Is Self-Efficacy Associated With Diabetes Self-Management Across Race/Ethnicity and Health Literacy?

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OBJECTIVE — Although prior research demonstrated that improving diabetes self-efficacy can improve self-management behavior, little is known about the applicability of this research across race/ethnicity and health literacy levels. We examined the relationship between diabetes self-efficacy and self-management behavior in an urban, diverse, low-income population with a high prevalence of limited health literacy.

RESEARCH DESIGN AND METHODS — We administered an oral questionnaire in Spanish and English to patients with type 2 diabetes at two primary care clinics at a public hospital. We measured self-efficacy, health literacy, and self-management behaviors using established instruments. We performed multivariate regressions to explore the associations between self-efficacy and self-management, adjusting for clinical and demographic factors. We tested for interactions between self-efficacy, race/ethnicity, and health literacy on self-management.

RESULTS — The study participants were ethnically diverse (18% Asian/Pacific Islander, 25% African American, 42% Latino/a, and 15% white), and 52% had limited health literacy (short version of the Test of Functional Health Literacy in Adults score <23). Diabetes self-efficacy was associated with four of the five self-management domains ($P < 0.01$). After adjustment, with each 10% increase in self-efficacy score, patients were more likely to report optimal diet (0.14 day more per week), exercise (0.09 day more per week), self-monitoring of blood glucose (odds ratio 1.16), and foot care (1.22), but not medication adherence (1.10, $P = 0.40$). The associations between self-efficacy and self-management were consistent across race/ethnicity and health literacy levels.

CONCLUSIONS — Self-efficacy was associated with self-management behaviors in this vulnerable population, across both race/ethnicity and health literacy levels. However, the magnitude of the associations suggests that, among diverse populations, further study of the determinants of and barriers to self-management is warranted. Policy efforts should be focused on expanding the reach of self-management interventions to include ethnically diverse populations across the spectrum of health literacy.

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Type 2 diabetes is one of the most common diseases in the U.S., affecting >16 million individuals (1). Diabetes disproportionately affects low-income and racial/ethnic minorities (2), and there is an urgent need to improve quality of care and lower rates of avoidable complications for these populations (3). Patients with diabetes are expected to perform daily self-management activities to help avoid diabetes-related morbidity and mortality. Self-management is a cornerstone of diabetes care, and it is believed that improving patient self-efficacy is a critical pathway to improved self-management.

The concept of self-efficacy is based on social cognitive theory, which describes the interaction between behavioral, personal, and environmental factors in health and chronic disease. The theory of self-efficacy proposes that patients' confidence in their ability to perform health behaviors influences which behaviors they will engage in (4–6). Because diabetes self-management incorporates behavioral, personal, and environmental factors into daily performance of recommended activities, the concept of self-efficacy is relevant for improving self-management. Among highly selected patients, self-efficacy has been shown to be important for appropriate self-management for many chronic health conditions (7–10), and, in diabetes, the research demonstrates mixed results for interventions that attempt to improve self-management behavior through improved self-efficacy (11–17).

Although a few recent studies have addressed selected racial/ethnic minority populations (18,19), little is known about the applicability of self-efficacy research to ethnically diverse and low-income patients with diabetes. In these populations, access barriers (20), costs of treatment (21), and cultural beliefs (22) may be key determinants of self-management behavior. To the extent that these factors contribute to high rates of failed attempts and/or lack of modeling of successful behaviors, they may also contribute to lower self-efficacy.

Within this patient population, individuals with limited health literacy may be especially vulnerable to these experiences. A growing body of research demonstrates that limited health literacy, a prevalent problem in vulnerable populations, is independently associated with poor self-rated health (23,24), higher utilization of services (25–28), fewer preventive services (29,30), and worse glycemic control and more diabetes com-

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Abbreviations: SMBG, self-monitoring of blood glucose; s-TOFHLA, short version of the Test of Functional Health Literacy in Adults.

A table elsewhere in this issue shows conventional and Système International (SI) units and conversion factors for many substances.

plications (31). Therefore, self-efficacy may be a relevant determinant of self-management behaviors among populations with limited health literacy (32–35).

We sought to determine whether diabetes self-efficacy was associated with recommended self-management behaviors in an urban, diverse population with a high prevalence of limited health literacy. Further, we examined whether a relationship between self-efficacy and self-management varied by health literacy score or race/ethnicity. Results from this study could inform future interventions to improve diabetes outcomes among ethnically diverse patients and those with limited health literacy (3).

