Effect of Intensive Glycemic Lowering on Health-Related Quality of Life in Type 2 Diabetes

ACCORD trial

OBJECTIVE—To compare the effect of intensive versus standard glycemic control strategies on health-related quality of life (HRQL) in a substudy of the Action to Control Cardiovascular Risk in Diabetes (ACCORD) trial.

RESEARCH DESIGN AND METHODS—A randomly selected subsample of 2,053 ACCORD participants enrolled in the HRQL substudy was assessed at baseline and 12-, 36-, and 48-month visits. HRQL assessment included general health status (the 36-Item Short Form Health Survey [SF-36]), diabetes symptoms (the Diabetes Symptom Distress Checklist), depression (Patient Health Questionnaire [PHQ]-9), and treatment satisfaction (Diabetes Treatment Satisfaction Questionnaire [DTSQ]). Repeated-measures ANOVA models were used to estimate change in HRQL outcomes by treatment group over 48 months adjusting for model covariates. The effects of early discontinuation of the ACCORD intensive glycemic control arm on study results were explored.

RESULTS—A total of 1,956 (95%) completed the self-report HRQL instrument(s) at baseline. The intensive arm had a larger decrease in SF-36 physical health component score than the standard arm (−1.6 vs. −1.1, P = 0.0345). Treatment satisfaction (DTSQ) showed larger improvement with intensive than standard (P = 0.0004). There were no differences in mean scores of the Diabetes Symptom Checklist and PHQ-9. Effects of participant transition following discontinuation of the intensive arm on HRQL were not significant.

CONCLUSIONS—The ACCORD trial strategy of intensive glycemic control did not lead to benefits in HRQL and was associated with modest improvement in diabetes treatment satisfaction. Thus patient acceptability was apparently not compromised with intensive and complex interventions such as those used in ACCORD.

Diabetes Care 34:807–812, 2011

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Received 8 October 2010 and accepted 21 January 2011.

DOI: 10.2337/dc10-1926.

A complete list of the ACCORD trial investigators can be found in the Supplementary Data.
of glycemic control strategy on patient appraisal of general health, symptoms, depression, and treatment satisfaction.

**RESEARCH DESIGN AND METHODS**—The ACCORD glycemia treatment trial methods and design have been previously reported (16,17). Briefly, this was a randomized controlled clinical trial of treatment for type 2 diabetes, conducted in 77 clinical centers across the U.S. and Canada. Central laboratory measures of HbA1c were used to reflect level of glycemic control. A total of 10,251 participants were recruited and randomly assigned to either intensive glycemia management with a target HbA1c <6.0% or standard glycemia management with a target HbA1c between 7.0 and 7.9%. To be eligible for ACCORD, participants had to have a confirmed diagnosis of type 2 diabetes; an HbA1c between ≥7.5 and 11%; and be either 1) age 40–79 years with cardiovascular disease or 2) age 55–79 years with anatomical evidence of significant atherosclerosis, albuminuria, left ventricular hypertrophy, or at least two additional risk factors for CVD (dyslipidemia, hypertension, current status as a smoker, or obesity). Key exclusion criteria included frequent or recent serious hypoglycemic events, unwillingness to do home glucose monitoring or inject insulin, a BMI of more than 45 kg/m², a serum creatinine level of greater than 1.5 mg/dL, or other serious illness. The ACCORD study protocols were approved by the institutional review board or ethics committee at each ACCORD site or coordinating center as well as by an ethics review panel at the National Heart, Lung, and Blood Institute. All patients provided written informed consent.

**HRQL substudy**

The ACCORD HRQL study was designed to detect meaningful change from baseline in HRQL associated with glycemic control treatment arms. Specifically, the prespecified objectives were to test potential treatment benefits from intensive glycemic versus standard therapy in terms of less symptom distress, improved general health (physical and psychological wellbeing), and improved treatment satisfaction. The impact of the intervention on depression, based on data from the Patient Health Questionnaire (PHQ-9), is reported here as a secondary outcome.

Of the 10,251 patients enrolled in the ACCORD trial, a randomly selected subsample of 2,053 was enrolled in the ACCORD HRQL substudy. Of these, $N = 1,024$ had been randomized to intensive glycemic control and $N = 1,029$ to standard control.

