Personal-Model Beliefs and Social-Environmental Barriers Related to Diabetes Self-Management

RUSSELL E. GLASGOW, PHD
SARAH E. HAMPSON, PHD
LISA A. STRYCKER, BA
LAURIE RUGGIERO, PHD

OBJECTIVE — The specific aims of the present study were to report on the level of personal beliefs and social and environmental barriers across different regimen areas and patient subgroups and on the relationship of personal models and perceived barriers to the level of self-management.

RESEARCH DESIGN AND METHODS — This study focused on several issues related to personal models (representations of illness) and perceived barriers to diabetes self-management among a large heterogeneous survey sample of 2,056 adults throughout the U.S.

RESULTS — Respondents felt that diabetes was a serious disease and that their self-management activities will control their diabetes and reduce the likelihood of long-term complications. Most frequently reported barriers were related to dietary adherence, followed by exercise and glucose testing barriers. Both personal models and barriers significantly predicted level of self-management in all three regimen areas studied (diet, exercise, and glucose testing) after controlling for the influence of demographic and medical history factors. Regimen-specific models and barriers proved to be stronger predictors than more global measures. Differences on personal models and barriers were observed among different patient groups (e.g., age, health insurance, and insulin-taking status). Possible reasons for these differences and implications for intervention and future research are discussed.

CONCLUSIONS — Both the personal-model and barriers scales had good internal consistency and predicted variance in each of the self-management variables after controlling for demographic and medical history factors. These brief self-report personal-model scales demonstrated good internal reliability and were as predictive of self-management as the lengthier interview-based measures in previous studies. The assessment of the treatment effectiveness component of personal models may be sufficient for most clinical purposes.

Numerous studies have documented the difficulty of diabetes regimen adherence (1,2) and explored psychosocial factors related to self-management. Unfortunately, the majority of these studies suffer from one or more of the following methodological limitations: failure to use theory or conceptual models to guide selection of measures; use of unvalidated or idiosyncratic measures of unknown reliability; use of small or unrepresentative samples; and failure to control for the influence of demographic and medical history factors when studying the relationship between psychosocial factors and self-management (3–5).

As part of a large-scale survey research project (6), we explored two important personal and interpersonal factors potentially related to diabetes self-management. We included a measure of both the patient's "internal environment," specifically personal-model cognitions about diabetes and its treatment (7), and social-environmental barriers to self-management (8). In our conceptual model, these two factors are considered to be among the most important factors influencing diabetes care (Fig. 1) (2,9).

Personal models are patients' representations of their illness, including disease-related beliefs, emotions, knowledge, and experiences. These representations guide the processing of incoming information and subsequent disease-related behaviors such as self-management and patient-provider interactions (10). Studies of personal models for both chronic and acute diseases have identified five components: beliefs about symptoms, disease course, consequences, cause, and cure (for acute diseases) or treatment effectiveness (for chronic diseases). In diabetes, the treatment-effectiveness component and, to a lesser extent, beliefs about disease seriousness have been prospectively predictive of dietary behavior and physical activity (7).

Personal models, particularly beliefs about treatment effectiveness, appear to act as important personal barriers or facilitators to diabetes self-management. It has been argued that diabetes research in general has focused too exclusively on personal characteristics (e.g., knowledge, beliefs) and not enough on environmental, social, and cultural factors (2,4,5). In the present study, we investigated both personal barriers, in the form of personal models, and interpersonal barriers. We were interested in both general and regimen-area specific (e.g., dietary self-management) barriers to self-management. We have previously found such barriers to predict diabetes self-management in both type I and type II diabetic samples (8,11).

The specific aims of the present study were to report on the level of personal beliefs and social and environmental barriers across different regimen areas and patient subgroups and on the relationship of personal models and perceived barriers to the level of self-management.

RESEARCH DESIGN AND METHODS

— Individuals with diabetes were identified via a list available through a nationwide marketing research group. Those in the marketing sample were representative of the national diabetes pop-

From the Oregon Research Institute (R.E.G., L.A.S.), Eugene, Oregon; the Department of Psychology (S.E.H.), University of Surrey, Guildford, U.K.; and the Department of Psychology (L.R.), University of Rhode Island, Kingston, Rhode Island.