RESEARCH DESIGN AND METHODS

— The methods for this study have been described in more detail in previous publications (31,36). This study of adults with type 2 diabetes was based in two primary care clinics at San Francisco General Hospital, staffed by University of California, San Francisco, attending faculty and residents. At the time of the study, the clinics did not have a disease-management system in place, but there were diabetes educators available for individual patient consultations.

We identified potential research subjects using the hospital system clinical and administrative database. The database contains laboratory, radiology, billing, use, and demographic information for patients who used the San Francisco city and county public health system in the 3 years preceding the study. Patients were eligible if they were >30 years, spoke English or Spanish, and had type 2 diabetes, controlled or uncontrolled, with or without complications (all ICD-9 codes of 250.X0 or 250.X2). Patients had to have at least two visits to the same physician in one of the participating clinics, the first visit within 12 months, and another within 6 months, of the interview date. We excluded patients with any documented diagnosis of end-stage renal disease, psychotic disorder, dementia, or blindness, because these conditions could interfere with interview completion and accurate health literacy assessment (37). To ensure that patients identified from the database reflected the inclusion and exclusion criteria, we provided primary care physicians (n = 89) with a list of their eligible patients and asked them to indicate additional patients to be excluded.

Bilingual trained interviewers enrolled all eligible English- or Spanish-speaking patients who attended a clinic appointment over a 6-month period of time, between June and December 2000. After informed consent was obtained from each participant, an oral questionnaire was administered in English or Spanish. Each part of the instrument was translated into Spanish and back-translated into English until concordance in meaning was attained. The Human Subjects Committee of University of California, San Francisco, approved the protocol.

Measures

We adapted a previously published, validated diabetes self-efficacy scale (38) that used eight items with 4-point Likert-type responses from "1 = not at all sure" to "4 = very sure." For each item patients rated their confidence in their ability to perform a recommended self-care routine. These items addressed diabetes-specific domains such as confidence in self-monitoring of blood glucose (SMBG), as well as general health domains such as confidence in ability to get medical attention and take care of health. We summed the responses to obtain an overall self-efficacy score, and for ease of interpretation, we transformed the score to a 100-point scale with a higher score representing greater self-efficacy.

To measure diabetes self-management, we used The Summary of Diabetes Self-Care Activities Questionnaire (39,40) that assesses the frequency with which a patient followed a diabetes routine over the prior 7 days in five domains: diet, exercise, SMBG, foot care, and medication adherence. For diet and exercise, patients reported the number of days in the past week that they followed the recommended diet or exercised at least 20 min, respectively. For foot care, we asked participants how often they checked their feet for cuts and sores and dichotomized the answers into "daily" and "less than daily" based on American Diabetes Association guidelines. Similarly, for SMBG, we asked patients how often they checked their blood glucose level and dichotomized the answers into "at least daily" and "less than daily" SMBG. For medication adherence, we asked patients how many of their diabetes pills they missed in the last 7 days. Because the majority of patients reported optimal medication adherence, we had few responses across the range of adherence. Therefore, we dichotomized responses into "perfect adherence" or "less-than-perfect adherence."

We asked each participant to report his or her race/ethnicity from the following choices: Asian or Pacific Islander, black or African American, Latino/a or Hispanic, white/Anglo, Native American, multiethnic, or other. To measure health literacy, we used the abbreviated form of the short version of the Test of Functional Health Literacy in Adults (s-TOFHLA), Spanish or English version (41). The abbreviated s-TOFHLA is a 36-item timed reading comprehension test that uses the modified Cloze procedure; every fifth to seventh word in a passage is omitted and four multiple choice options are provided. The abbreviated s-TOFHLA contains two health care passages, the first selected from instructions for preparation for an upper gastrointestinal tract radiograph series (Gunning-Fog Index readability grade 4.3) and the second from the patient's "Rights and Responsibilities" section of a Medicaid application (Gunning-Fog Index readability grade 10.4). The abbreviated s-TOFHLA is scored on a 0–36 scale. Using established convention, we categorized patients as having inadequate health literacy if the s-TOFHLA score was between 0 and 16, marginal health literacy if it was between 17 and 22, and adequate health literacy if it was between 23 and 36 (42).

Analysis

To assess the self-efficacy scale, we measured internal consistency–reliability by calculating the Cronbach α (43) for the overall sample and for the four most frequent racial/ethnic groups. We omitted Native American (n = 2), multiethnic (n = 6), and other (n = 11) ethnicity categories from the stratified α calculations because of the small number of respondents. We also calculated the Cronbach α among those with adequate versus less-than-adequate health literacy. In calculating the α by health literacy, we grouped marginal health literacy participants in the less-than-adequate literacy group because of the small number of marginal literacy participants, as prior investigators have done (44).

