-rated health, and mortality in the US'. *Social Science & Medicine* 2003;56(12):2505–2514. [PubMed: 12742613]
- Gavard JA, Lustman PJ, Clouse RE. 'Prevalence of depression in adults with diabetes. An epidemiological evaluation'. *Diabetes Care* 1993;16:1167–1178. [PubMed: 8375247]
- Goldney RD, Phillips PJ, Fisher LJ, Wilson DH. 'Diabetes, depression, and quality of life: a population study'. *Diabetes Care* 2004;27:1066–1070. [PubMed: 15111522]
- Grandinetti A, Chang HK, Mau MK, Curb JD, Kinney EK, Sagum R, Arakaki RF. 'Prevalence of glucose intolerance among Native Hawaiians in two rural communities. Native Hawaiian Health Research (NHHR) Project'. *Diabetes Care* 1998;21:549–554. [PubMed: 9571341]
- Grandinetti A, Kaholokula JK, Crabbe KM, Kenui CK, Chen R, Chang HK. 'Relationship between depressive symptoms and diabetes among native Hawaiians'. *Psychoneuroendocrinology* 2000;25:239–246. [PubMed: 10737695]

- Hanninen JA, Takala JK, Keinanen-Kiukaanniemi SM. 'Depression in subjects with type 2 diabetes. Predictive factors and relation to quality of life'. *Diabetes Care* 1999;22:997–998. [PubMed: 10372255]
- Harris MD. 'Psychosocial aspects of diabetes with an emphasis on depression'. *Current Diabetes Reports* 2003;3:49–55. [PubMed: 12643146]
- Haynes, S. N. & O'Brian, W. H. (1999) *Principals and Practices of Behavioral Assessment*, Plenum, New York.
- Hertzog C, Alistine JV, Usala PD, Hultsch DF, Dixon R. 'Measurement properties of the Center for Epidemiological Studies Depression Scale (CES-D) in older populations'. *Psychological Assessment* 1990;2:64–72.
- Jackson-Triche ME, Greer Sullivan J, WeUs KB, Rogers W, Camp P, Mazel R. 'Depression and health-related quality of life in ethnic minorities seeking care in general medical settings'. *Journal of Affective Disorders* 2000;58:89–97. [PubMed: 10781698]
- Judd LL, Akiskal HS, Paulus MP. 'The role and clinical significance of subsyndromal depressive symptoms (SSD) in unipolar major depressive disorder'. *Journal of Affective Disorders* 1997;45:5–17. [PubMed: 9268771]
- Kaholokula JK, Haynes SN, Grandinetti A, Chang HK. 'Biological, psychosocial, and sociodemographic variables associated with depressive symptoms in persons with type 2 diabetes'. *Journal of Behavioral Medicine* 2003;26:435–458. [PubMed: 14593852]
- Karter AJ, Ferrara A, Liu JY, Moffet HH, Ackerson LM, Selby JV. 'Ethnic disparities in diabetic complications in an insured population'. *Journal of the American Medical Association* 2002;287:2519–2528. [PubMed: 12020332]
- Kraemer, H. C. & Thiemann, S. (1987) *How Many Subjects?*, Sage, Newbury Park, CA.
- Lin EH, Carter WB, Kleinman AM. 'An exploration of somatization among Asian refugees and immigrants in primary care'. *American Journal of Public Health* 1985;75:1080–1084. [PubMed: 4025659]
- Littlefield CH, Rodin GM, Murray MA, Craven JL. 'Influence of functional impairment and social support on depressive symptoms in persons with diabetes'. *Health Psychology* 1990;9:737–749. [PubMed: 2286183]
- Lloyd CE, Dyer PH, Barnett AH. 'Prevalence of symptoms of depression and anxiety in a diabetic clinic population'. *Diabetic Medicine* 2000;17:198–202. [PubMed: 10784223]
- Lubben JE. 'Assessing social networks among elderly populations'. *Journal of Family and Community Health* 1988;11:45–52.
- Lustman PJ, Freedland KE, Griffith LS, Barnes LD, Miller CR, Anderson KH, McGill JB, Rubin EH, Clouse RE. 'Effects of major depression on health-related quality of life in type 2 diabetes: a controlled analysis'. *Diabetes* 1999;48:A73.
- Lustman PJ, Anderson RJ, Freedland KE, de Groot M, Carney RM, Clouse RE. 'Depression and poor glycemic control: a meta-analytic review of the literature'. *Diabetes Care* 2000;23:934–942. [PubMed: 10895843]
- Mau MK, Grandinetti A, Arakaki RF, Chang HK, Kinney EK, Curb JD. 'The insulin resistance syndrome in native Hawaiians. Native Hawaiian Health Research (NHHR) Project'. *Diabetes Care* 1997;20:1376–1380. [PubMed: 9283783]
- Newsom JT, Schulz R. 'Social support as a mediator in the relation between functional status and quality of life in older adults'. *Psychology and Aging* 1996;11:34–44. [PubMed: 8726368]
- Nichols GA, Brown JB. 'Unadjusted and adjusted prevalence of diagnosed depression in type 2 diabetes'. *Diabetes Care* 2003;26:744–749. [PubMed: 12610032]
- Ponce, D. (1980) 'The Filipinos: mental health implications', in *People and Cultures of Hawai'i: A Psychosocial Profile*, eds J. F. McDermott, Jr., W.-S. Tseng & T. W. Maretzki, University of Hawai'i Press, Honolulu, HI.
- Puavilai G, Chanprasertyotin S, Sriphrapradaeng A. 'Diagnostic criteria for diabetes mellitus and other categories of glucose intolerance: 1997 criteria by the Expert Committee on the Diagnosis and Classification of Diabetes Mellitus (ADA), 1998 WHO consultation criteria, and 1985 WHO criteria. World Health Organization'. *Diabetes Research and Clinical Practice* 1999;44:21–26. [PubMed: 10414936]