Address correspondence and reprint requests to Russell E. Glasgow, PhD, Oregon Research Institute, 1715 Franklin Blvd., Eugene, OR 97403-1983. E-mail: russ@ori.org.

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ulation, based on the following characteristics: income, population density, geographic region, age, and number of people in the household. A total of 2,800 individuals were sent surveys. This included 1,300 individuals who were representative of the U.S. population with diabetes of the above characteristics and an additional 1,500 insulin-using individuals recruited to obtain a sufficient sample of type I patients to permit the examination of subgroup differences.

The survey included questions on sociodemographic and health status characteristics, as well as psychosocial factors and diabetes self-management. To maximize accurate disclosure, a self-administered questionnaire was mailed through an independent marketing group not linked to the individual's medical care. Individuals were informed that their responses would remain confidential. A raffle for monetary prizes was used as an incentive for participation. The final recruitment rate was 73.4% for a sample of 2,056 participants, including 988 from the representative sample and 1,068 from the augmented sample of individuals taking insulin.

The sample was generally older (mean age, 59 years), female (62%), married (62%), and Caucasian (95%), although there were over 100 African-American respondents. The majority had been diagnosed >10 years, 14% had type I, 56% were insulin-treated type II diabetic patients, and 30% were type II patients not on insulin. The survey methodology and sample are described in greater detail by Ruggiero et al. (6).

Personal models

Beliefs about the seriousness of diabetes were assessed using a four-item scale. Beliefs about treatment effectiveness were measured separately for each of the regimen areas (e.g., physical activity, glucose testing, recording glucose test results, taking medication, checking feet, eating low-fat foods). There were two personal model items for each regimen area: "How *important* do you believe _____ is for controlling your diabetes?" and "How *likely* do you think it is that _____ will prevent future complications?" Participants responded on a five-point rating scale (1, not at all important or not at all likely; 5, very important or very likely). Within each regimen area, scores on the importance and prevention dimensions were averaged to produce a regimen-specific effectiveness score.

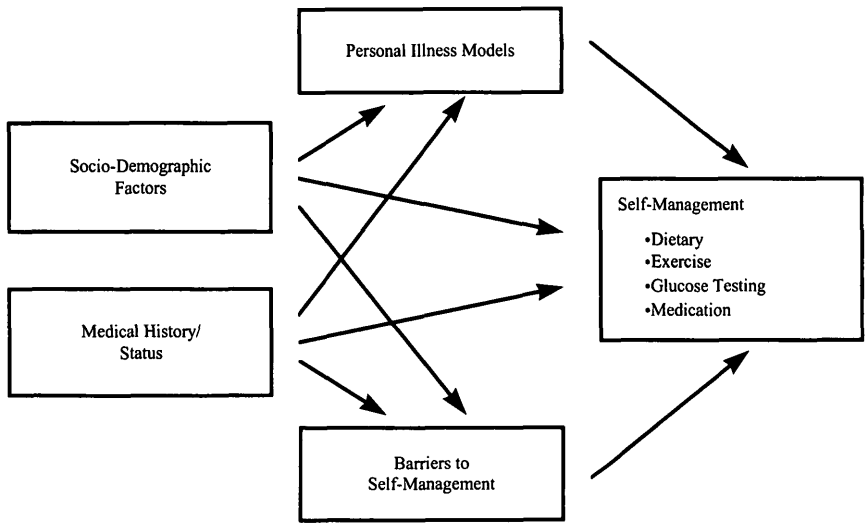

Figure 1—*Model of key variables influencing diabetes self-management.*

Barriers measures

Two instruments derived from our previous research were used. A 31-item scale assessed challenges to glucose testing, regular physical activity, healthy low-fat eating, and diabetes medication (7 items per area). There were also four general barriers (e.g., traveling, unexpected events) that produce challenges across areas. Following procedures of Glasgow et al. (11), a summary score was calculated by averaging scores across the six-point frequency of occurrence scales ("never" to "daily"). Given the difficulty of dietary adherence, compared with other diabetes self-management areas, an additional 27-item questionnaire used by Glasgow et al. (12) assessed more detailed barriers to dietary self-management. This instrument produced both an overall dietary-barriers score and three subscores of barriers when eating away from home, eating at home, and purchasing food. Subjects responded to each item on an eight-point frequency of occurrence scale, ranging from 0 ("does not apply to me") to 7 ("daily").