Because the self-management domains tend not to be correlated with each other within individuals (40,45), we analyzed the relationship between self-efficacy and each self-management domain separately. First, we created univariate models for the association of self-efficacy and each self-management outcome. Diet and exercise were continuous variables; therefore, we performed an unadjusted linear regression of a 10-point increase in self-efficacy score on the frequency of following a diabetic diet or frequency of exercise in the prior week. We used a univariate logistic regression to calculate an unadjusted odds ratio for the association of self-efficacy score and performance of recommended SMBG, foot care, and medication adherence.

Next, to address potential confounders, we adjusted the self-efficacy–self-management models for other correlates of self-management. To control for disease-related variability in self-management, we tested clinical characteristics such as duration of diabetes, medication regimen, and presence of complications in multivariate models. To further refine our model, we tested demographic characteristics such as sex and income as potential covariates in a similar fashion. When factors were significantly associated with more than one self-management domain, we included them in the model. For consistency, we included the same covariates in the multivariate analysis of each domain of self-management.

Third, after obtaining a disease-adjusted model for the self-efficacy–self-management associations, we forced race/ethnicity into the model to adjust for race/ethnicity-associated confounders and to assess whether race/ethnicity was independently associated with self-management. Specifically, we included four groups: Asian/Pacific Islander, African American, Hispanic, and white/non-Hispanic. We omitted Native American (n = 2), multiethnic (n = 6), and other (n = 11) ethnicity categories from the multivariate analysis because of the small number of respondents, which reduced our sample by 19 respondents.

Finally, we included health literacy score, as a continuous variable, in the multivariate models because of its potential to confound the self-efficacy–self-management associations (31). The final multivariate models incorporated the main predictor, self-efficacy, as well as significant diabetes-related factors, race/ethnicity, and health literacy, on each self-management outcome. We assessed model fit for the linear regression models by checking for normality of residuals, linearity of continuous variables, and evidence of violation of constant variance. Similarly, for the logistic models, we applied the Hosmer-Lemeshow goodness-of-fit test. We also tested for two-way interactions between self-efficacy and race/ethnicity and self-efficacy and health literacy on the five self-management outcomes.

RESULTS — Eight hundred fifty-eight patients were identified by the San Francisco General Hospital clinical database as potentially eligible for the study. Of these, 142 were subsequently ineligible because their primary care physician informed us that the patient was not in his or her panel (n = 10); did not have type 2 diabetes (n = 25); did not speak English or Spanish fluently (n = 28); had moved out of the area (n = 35); had a psychiatric condition, e.g., dementia, psychosis, or mental retardation (n = 23); had died (n = 1); or was identified as ineligible by the physician (n = 20). Of the 716 remaining eligible patients, 261 did not make a primary care visit during the enrollment period. All remaining 455 patients were approached at the time of a clinic appointment. Of these, 36 refused to participate or were excluded because they were too ill to participate (n = 9) or were acutely intoxicated (n = 2), and 6 were excluded because they had poor visual acuity (≥20/50). Thus, 413 patients completed the questionnaire. For 408 of the 413 patients at least one HbA_{1c} value was available in the San Francisco General Hospital database; these patients comprised our study sample. Patients who refused to participate and patients who were not interviewed by virtue of not attending a clinic appointment during the enrollment period were more likely than study subjects to be younger and male, but were not different in terms of race/ethnicity or language.

The study participants (n = 408) were ethnically diverse. Seventy-five (18%) were Asian/Pacific Islander, 100 (25%) were African American, 165 (40%) were Hispanic, and 51 (12%) were white/non-Hispanic. They had low income and were predominantly uninsured or publicly insured (Table 1; 198 (48.5%) had adequate health literacy (s-TOFHLA score >22), 54 (13.3%) marginal health literacy, and 156 (38.3%) inadequate health literacy.

The mean self-efficacy score for the overall sample was 74 of 100 (SD 18). The mean self-efficacy scores did not differ significantly across race/ethnicity or literacy levels (Table 2). The standardized Cronbach α for the scale was 0.78, and the scale had similar internal consistency–reliability across race/ethnicity and health literacy level (Table 2).