**Study outcomes and covariates**

Four distinct measures, general health, treatment satisfaction, diabetes-related symptoms, and depression, were used to measure HRQL. Data were collected by self-report questionnaire administered at the ACCORD baseline, 12-, 36-, and 48-month visits. General health status was assessed using the 36-Item Short Form Health Survey, Version 2 (SF-36) (19), where aggregate physical health (PH) and mental health (MH) component scores were calculated. The component scores are weighted combinations of individual items and have a general population norm of 50 and a standard deviation of 10, with higher scores representing better health. The PH component refers to ratings of limitations in physical, social, and role activities; severe bodily pain; fatigue; and self-rated health. The MH component refers to psychological distress, social and role disability as a result of emotional problems, and self-rated health.

A 60-item version of the Diabetes Symptoms Distress Checklist (DSC) (7) was used to assess the presence and severity (impact on functional status) of diabetes-related symptoms. Participants report whether or not they had experienced the given symptom or feeling and rate symptom distress on a scale of 0–4 (0 = not at all, 1 = somewhat, 2 = moderately, 3 = very much, 4 = extremely).

Satisfaction with diabetes treatment was assessed using the eight-item World Health Organization Diabetes Treatment Satisfaction Questionnaire (WHO-DTSQ), an authorized version identical to the DTSQ status version widely used in diabetes clinical trials (20). The DTSQ includes an overall six-item measure of satisfaction with the diabetes regimen with scores ranging from 0 to 36, with higher scores indicating higher satisfaction. For a subset of participants (ACCORD vanguard phase), only five satisfaction items were measured; therefore we converted the DTSQ score to a range from 0 to 100. In addition to the six-item measure, there were also two standard questions assessing perceived frequency of hyperglycemia and hypoglycemia ranging from 0 to 6, with higher scores indicating more frequent perception of high or low blood glucose.

Depression was assessed using the 9-item depression measure from the Patient Health Questionnaire (PHQ-9). The PHQ-9 is the self-report version of the PRIME-MD, a well-validated psychiatric diagnostic interview for use in primary care settings (18). Scores range from 0–27, and the score is treated as a continuous variable.

**Data analysis**

All statistical analyses were conducted using SAS software Version 9 (SAS Institute, Cary, NC). Statistical significance was defined as $P$ value <0.05. Descriptive analyses of baseline clinical and HRQL characteristics were used to assess the representativeness of the HRQL subsample in relation to the ACCORD study population and to illustrate successful randomization of the HRQL substudy participants. Baseline characteristics of the two study groups were compared using $X^2$ tests, $t$ tests, and Wilcoxon tests.

To examine the effects of glycemic control treatment arm before the end of the glycemia trial on study outcomes of general health, treatment satisfaction, diabetes-related symptoms, and depression, each outcome measure was considered in three separate sets of repeated-measures linear models. We used data up until 5 February 2008, when the ACCORD glycemia trial was stopped. Each set modeled the change in the HRQL measure, and each set included the following terms: glycemia intervention, secondary trial assignment, prior CVD at baseline, the baseline HRQL measure, time, and a time-by-glycemia interaction term. A first set, as specified in the protocol, included only these measures. The second set added age, race, and sex. The final set added the set of covariates listed above.

We report the overall test of the glycemia term across all visits. We visually examined the estimated change in HRQL measure across the three time points in plots. Because it is possible that intensive glucose control increases, decreases, or leaves unchanged patients’ HRQL, we used two-sided $P$ values to determine statistical significance as is conventional in clinical trial reports. Our prespecified $\alpha$-level was 0.05. Although no formal adjustments for multiple comparisons were made, given the number of tests performed we estimate the probability of finding at least one model with a $P$ value less than 0.05 to be 70.5%.

**Early discontinuation of ACCORD intensive glycemia treatment**

The glycemia intervention of ACCORD study was stopped early on 5 February 2008 because of higher mortality in the intensive group (21). All patients were
transitional to the standard glycemia-regimen and continued in the ACCORD blood-pressure and lipid studies for their planned durations of at least 4 years of follow-up. To assess potential effects of the transition to standard therapy on HRQL outcomes, we conducted an additional set of analyses including the HRQL data collected after the end of the glycemia trial. Not all participants had post-transition HRQL measures, and those that did have measures were at the months 36 and 48 visits. We added a term to the model to indicate whether the measure was post-transition and added an interaction term for post-transition and glycemia arm.

