Association of Health Literacy With Self-Management Behavior in Patients With Diabetes

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Limited health literacy, common in patients with diabetes, has been associated with worse diabetes outcomes (1–4). While patients with limited health literacy have worse diabetes knowledge (2–5), knowledge does not necessarily predict outcomes (6–8). Because diabetes requires extensive self-care, differences in self-management behaviors may be a key contributor to the disparity in outcomes. In fact, low health literacy has been associated with poor self-care in other chronic illnesses (9,10). However, no study has examined the relationship between health literacy and self-management behaviors in patients with diabetes. In addition, studies have not assessed whether diabetes education, which is widely recommended, is effective in improving self-management behaviors in patients with limited health literacy. The objectives of our study were to examine the association of health literacy with self-management behaviors in patients with diabetes and to determine whether diabetes education improves self-management behaviors in patients with limited compared with adequate health literacy. Understanding the relationship between health literacy and self-management behaviors should enhance efforts to improve diabetes outcomes.

RESEARCH DESIGN AND METHODS

— We conducted a prospective observational study of patients enrolled in diabetes education classes at the Hospital of the University of Pennsylvania. The classes consist of an individual meeting with a diabetes educator and three weekly 3-h group classes and are recognized by the American Diabetes Association (11). All patients ≥18 years of age present for a regularly scheduled diabetes class were recruited. Patients who did not speak English were excluded. Participants were compensated with a $10 gift certificate. Written consent was obtained, and the institutional review board approved this study.

At the first class, diabetes educators administered a questionnaire regarding demographic information, social support (12), and diabetes history. Health literacy was measured with the short-form Test of Functional Health Literacy in Adults, a 36-item timed reading comprehension test shown to be a valid measure of functional health literacy (13). Patients scoring <22 on the 36-point scale were considered to have inadequate or marginal health literacy. Self-management behaviors were assessed using the Summary of Diabetes Self-Care Activities Measure (SDSCA), a valid self-report measure that assesses how often self-care activities (diet, exercise, self-glucose monitoring, foot care, and medication adherence) are performed in a given week (14). Other outcome measures included knowledge, using the Diabetes Knowledge Questionnaire (DKQ) (15), and glycemic control, which was assessed by obtaining HbA_{1c} levels from medical records. Follow-up questionnaires (DKQ, SDSCA) were administered by telephone interview. Baseline differences in demographics and DKQ and SDSCA scores between literacy groups were compared with *t* tests and χ^2 tests. The DKQ and SDSCA baseline and 3-month values within literacy groups were compared with paired *t* tests. Nonparametric tests were also performed; there were no differences in results. Effect sizes, which summarize the magnitude of differences between and within groups relative to the pooled SD, were computed. Effect sizes are standardly interpreted as 0.20 = small effect, 0.50 = moderate effect, and 0.80 = large effect. ANCOVA compared 3-month outcomes adjusting for baseline values, age, years of education, and income. A second ANCOVA omitted education as a covariate; the results were nearly identical.

RESULTS

— Fifty-eight percent (n = 92) of eligible class attendees participated. The primary language for all participants was English. There were no differences between participants and nonparticipants in age, sex, race, education, or HbA_{1c} ($P > 0.05$). Of the participants, 77% had adequate and 23% had limited (8% marginal, 15% inadequate) health literacy. Lower literacy was associated with being older, having less education, lower annual income, and more self-reported diabetes complications ($P < 0.05$) (Table 1). There were no differences in years with diabetes or level of social support received from family or friends. At baseline, patients with adequate health literacy had better knowledge of diabetes ($P = 0.014$), but health literacy was not associated with HbA_{1c} or self-management behaviors.

Follow-up data were available for 77 patients (84%), of whom 78% had ade-

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Abbreviations: DKQ, Diabetes Knowledge Questionnaire; SDSCA, Summary of Diabetes Self-Care Activities Measure.