The proportion of patients who reported optimal self-management over the prior week varied by domain: 33% reported optimal diet adherence, 35% reported exercising 4 or more days in the prior week; 63% reported that they checked their feet daily for cuts and sores, 54% performed daily SMBG, and 64% reported missing no medication doses in the prior 7 days.

In the univariate analysis, we found an association between increasing self-efficacy score and self-management with regard to diet, exercise, SMBG, and foot care. We did not observe an association between self-efficacy and medication adherence (Table 3, model A). When we adjusted the univariate models for disease-related factors, the relationships between self-efficacy and the self-management outcomes did not change (Table 3, model B). Next, we adjusted for race/ethnicity as well as disease characteristics, and the self-efficacy–self-management associations persisted (Table 3, model C). Our final multivariate model included disease characteristics, race/ethnicity, and health

Table 1—*Patient characteristics*

	Total
n	408
Age (years)	58.1 ± 11.4
Ethnicity	
Asian/Pacific Islander	75 (18)
African American	100 (25)
Hispanic	165 (40)
White/non-Hispanic	51 (12)
Native American	2 (0.5)
Multiethnic	6 (1.5)
Other	11 (3)
Household annual income <$20,000	379 (93)
Years with diabetes	9.5 ± 8.0
Treatment regimen	
Diet alone	23 (6)
Oral hypoglycemic alone	223 (54)
Insulin alone	49 (12)
Insulin and oral hypoglycemic	113 (28)
Received diabetes education	318 (78)
Health literacy	
Inadequate (s-TOFHLA score 0–16)	156 (38.25)
Marginal (s-TOFHLA score 17–22)	54 (13.25)
Adequate (s-TOFHLA score 23–36)	198 (48.5)
Language	
Spanish	148 (36)
English	260 (64)

Data are means ± SD or n (%).

Table 2—*Self-efficacy scale performance*

	Self-efficacy score	Standardized Cronbach α
Overall	74 ± 18 (16–100)	0.78
Ethnicity		
Asian/Pacific Islander	76 ± 18 (29–100)	0.76
African American	82 ± 15 (29–100)	0.80
Hispanic	67 ± 18 (16–100)	0.73
White/non-Hispanic	75 ± 15 (33–100)	0.71
Health literacy		
Inadequate/marginal	73 ± 19 (16–100)	0.78
Adequate	74 ± 17 (29–100)	0.76

Data are means ± SD (range) unless otherwise indicated.

literacy score as covariates, and, again, patients with a higher self-efficacy score were more likely to report optimal diet, exercise, SMBG, and foot care but not medication adherence (Table 3, model D). Using the final multivariate model, with each 10% increase in self-efficacy score, patients were more likely to report optimal diet (0.14 day more per week), exercise (0.09 day more per week), SMBG (increased odds of daily SMBG by 16%), and foot care (increased odds of daily foot care by 22%). Neither sex nor low-income status was associated with self-management (not shown). We did not find significant interactions between self-efficacy and race/ethnicity or self-efficacy and health literacy on the self-management outcomes, but we did see a trend toward improved medication adherence with higher self-efficacy scores among African-American and white participants (*P* value for interaction 0.08).

CONCLUSIONS— We found that, in our diverse sample, self-efficacy was significantly associated with diet, exercise, SMBG, and foot care. When viewed in the context of long-term diabetes management, these incremental differences in self-management behaviors are clinically significant. The diabetes self-efficacy scale from this study performed well overall and across race/ethnicity and health literacy, with internal consistency–reliability scores within the accepted range for psychological measures (46). Even when adjusted for strong clinical predictors of self-management, such as insulin use and duration of diabetes, the relationship between self-efficacy and diabetes self-management remained. Therefore, self-efficacy is independently associated with disparate self-management behaviors. Furthermore, our race/ethnicity-adjusted analysis showed strikingly similar self-efficacy–self-management associations, suggesting that in our sample, race/ethnicity-related predictors of self-management function through mechanisms other than self-efficacy.

We also investigated whether the relationship between self-efficacy and self-management behaviors was influenced by health literacy. Adjusting for health literacy does not alter the self-efficacy–self-management associations: we conclude that carefully designed self-management interventions that target self-efficacy may be effective in populations with limited health literacy, as suggested by recent studies (35,44,47,48).

We did not find an association between self-efficacy and medication adherence. Other diabetes-related factors such as adverse medication effects and complexity of regimen as well as system-related factors such as costs and access are known determinants of medication adherence (21,49) that may supersede self-efficacy among this population. Alternatively, investigators have noted that self-report may not accurately measure medication adherence (50), which may have affected our results. Because medication adherence has been shown to be associated with glycemic control (51,52), more detailed studies should address barriers to medication adherence across diverse populations.