Self-management

The survey collected information on self-management behaviors for each of four daily self-management behaviors: diet, exercise, medication use, and glucose self-testing. The level of self-management was assessed using a composite score of the following items: *1*) the number of the past 7 days individuals performed the behavior of interest; 2) the number of recommended behaviors performed in the past 7 days (five-point Likert scale from none to all); and 3) the frequency with which the behavior of interest was performed as recommended in the past month (five-point Likert scale from never to always). Each item was standardized using *T* scores (50 ± 10 [mean ± SD]), then all of the items that were available for each behavior were averaged to calculate the composite score for that behavior. Items for the scale were drawn from the Summary of Diabetes Self-Care (13).

Analyses

Coefficient alphas were computed to assess scale reliability, and Pearson correlations were used to assess relations among scales. A series of hierarchical multiple regression analyses were performed to predict the level of self-management in each of the three regimen areas: glucose testing, exercise, and diet. (Because self-management scores for medication-taking were heavily skewed toward maximum reported compliance and because of the substantially smaller sample size, we did not model medication management.) To ensure that psychosocial predictors accounted for unique variance, we first entered the demographic and medical history variables of sex, age, race (Caucasian or African-American), education, insulin use, and diabetes duration. On the second step, one set of regression analyses entered the total personal-model and total barriers summary scores and another set entered the relevant personal-model and barriers summary scores for that specific regimen area. (We

Table 1—*Personal-model treatment effectiveness ratings by regimen area* (n = *1,985*)

Item	
Taking your diabetes medication as prescribed	4.52 ± 1.01
Not eating many sweets	4.21 ± 0.89
Testing your glucose level regularly	4.09 ± 1.04
Checking your feet regularly	4.07 ± 1.02
Drinking little or no alcohol	4.05 ± 1.28
Following a low-fat high-fiber eating plan	3.94 ± 0.99
Exercising regularly	3.91 ± 0.98
Not smoking	3.89 ± 1.49
Following a low-calorie diet	3.85 ± 1.07
Recording your glucose test results regularly	3.82 ± 1.20
Managing sick days as recommended	3.60 ± 1.48

Data are means ± SE. Means are determined from a five-point scale where 3 = fairly, 4 = very, and 5 = extremely effective.

also explored the possibility that two-way interactions between various demographic and psychosocial factors [e.g., sex by treatment effectiveness] would further enhance prediction. In no case did such terms increase the R^2 by >0.01, thus because of space limitations, these results are not included in this report.)

RESULTS

Basic descriptive information

Personal-model variables. Beliefs about the seriousness of diabetes, measured by a four-item scale (alpha, 0.75), indicated that participants viewed their diabetes as fairly serious (3.1 ± 0.9). The two items measuring treatment effectiveness for specific regimen areas were highly correlated for all areas (correlations of 0.67–0.84). Therefore, the mean of these items was used to assess regimen-specific treatment effectiveness. A total treatment effectiveness score was also calculated as the mean of all 11 regimen-specific scores (alpha, 0.89). Treatment effectiveness scores for each of the 11 regimen areas are shown in Table 1. The highest-rated self-management activities reflect the widely held belief that diabetes management is primarily a question of taking the prescribed medications and avoiding sweets. Low-fat, low-calorie, and high-fiber eating plans were lower in perceived effectiveness, as were exercise and not smoking.

Barriers. On the general self-management barriers scale, scores ranged from 1.1 to 3.5 with a mean of 1.9 ("once per month"). As can be seen in Table 2, average scores on the diet subscale were higher than those for the other regimen areas (2.55 vs. <2.0 for all others). Barriers to exercise were next most frequent, and barriers to glucose testing and medication taking were both relatively infrequent (~1.5, between "very rarely or never" and "once per month"). The internal consistency of the barriers scale was fairly high, both for the overall scale (alpha, 0.92) and for the four subscales (alpha, 0.76–0.80).