**RESULTS**

**Baseline sample characteristics**

Table 1 presents the characteristics of the 2,053 participants who were included in the ACCORD HRQL substudy. There were no statistically significant differences in any of the characteristics examined by study sample. Clinical status of the HRQL substudy group at baseline was a mean HbA1c of 8.3 ± 1%; means for weight and BMI were 94 kg and 32 kg/m², respectively, and the average duration of diabetes was 10 years (vs. 9 years in those not in the HRQL study, \( P = 0.0536 \)), with ∼37% already on an insulin treatment regimen at baseline. A comparison of Table 1 covariates on ACCORD treatment group status of intensive glycemia (goal HbA1c <6%) versus standard therapy (goal HbA1c 7.0–7.9%) found no statistically significant results (data not shown).

Among ACCORD HRQL study participants, the analytic sample included 1,956 (95%) who completed one or more instruments within the baseline HRQL assessments (974/1,024 for intensive glycemia, and 982/1,029 for standard therapy). Sample sizes available for repeated-measures analysis of the HRQL follow-up at 12, 36, and 48 months were \( N = 921, \) \( N = 549, \) and \( N = 208 \) for intensive treatment and \( N = 937, \) \( N = 583, \) and \( N = 208 \) for standard therapy.

Table 2 presents baseline HRQL scores by ACCORD glycemia treatment group status. At baseline, ACCORD HRQL study participants reported lower physical health (PH component score) than the general population norm of 50.0 (means = 38.0 and 37.4 per treatment group), whereas psychological well-being was similar to the general population norm of 50.0 reported by Ware et al. (19). HRQL study participants in the intensive treatment group had statistically significantly higher physical health component score mean (i.e., somewhat better HRQL) and lower (i.e., somewhat worse) MH component score mean than those assigned to standard therapy, although these differences were very small. The mean number of nonzero diabetes-related symptoms assessed on the Diabetes Symptoms Distress Checklist total symptoms reported in the intensive and standard glycemia treatment groups was 17.2 and 16.9, respectively, with a mean symptom distress rating of ∼1.5, or the midpoint in the scale between somewhat and moderately. For the purposes of this study, diabetes treatment satisfaction assessed with the DTSQ treatment satisfaction scale, transformed to a percentage scale (0 to 100), was 72.5 vs. 74.0 and for the single item frequency ratings was a mean of ∼1.3 for perceived hypoglycemia and 3.6 for perceived hyperglycemia.

Results for the general linear models for repeated measures for the HRQL study outcomes through the active glycemia intervention are presented in Table 3. The results from the prespecified analyses, adjusted only for trial assignment and stratification variables, did not vary substantially from the results from a fully adjusted model including a variety of baseline covariates. After controlling for baseline covariates, change in HRQL over the 48-month duration in-trial was statistically significant for the SF-36 PH component, and DTSQ treatment satisfaction scale. For physical health, the intensive glycemic control arm had a slight (0.5 point) reduction in mean PH component change score (i.e., lowered HRQL) relative to those in the standard treatment arm (∼1.6 vs. ∼1.1; \( P = 0.0345 \)). For treatment satisfaction, DTSQ scores were significantly higher (i.e., greater satisfaction) than baseline in both groups, with a larger improvement in satisfaction.
with the treatment regimen (2.4 points; \( P = 0.0004 \)) in the intensive arm. DTSQ single-item ratings of satisfaction with high and low blood glucose showed that participants in the intensive arm reported perceived improved (less) frequency of high blood glucose (−1.7 unit reduction from baseline, \( P < 0.0001 \)), but perceived frequency of hypoglycemia was increased (0.8 unit increase from baseline, \( P < 0.0001 \)).

Results for all time points grouped as pretransition and post-transition to the ACCORD standard glycemia-regimen and all data collected (not shown) revealed similar treatment group outcomes as the in-trial period results shown in Table 3, but with a somewhat larger improvement in mean DTSQ treatment satisfaction means in the intensive treatment group (pretransition: −0.8 vs. −0.8; post-transition: −0.8 vs. −1.2 for standard vs. intensive treatment groups, respectively). The difference between groups in the SF-36 PH and MH components was not statistically significant (\( P = 0.1279 \) and \( P = 0.1414 \), respectively). Group and transition (prepost) interactions for the HRQL outcomes were also tested, and none of the \( P \) values for interaction terms reached statistical significance.