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

Table 1—*Characteristics of study participants before and after diabetes education*

Baseline characteristics	Adequate health literacy	Limited health literacy	*P*
n	71	21	—
Age (mean years)	58.2	67.2	0.001
Sex (% women)	58.6	81.0	0.061
Race (%)	—	—	0.379
White	36.2	20	—
Black	60.0	75	—
Other	2.9	5	—
Education (mean years)	14.0	10.2	<0.001
Income <$20,000 (%)	36.5	78.9	0.001
Commercial insurance (%)	57.8	10.5	0.002
Type of diabetes	—	—	0.42
Type 1 (%)	10.6	4.8	—
Type 2 (%)	89.4	95.2	—
Diabetes duration (mean years)	7.8	9.3	0.586
Prior diabetes education (%)	17.6	28.6	0.276
Self-reported diabetes complications (%)	32.4	47.6	0.042
HbA_{1c}*	8.4	8.2	0.683
Diabetes knowledge score†	17.2	13.9	0.014
Self-management behaviors‡			
Diet	4.3	4.7	0.472
Exercise	2.7	2.3	0.524
Foot care	4.0	4.7	0.203
Medication adherence	6.0	6.6	0.244
Self-glucose monitoring	4.1	5.1	0.195
At 3 months§	*n* = 61 (mean ± SE)	*n* = 16 (mean ± SE)	*P*
HbA_{1c}*	7.1 ± 0.19	7.0 ± 0.42	0.086
Diabetes knowledge†	19.9 ± 0.51	18.0 ± 1.08	<0.000
Self-management behaviors‡			
Diet	5.2 ± 0.22	6.0 ± 0.47	<0.000
Exercise	2.8 ± 0.31	2.1 ± 0.67	0.022
Foot care	5.0 ± 0.27	5.1 ± 0.58	0.001
Medication adherence	6.9 ± 0.2	6.4 ± 0.42	0.751
Self-glucose monitoring	5.4 ± 0.24	6.6 ± 0.54	0.002

*All HbA_{1c} values were from the same laboratory. †The diabetes knowledge score is based on the number of correctly answered items out of 24. ‡The self-management behavior values are based on number of days of adherence out of the last 7 days. §The 3-month values are adjusted for age, income, years of education, and baseline values using ANCOVA.

quate and 22% had limited (8% marginal, 14% inadequate) health literacy. There were no differences between responders and nonresponders in health literacy or other baseline characteristics. At 3 months, paired *t* tests showed improvement in HbA_{1c}, knowledge, and self-management behaviors for both literacy groups. For the adequate literacy group, effect sizes ranged from 0.53 for HbA_{1c} and diabetes knowledge to 0.13 for exercise. For the limited literacy group, effect sizes ranged from 0.49 for HbA_{1c} to 0.13 for exercise. Adjusted 3-month outcomes showed no significant differences between the groups in HbA_{1c}, but patients with adequate health literacy had higher knowledge scores (Table 1). Patients with adequate health literacy exercised more, but patients with lower literacy reported better adherence to diet, self-glucose monitoring, and foot care.

CONCLUSIONS — In this study, diabetes education was effective in improving self-management, diabetes knowledge, and glycemic control for patients with adequate and limited health literacy. These findings are encouraging from a clinical and public health perspective. Expanding educational programs for patients with low literacy may reduce disparities in diabetes outcomes related to literacy status.

An unexpected finding was that at 3 months, the adequate health literacy group performed worse in certain self-management behaviors compared with the limited literacy group. This may be related to baseline diabetes education status, as more patients in the limited literacy group had previously received diabetes education (28.6 vs. 17.6%, $P = 0.276$). Reinforcement of previously taught behaviors may have led to greater improvement in the limited literacy group.

Our study has several limitations. First, our study participants were a sample of patients already enrolled in diabetes education and may not be representative of all diabetic patients (16,17). Second, our sample was small. Lack of power or chance may explain why patients with ad-

equate health literacy performed worse in certain self-management behaviors. Third, the attrition rate was relatively high (16%) and was higher for patients with limited (24%) compared with adequate (14%) literacy. In addition, the prevalence of low literacy was lower than that observed in other primary care settings (1–5). Finally, given the short duration of follow-up, we cannot ascertain whether the improvements in self-management behaviors are sustainable or whether any differences in behavior over time between literacy groups may explain the association of limited health literacy with worse outcomes, even when adjusting for diabetes education (3). It should also be noted that we used the construct of "health literacy." As recently pointed out by the Institute of Medicine, health literacy, as measured by the short-form Test of Functional Health Literacy in Adults, assesses reading comprehension skills, which is just one component of literacy (18).

In summary, patients with limited health literacy benefit from diabetes education and show similar or better improvement in self-management behaviors compared with those with adequate health literacy. Future efforts should focus on improving educational outreach for patients with low literacy skills.

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