Dietary barriers. The average item score

Table 2—*Overall results on general and dietary self-management barriers scale*

Scale or subscale	Items	Mean ± SD	Alpha coefficient
Total scale	31	1.90 ± 0.66	0.92
Diet subscale	7	2.55 ± 0.49	0.76
Exercise subscale	7	1.97 ± 0.62	0.76
Glucose testing subscale	7	1.56 ± 0.46	0.80
Medication taking subscale	7	1.45 ± 0.49	0.76
Total dietary barriers	27	2.72 ± 0.57	0.92
At home subscale	7	3.02 ± 0.52	0.79
Food purchasing	8	2.70 ± 0.57	0.75
Away from home	5	2.29 ± 0.57	0.70

Table 3—*Total barrier and personal model summary scores by patient characteristics*

Patient characteristic or level	*n*	Total barrier score (mean ± SD)	*P* value	Treatment effectiveness summary score (mean ± SD)	*P* value
Sex			0.0031		0.0000
Male	757	1.80 ± 1.00*		3.91 ± 0.79*	
Female	1,225	1.94 ± 1.03†		4.13 ± 0.72†	
Age (years)			0.0000		0.0000
<40	235	2.54 ± 1.19*		3.83 ± 0.86*	
40–49	258	2.24 ± 1.09†		3.98 ± 0.77*†	
50–59	399	1.97 ± 0.91‡		4.06 ± 0.74†	
60–69	582	1.73 ± 0.90‖		4.08 ± 0.74†	
70+	476	1.49 ± 0.89¶		4.10 ± 0.71†	
Education			0.0096		0.0000
High school or less	1,030	1.83 ± 1.06*		4.11 ± 0.76*	
College or more	906	1.95 ± 0.95†		3.97 ± 0.75†	
Race/ethnicity			0.0002		0.0000
Caucasian	1,370	1.89 ± 1.01†		4.04 ± 0.76†	
African-American	103	1.68 ± 1.20*		4.23 ± 0.70*	
Type of health insurance			0.0000		0.0005
Private	862	1.82 ± 0.93*		4.05 ± 0.72†	
MCO	482	2.01 ± 1.00†		3.97 ± 0.76†	
Government	458	1.70 ± 0.98*		4.13 ± 0.76*	
None	95	2.09 ± 1.19†		3.96 ± 0.82*†	
Type of Diabetes			0.0000		0.0000
Type I	254	2.32 ± 1.03‡		3.91 ± 0.77*	
Overall type II	1,578	1.79 ± 0.96		4.08 ± 0.72	
Insulin-treated	1,025	1.90 ± 0.97†		4.19 ± 0.64†	
Pills	464	1.62 ± 0.89*		3.94 ± 0.77†	
Diet only	89	1.48 ± 1.01*		3.64 ± 0.92‡	

Groups sharing the same footnote symbol are not significantly different; groups having different footnote symbols are significantly different as assessed by Tukey HSD (honestly significant difference) tests following a significant overall analysis of variance result. *P* values were determined by one-way analysis of variance. MCO, managed care organization.

on the overall dietary barriers instrument was 2.7 (between "once and twice per month"). The most frequent dietary barriers (Table 2) were encountered at home (3.0, "once per week"), followed by food purchasing (2.7) and away from home (2.3). The internal consistency of the dietary barriers scale was high, for both the overall scale (alpha, 0.92) and the four subscales (alpha, 0.70–0.79).

Barriers and models by patient characteristics. Table 3 summarizes the results on overall barriers and personal-model summary scores by participant subgroups. Greater total barrier scores were significantly associated with being female, younger, more highly educated, Caucasian, having type I diabetes, and having managed care or no insurance. Higher treatment effectiveness scores were given by female subjects, older people, less-educated respondents, African-Americans, individuals with government-sponsored health insurance, and patients with type II diabetes on insulin.