**CONCLUSIONS**—The ACCORD trial included HRQL as a secondary objective to more fully understand the potential benefits of intensive glycemic control through the patient’s point of view. After baseline HRQL status and clinical covariates in repeated-measures analysis were controlled, the results obtained for change in HRQL over a 48-month observation period after randomization did not show meaningful benefit between intensive glycemic control as compared with standard glycemic control strategies in domains of general health, diabetes symptoms, or depression. The pattern of no intensive treatment benefit on HRQL is consistent with the results for the ACCORD main study (1) of lack of cardiovascular benefit from intensive glycemia treatment with a target of Hba1c <6%. There were no demonstrated effects upon MH simply from improved glycemic control in the intensive arm. Although there is some evidence in the literature of modest benefits to emotional wellbeing from improved glycemia, studies are mixed plausibly because of treatment variation and approach (22). In ACCORD both treatment arms had targets of improved glycemic control, with the intensive arm designed to achieve greater control albeit with potentially greater treatment complexity. Although the SF-36 PH component score was significantly different between groups, the absolute net difference of 0.5 units of change is trivial and well below a general threshold of ~3-5 points for a minimally important difference on these measures (19) and therefore clinically insignificant. The pattern of results indicates that for all HRQL study outcome measures considered, with the exception of treatment satisfaction (which had a trend toward increased satisfaction), there was a pattern of stability over time in scores for both treatment groups. The SF-36 PH and MH component scores were preplanned HRQL outcome measures in this study. A post hoc analysis of the eight individual SF-36 scale score means exploring the consistency of effects among the HRQL concepts that comprise the SF-36 component scores revealed no unusual or inconsistent influences on these summary component scores.

The finding of no decrement in treatment satisfaction, either when compared with those in standard treatment arm or over time, is notable because one source of reluctance in initiating intensive treatment regimens like the ACCORD intervention is reasonable concern over patient burden. The lack of decrement in subjective wellbeing particularly in the context of intensive glucose treatment may be related to several processes. There was increased access to providers, including both clinic visits and telephone contact in the intensive treatment arm. This may have increased perceived care quality and may have supported patient self-efficacy for managing diabetes. Patients' perception of optimal Hba1c control in the intensive control arm, which sought to lower Hba1c to <6%, may also have been important in this regard. Research on treatment satisfaction in diabetes has shown that having improved blood glucose or Hba1c levels is an important driver of satisfaction regardless of treatment intensity (23,24) and may influence patient appraisals of treatment effectiveness. Thus the results from this study add to the literature on treatment intensity, finding that patients may perceive intensive treatment as favorable. The finding that patients perceived hyperglycemia as a bigger problem than hypoglycemia may indicate the relative importance patients attach to hyperglycemia versus hypoglycemia.

The early stopping of the ACCORD intensive glycemic control arm resulted in the transition of the intensively treated participants to standard glycemic control. Analysis examining HRQL outcomes of data up to glycemia trial discontinuation on 5 February 2008 and all data through to final follow-up showed that results were highly similar pre- and post-transition. Death and trial inactivity were censoring events in this repeated-measures analysis by dictating the last valid HRQL assessment point entered into analysis (last observation carried forward). In the HRQL study sample there were a total of 78 deaths over the study period; 25 of these events resulted in no valuable HRQL information (all time points missing), in 44 events, HRQL baseline and 12-month information was possible to collect, and in nine events all but the 48-month HRQL assessment was possible to collect. We examined baseline status predictors of death or inactivity in the HRQL sample from standard demographic status, lifestyle, comorbidity, diabetes, and biomarker variables. Results found higher frequency of either death or inactivity (events) was associated with older age, being a current smoker, living alone,
Table 3: Results of repeated-measures analyses of HRQoL outcomes by study visit and change in score from baseline across all visits.

| Variable | Estimate | 95% CI | p Value |
|----------|----------|--------|---------|
| SF-36 Physical Component Score | 0.3 | (-0.2 to 0.3) | 0.3361 |
| SF-36 Mental Component Score | 1.4 | (1.2 to 1.7) | 0.0004 |
| DTSQ Total Score | 0.7 | (0.6 to 0.9) | 0.0001 |
| DTSQ Symptom Component | 1.4 | (1.4 to 1.6) | 0.1940 |
| DTSQ Treatment Component | 0.2 | (0.1 to 0.3) | 0.2051 |
| WHO-DTSQ | 0.9 | (0.9 to 1.5) | 0.0001 |
| PHQ-9 | 1.5 | (1.5 to 2.0) | 0.0001 |

In summary, this study demonstrated that no significant HRQoL benefits were observed in the ACCORD intensive glycemic control group compared to the standard glycemic control group. This result is consistent with the findings of the ACCORD trial, which also showed no significant differences in HRQoL between the two treatment groups. However, it is important to note that the results of this study should be interpreted with caution due to the limitations of the study design and sample size.
and that treatment acceptability is not a limiting factor in complex interventions such as ACCORD.