- Radloff LS. 'The CES-D scale: a self-report depression scale for research in the general population'. *Applied Psychological Measures* 1977;1:385–401.
- Rogers, T. & Izutsu, S. (1980) 'The Japanese', in *People and Cultures of Hawai'i: A Psychosocial Profile*, eds J. F. McDermott, Jr., W.-S. Tseng & T. W. Maretzki, University of Hawai'i Press, Honolulu, HI.
- Rohlfing CL, Wiedmeyer HM, Little RR, England JD, Tennill A, Goldstein DE. 'Defining the relationship between plasma glucose and HbA1c: analysis of glucose profiles and HbA1c in the Diabetes Control and Complications Trial'. *Diabetes Care* 2002;25:275–278. [PubMed: 11815495]
- Talbot F, Nouwen A. 'A review of the relationship between depression and diabetes in adults: is there a link?'. *Diabetes Care* 2000;23:1556–1562. [PubMed: 11023152]
- US Department of Health and Human Services (2001) *Mental Health: Culture, Race, and Ethnicity—A Supplement to Mental Health: A Report of the Surgeon General*, US Department of Health and Human Services, Substance Abuse and Mental Health.
- Utz, S. W, Padgett, L., Blank, M., Guarini, J., Morton, S., Wilson, L. & Simmons, W. (2001, November) 'Comparisons of specific illness beliefs of rural and urban blacks and whites', *Southern Online Journal of Nursing Research*, vol. 2, no. 7. Available at: http://www.snrs.org/members/SOJNR_articles/iss07vol02.pdf (accessed 17 June 2003).
- Ware, J. E., Snow, K. K., Kosinski, M. & Gandek, B. (1993) *SF-36 Health Survey: Manual and Interpretation Guide*, The Health Institute, New England Medical Center, Boston.
- World Health Organization and Expert Committee on Diabetes (1985) *Diabetes Mellitus. Report of a WHO Study Group*, Technical Report Series, no. 727, pp. 1–113.

Figure 1.
The Correlation between CES-D Scores and the Interaction between Ethnicity and the SF-36 Physical Functioning Subscale Scores.

Figure 2.
The Correlation between CES-D Scores and the Interaction between Ethnicity and the SF-36 Bodily Pain Subscale Scores.

Figure 3.
The Correlation between CES-D Scores and the Interaction between Ethnicity and the SF-36 General Health Subscale Scores.

Figure 4.
The Correlation between CES-D Scores and the Interaction between Ethnicity and the SF-36
Vitality Subscale Scores.

Figure 5.
The Correlation between CES-D Scores and the Interaction between Ethnicity and the SF-36 Role-Emotional Functioning Subscale Scores.