Prediction of self-management

Table 4 presents the results of hierarchical multiple regression analyses to predict each of the three self-management summary scores from *1*) demographic and medical history variables and 2) total treatment effectiveness, total barriers, and a patient's perception of the seriousness of diabetes. Demographic variables accounted for a small but significant amount of the variance in glucose testing, diet, and exercise self-care; R^2 values ranged from 0.01 to 0.08. The addition of summary scores for total barriers, total treatment effectiveness, and general perception of diabetes seriousness significantly improved the prediction of each of the self-care outcomes, increasing R^2 values to 0.11 for exercise, to 0.17 for glucose testing, and to 0.20 for diet.

Table 5 presents the results of regression analyses to predict each of the self-management summary scores from *1*) demographic and medical history variables and 2) regimen-specific treatment effectiveness, regimen-specific barriers, and perceptions of the seriousness of diabetes. Regimen-specific barrier and treatment effectiveness subscales also significantly improved prediction of each of the dependent variables beyond that explained by demographic factors. Using regimen-specific barriers and treatment effectiveness ratings boosted R^2 values to 0.20 for exercise, to 0.26 for glucose testing, and to 0.24 for diet.

Table 4—*Results of hierarchical regression using general regimen variables to predict diabetes self-management*

Dependent variable, step, and independent variable	Multiple *R*	Significance of improvement in R^2	*r*	Partial correlation	Significance of beta
Dietary intake					
I. All barriers scale					
Step 1	0.20	0.00			
Age			0.16	0.18	0.00
Insulin-taking			−0.08	−0.10	0.00
Sex			0.05	0.06	0.01
Step 2	0.45	0.00			
Total treatment effectiveness			0.39	0.37	0.00
Total barriers			−0.16	−0.14	0.00
Seriousness			0.02	−0.06	0.00
II. Diet scale					
Step 1	0.20	0.00			
Age			0.16	0.18	0.00
Insulin-taking			−0.08	−0.10	0.00
Sex			0.05	0.06	0.02
Step 2	0.46	0.00			
Total treatment effectiveness			0.39	0.36	0.00
Total diet barriers			−0.22	−0.17	0.00
Seriousness			0.02	−0.04	0.08
Physical activity					
Step 1	0.10	0.01			
Education			0.06	0.06	0.00
Age			0.04	0.06	0.01
Step 2	0.33	0.00			
Total treatment effectiveness			0.26	0.30	0.00
Seriousness			−0.07	−0.13	0.00
Total barriers			−0.11	−0.09	0.00
Glucose testing					
Step 1	0.28	0.00			
Insulin-taking			−0.19	−0.20	0.00
Age			0.17	0.20	0.00
Education			0.04	0.07	0.01
Step 2	0.41	0.00			
Total treatment effectiveness			0.31	0.26	0.00
Total barriers			−0.13	−0.11	0.00
Seriousness			0.08	0.02	0.33

CONCLUSIONS — Both the personal-model and barriers scales had good internal consistency and predicted variance in each of the self-management variables after controlling for demographic and medical history factors. The amount of variance accounted for was modest to substantial (for diet-specific measures) and varied across regimen area. In all cases, these psychosocial and behavioral factors were much stronger predictors than was a combination of demographic and other patient characteristics. The regimen-specific measures were stronger predictors than were more general measures of personal models and barriers, as would be predicted by social cognitive theory (14). An implication of this finding is that it may only be necessary to assess personal models and barriers for specific self-management areas in which the patient has difficulty or on which the patient is currently focusing, thus substan-

Table 5—*Results of hierarchical regression using regimen-specific variables to predict diabetes self-management*