Acknowledgments—The ACCORD study was supported by grants (N01-HC-95178, N01-HC-95179, N01-HC-95180, N01-HC-95181, N01-HC-95182, N01-HC-95183, N01-HC-95184, IAA-Y1-HC-9035, and IAA-Y1-HC-1010) from the National Heart, Lung, and Blood Institute; by other components of the National Institutes of Health, including the National Institute of Diabetes and Digestive and Kidney Diseases, the National Institute on Aging, and the National Eye Institute; by the Centers for Disease Control and Prevention; and by General Clinical Research Centers.

The following companies provided study medications, equipment, or supplies: Abbott Laboratories, Amylin Pharmaceutical, AstraZeneca, Bayer HealthCare, Closer Healthcare, GlaxoSmithKline, King Pharmaceuticals, Merck, Novartis, Novo Nordisk, Omron Healthcare, sanofi-aventis, and Schering-Plough. R.T.A. is a consultant for Abbott Laboratories, Inc. D.G. is a consultant for Merck Inc. and serves as a DSMB member for Takeda Inc. J.-A.S.-H. is an investigator of clinical trials sponsored by Merck, GSK, Lilly and Abbott Laboratories through HealthPartners Research Foundation. R.C. serves as an investigator on clinical trials sponsored by Amylin, Abbott, Bayer, Duichi Sankyo, Dexcom, Edwards Lifesciences, Eli Lilly, Hygeia, Intarica, Johnson and Johnson/LifeScan, MannKind, Medtronic, Merck, Novo Nordisk, Quotient Diagnostics, ResMed, Roche, sanofi-aventis, Schering-Plough, Takeda, Valeritas; and serves as an Advisory Board Member for Abbott, Bayer, CelQuest, Eli Lilly, Novo Nordisk, and Roche. No other potential conflicts of interest relevant to this article were reported.

R.T.A. wrote the manuscript and researched data. K.M.V.N. researched data, contributed to discussion, and edited the manuscript. P.Z. researched data, contributed to discussion, and reviewed and edited the manuscript. M.K.A. contributed to discussion and edited the manuscript. D.L.S. researched data and reviewed and edited the manuscript. J.A.S.-H. contributed to discussion and reviewed and edited the manuscript. T.B. researched data and reviewed and edited the manuscript. R.C. contributed to discussion, and reviewed and edited the manuscript. P.J.O. researched data, contributed to discussion, and reviewed and edited the manuscript. A.S. contributed to discussion, co-wrote the manuscript, and reviewed and edited the manuscript. P.Z. researched data, contributed to discussion, and reviewed and edited the manuscript. M.D.S. contributed to discussion, researched data, and reviewed and edited the manuscript. A.S. contributed to discussion, and reviewed and edited the manuscript. M.F. contributed to discussion, and reviewed and edited the manuscript. T.B. contributed to discussion, and reviewed and edited the manuscript. K.M.V.N. researched data.

The authors thank Jane Waldeck, Pennsylvania State University College of Medicine, for help with preparing the manuscript.