Although the associations between our measure of self-efficacy and self-management in this study were consistent and statistically significant, the modest effect sizes we found underscore the importance of further study of self-efficacy and self-management among vulnerable groups with diabetes. In disadvantaged populations, a variety of experiences and barriers may undermine self-management performance, including comorbid conditions such as depression or chronic pain (53–55), patient-physician communication problems (45,56), and economic barriers such as the cost of glucose test strips or medications (20,21,55,57). Moreover, in low-income neighborhoods, external barriers, such as lack of safe space to exercise (58) and the scarce availability of recommended fresh foods (59,60), may limit patients' abilities to follow lifestyle recommendations. We cannot determine whether such experiences and barriers would affect self-management independent of self-efficacy. In addition, because the self-efficacy instrument we used does not specifically address such factors, our self-efficacy scores may not detect the extent to which these experiences or barriers may influence diabetes self-efficacy, which may, in part, explain the modest effect sizes we observed. Nevertheless, the consistency of

Table 3—*Association between self-efficacy score and self-management outcomes*

Model	Diet coefficient*	Exercise coefficient*	SMBG OR*	Foot care OR*	Medication OR*
A. Unadjusted	0.16 (0.072–0.24)	0.11 (0.026–0.19)	1.18 (1.06–1.33)	1.23 (1.13–1.43)	1.04 (0.93–1.17), NS
B. Adjusted for diabetes factors†	0.14 (0.06–0.23)	0.09 (0.015–0.18)	1.16 (1.03–1.31)	1.22 (1.10–1.41)	1.10 (0.94–1.20), NS
C. Adjusted for above and race/ethnicity‡	0.15 (0.065–0.23)	0.09 (0.011–0.18)	1.15 (1.10–1.42)	1.24 (1.04–1.33)	1.05 (0.94–1.20), NS
D. Final model: adjusted for above and health literacy§	0.16 (0.075–0.24)	0.10 (0.020–0.19)	1.14 (1.04–1.33)	1.27 (1.13–1.45)	1.08 (0.96–1.22), NS

Sequential models with addition of significant covariates are shown. All *P* values are <0.05 except where indicated by NS. *Regression coefficients/odds ratios (ORs) for a 10-point increase in the 0- to 100-point self-efficacy scale. †Adjusted for duration of diabetes and insulin use. ‡Adjusted for duration of diabetes, insulin use, and race/ethnicity. §Adjusted for duration of diabetes, insulin use, race/ethnicity, and literacy score.

the self-efficacy–self-management associations attests to the importance of self-efficacy within the context of these other issues in vulnerable groups.

Our study has several additional limitations. First, although a debate exists as to the utility of disease-specific versus global self-efficacy instruments (61), we elected to use a disease-specific measure. Investigators have measured diabetes self-efficacy with disparate instruments ranging from a single item to in-depth cognitive interviews (62–69). Because of the variety of self-efficacy measures and analytic strategies in the published literature, we cannot accurately compare the effect sizes for the self-efficacy–self-management associations we found to those found in other studies. Second, we measured diabetes self-management behaviors by self-report. Although self-report provides an imperfect estimate of health behavior, it represents the most common method of health behavior measurement (69). Because we assessed each domain of self-management with a single item, our results should be interpreted with caution. Although we cannot exclude the possibility of differential mis-measurement (due to social desirability or culturally specific interpretations of questions by race/ethnicity or literacy), the consistency of the relationships across these subgroups makes measurement bias less likely. Finally, although we conceptualized self-efficacy as a predictor of self-management based on prior intervention studies (5,11,12,14–16,18,62), given the cross-sectional study design we cannot determine that the self-efficacy–self-management relationship was causal. Because successful performance of self-management behavior could improve self-efficacy over time, it is likely that there is a reciprocal relationship between these constructs that requires further prospective investigation.

The consistency of the self-efficacy–self-management relationships across self-management domains in our sample suggests that self-efficacy constitutes a useful intervention target in vulnerable populations. However, because of the numerous barriers to effective self-management that these patients face, interventions must address self-efficacy within the context of the patients' environment. In addition, to increase the effectiveness of diabetes self-management interventions, the dimensions that contribute to self-efficacy and its development over time should be explored in prospective studies. Finally, policy should be focused on expanding the reach of diabetes self-management interventions to include racial/ethnically diverse populations across the spectrum of health literacy.

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