Dependent variable, step, and independent variable	Multiple R	Significance of improvement in R^2	r	Partial correlation	Significance of beta
Dietary intake					
I. All barriers scale					
Step 1	0.20	0.00			
Age			0.16	0.18	0.00
Insulin-taking			−0.08	−0.11	0.00
Sex			0.05	0.06	0.01
Step 2	0.49	0.00			
Diet treatment effectiveness			0.39	0.34	0.00
Diet barriers			−0.30	−0.24	0.00
Seriousness			0.02	−0.05	0.03
II. Diet scale					
Step 1	0.21	0.00			
Age			0.16	0.18	0.00
Insulin-taking			−0.08	−0.11	0.00
Sex			0.05	0.05	0.02
Step 2	0.53	0.00			
Diet treatment effectiveness			0.39	0.31	0.00
Diet barrier subscales					
General			−0.36	−0.21	0.00
Purchasing			−0.21	0.04	0.08
Away			−0.26	−0.03	0.10
At home			−0.24	0.03	0.15
Seriousness			0.02	−0.01	0.69
Physical activity					
Step 1	0.10	0.01			
Education			0.06	0.06	0.00
Age			0.04	0.06	0.02
Step 2	0.45	0.00			
Physical activity treatment effectiveness			0.41	0.43	0.00
Seriousness			−0.07	−0.10	0.00
Physical activity barriers			−0.09	−0.07	0.00
Glucose testing					
Step 1	0.28	0.00			
Insulin-taking			−0.19	−0.20	0.00
Age			0.17	0.20	0.00
Education			0.04	0.07	0.01
Step 2	0.51	0.00			
Glucose treatment effectiveness			0.44	0.39	0.00
Glucose barriers			−0.15	−0.12	0.00
Seriousness			0.08	0.01	0.60

tially shortening assessment time.

Of the three psychosocial constructs (barriers, treatment effectiveness, and seriousness), treatment effectiveness was consistently the strongest predictor of self-management across the three regimen areas. This finding extends previous research in several ways. These brief self-report personal-model scales demonstrated good internal reliability and were as predictive of self-management as the lengthier interview-based measures in previous studies (7,10). This study also demonstrated the utility of assessing regimen-specific treatment effectiveness, which was equally or more predictive than the total score. In contrast, beliefs about the seriousness of one's diabetes were not predictive of any aspect of self-management. The assessment of the treatment effectiveness component of personal models may be sufficient for most clinical purposes.

The barriers scales were not quite as predictive as in our previous research (8,11). Although partial correlations of 0.07–0.24 (unadjusted correlations of 0.11–0.36) are important from a public health perspective and have implications for population-wide interventions, it is possible that the explanatory power of barriers could be enhanced. From a stress-coping perspective (15), one would expect that combining information on barriers (stress and/or environment) with assessment of patients' coping or problem-solving skills would enhance prediction.

From a systems perspective, one would also expect that combining information on resources or support available would enhance prediction. Knowing about the barriers one faces is important, but also having information about resources available (and their coping ability) should enhance understanding and prediction. A final limitation of the barriers scale used in this study may be that it assessed the frequency of different barriers but not the level of difficulty posed by each barrier. A frequent barrier may interfere with self-management only if it is perceived as difficult. These issues should be investigated in future research.

Subgroup findings indicate that patients who were more likely to have more barriers to self-care and less strong beliefs in treatment effectiveness were younger individuals who were more educated and had type I diabetes. These patients may be worthwhile to target to increase beliefs in treatment effectiveness and provide problem-solving skills.

This study has both strengths and weaknesses. The size and heterogeneity of the sample from around the U.S., including a moderate-sized African-American sample, is one of the greatest strengths. The use of hierarchical regressions, which control for demographic and medical factors, is a conservative approach that enhances confidence in conclusions about the psychosocial measures (5). A third strength is that we considered two potentially important psychosocial factors in combination rather than in isolation. Research that simultaneously investi-

gates several conceptually important factors and research based upon more comprehensive theories of behavior (4,5,16) is needed in diabetes. The primary limitations of this study are its concurrent cross-sectional nature and the reliance on self-report measures of self-management. Both of these limitations are due to expense and inherent limitations of conducting this type of national sample mail survey and still attempting to produce a high response rate. We note that previous research (13) has validated the self-report composites used in this study against more objective and "state of the art" behavioral measures.

The primary challenge for future behavioral assessment research in diabetes is to demonstrate that these measures are useful for intervention design and planning. For example, does treatment informed by and tailored on a patient's personal models and barriers produce superior outcomes to that which is not? Our measures should be useful in guiding interventions and improving patients' lives, not just in correlating with other measures.

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