Table 1
Participants' Characteristics and Descriptive Statistics by Ethnicity and Combined Sample for Sex, Marital Status, and Education Level

Characteristics	Native Hawaiians		Filipinos		Japanese		Mixed-ethnic ancestry		Combined	
	N	%	N	%	N	%	N	%	N	%
Total	94	50	30	16	35	18	31	16	190	100
Sex										
Male	46	49	13	43	18	51	14	45	91	48
Female	48	51	17	57	17	49	17	55	99	52
Marital status										
Never married	15	16	2	7	4	11	1	3	22	12
Currently married	56	60	21	70	26	74	23	74	126	67
Disrupted marital	22	24	7	23	5	14	7	23	41	21
Education level										
Non-high school	16	19	14	48	6	17	10	33	46	25
High school/GED	55	63	11	38	18	51	10	33	94	52
Some college/tech./voc.	13	15	1	3	7	20	6	20	27	15
College degree	3	4	3	10	4	12	4	14	14	8

Note: No significant differences were observed across ethnic groups on the above factors based on χ^2 analyses. Because there were cells with an expected count less than five in χ^2 analysis of education level by ethnic groups, logistic fit analysis was done with education level as a continuous variable to further examine the association between education level and ethnic groups.

Table 2
Descriptive Statistics by Ethnicity and Combined Sample for Age, HbA1c Values, CES-D, LSNS, and SF-36 Subscales

Characteristics	Native Hawaiians			Filipinos			Japanese			Mixed-ethnic ancestry			Combined		
	N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD
Age	94	54.5 _b	11.9	30	63.6 _a	12.3	35	64.7 _a	11.9	31	61.9 _a	14.6	190	59.0	13.2
HbA1c values	94	7.7 _a	2.0	30	6.9 _{a+b}	1.8	35	6.7 _b	1.4	31	7.2 _{a+b}	1.8	190	7.3	1.9
CES-D scores	85	7.4	5.9	30	9.2	7.9	35	4.9	7.0	30	8.1	7.0	180	7.3	6.8
LSNS scores	85	9.0	4.3	30	9.4	3.2	35	9.4	3.7	30	9.9	4.2	180	9.3	4.0
SF-36 subscales															
PF	85	78.1	27.9	30	70.5	27.9	35	82.3	21.1	30	76.5	25.8	180	77.4	26.4
RP	85	78.8	36.3	30	69.2	43.4	34	77.9	38.8	30	69.2	41.6	179	75.4	38.8
RE	85	83.1	33.2	30	78.9	40.6	34	85.3	36.0	30	83.3	32.5	179	82.9	34.7
SF	85	83.1	22.1	30	77.9	24.1	35	89.3	17.5	30	80.8	20.2	180	83.1	21.5
BP	85	71.8	26.2	30	63.2	25.3	35	75.1	20.1	30	74.8	23.9	180	71.5	24.7
VT	85	70.4	18.4	30	66.5	19.8	35	70.1	16.7	30	66.3	24.6	180	69.0	19.4
GH	85	64.3	17.9	30	64.7	21.0	35	65.1	16.7	30	61.4	21.3	180	64.0	18.7
HT	84	2.5	1.0	30	2.9	1.0	35	2.9	0.63	30	2.6	1.0	179	2.7	0.9

Note: Means with different subscripts differ significantly at $p < 0.05$ by Tukey–Kramer HSD analysis. Higher scores on the SF-36 subscales (range 0–100) indicate better health-related quality of life. Higher scores on the CES-D (range 0–60) indicate more depressive symptoms. Lower scores on the LSNS (range 6–30) indicate better social support. Combined = combined sample; HbA1c = hemoglobin A1c; CES-D = Center for Epidemiological Studies—Depression Scale; LSNS=Lubben Social Network Scale; PF=Physical Functioning; RP = Role-Physical Functioning; RE = Role-Emotional Functioning; SF=Social Functioning; BP=Bodily Pain; VT=Vitality; GH=General Health; and HT = Health Transition.

Table 3
Internal Consistency (Cronbach's Alphas) for CES-D, LSNS, and the SF-36 Subscales

Samples	CES-D	LSNS	SF-36 subscales						
			PF	RP	BP	GH	VT	SF	RE
Combined sample	0.81	0.75	0.93	0.92	0.88	0.74	0.81	0.63	0.88
Native Hawaiian	0.72	0.80	0.95	0.91	0.88	0.69	0.81	0.72	0.86
Filipino	0.88	0.58	0.92	0.94	0.89	0.81	0.68	0.48	0.98
Japanese	0.86	0.78	0.91	0.94	0.85	0.73	0.81	0.62	1.0
Mixed-ethnic ancestry	0.84	0.69	0.91	0.91	0.90	0.77	0.87	0.42	0.71

CES-D = Center for Epidemiological Studies—Depression Scale; LSNS = Lubben Social Network Scale; PF = Physical Functioning; RP = Role-Physical Functioning; BP = Bodily Pain; GH = General Health; VT = Vitality; SF = Social Functioning; and RE = Role-Emotional Functioning.