References

1. Gerstein HC, Miller ME, Byington RP, et al.; Action to Control Cardiovascular Risk in Diabetes Study Group. Effects of intensive glucose lowering in type 2 diabetes. N Engl J Med 2008;358:2545–2559
2. Sullivan MD, Anderson RT, Aron D, et al.; ACCORD Study Group. Health-related quality of life and cost-effectiveness components of the Action to Control Cardiovascular Risk in Diabetes (ACCORD) trial: rationale and design. Am J Cardiol 2007;99(12A):901–1021
3. U.K. Prospective Diabetes Study Group. Quality of life in type 2 diabetic patients is affected by complications but not by intensive policies to improve blood glucose or blood pressure control (UKPDS 37). Diabetes Care 1999;22:1125–1136
4. Songer T. Disability in diabetes. In Diabetes in America. Harris MI, Ed. Washington, DC, U.S. Govt. Printing Office, 1995 (NIH publ. no. 95-1468)
5. Rubin RB, Peyrot M. Quality of life and diabetes. Diabetes Metab Rev 1999;15:205–218
6. Egede LE. Diabetes, major depression, and functional disability among U.S. adults. Diabetes Care 2004;27:421–428
7. Testa MA, Simonson DC. Health economic benefits and quality of life during improved glycemic control in patients with type 2 diabetes mellitus: a randomized, controlled, double-blind trial. JAMA 1998;280:1490–1496
8. Gulliford MC, Mahabir D. Relationship of health-related quality of life to symptom severity in diabetes mellitus: a study in Trinidad and Tobago. J Clin Epidemiol 1999;52:773–780
9. Goddijn PP, Bilo HJ, Feikens EJ, Groenier KH, van der Zee KL, Meysboom-de Jong B. Longitudinal study on glycemic control and quality of life in patients with Type 2 diabetes mellitus referred for intensified control. Diabet Med 1999;16:23–30
10. Cicchianowski PS, Katon WJ, Russo JE, Hirsch IB. The relationship of depressive symptoms to symptom reporting, self-care and glucose control in diabetes. Gen Hosp Psychiatry 2003;25:246–252
11. Currie CJ, Poole CD, Woelh A, et al. The health-related utility and health-related quality of life of hospital-treated subjects with type 1 or type 2 diabetes with particular reference to differing severity of peripheral neuropathy. Diabetologia 2006;49:2272–2280
12. Kovacs M, Iyengar S, Goldston D, Stewart J, Obrosky DS, Marsh J. Psychological functioning of children with insulin-dependent diabetes mellitus: a longitudinal study. J Pediatr Psychol 1990;15:619–632
13. Eaton WW, Armenian H, Gallo J, Pratt L, Ford DE. Depression and risk for onset of type II diabetes. A prospective population-based study. Diabetes Care 1996;19:1097–1102
14. Wikblad K, Leksell J, Wibell L. Health-related quality of life in relation to metabolic control and late complications in patients with insulin dependent diabetes mellitus. Qual Life Res 1996;5:123–130
15. Peyrot M, Rubin RR. Levels and risks of depression and anxiety symptomatology among diabetic adults. Diabetes Care 1997;20:585–590
16. Buse JB, Bigger JT, Byington RP, et al.; ACCORD Study Group. Action to Control Cardiovascular Risk in Diabetes (ACCORD) trial: design and methods. Am J Cardiol 2007;99(12A):21–33
17. Gerstein HC, Riddle MC, Kendall DM, et al.; ACCORD Study Group. Glycemia treatment strategies in the Action to Control Cardiovascular Risk in Diabetes (ACCORD) trial. Am J Cardiol 2007;99(12A):34–43
18. Spitzer RL, Kroenke K, Williams JB. Validation and utility of a self-report version PRIME-MD the PHQ primary care study. Primary Care Evaluation of Mental Disorders. Patients Health Questionnaire. JAMA 1999;282:1737–1744
19. Ware JE, Kosinski M, Dewey JE. How to Score Version Two of the SF-36 Health Survey. Lincoln, RI, QualityMetric, Inc., 2000
20. Bradley C. Diabetes treatment satisfaction questionnaire. In Handbook of Psychology and Diabetes: A Guide to Psychological Measurement in Diabetes Research and Practice. Chur, Switzerland, Harwood Academic, 1994, p. 111–132
21. Riddle MC, Ambrosius WT, Brillon DJ, et al.; Action to Control Cardiovascular Risk in Diabetes Investigators. Epidemiologic relationships between A1C and all-cause mortality during a median 3.4-year follow-up of glycemic treatment in the ACCORD trial. Diabetes Care 2010;33:983–990
22. Zhang X, Norris SL, Chowdhury FM, Gregg EW, Zhang P. The effects of interventions on health-related quality of life among persons with diabetes: a systematic review. Med Care 2007;45:820–834
23. Anderson RT, Girmian CJ, Pawaskar MD, et al. Diabetes Medication Satisfaction Tool: a focus on treatment regimens. Diabetes Care 2009;32:51–53
24. Peyrot M, Rubin RR. How does treatment satisfaction work? Modeling determinants of treatment satisfaction and preference. Diabetes Care 2009;32:1411–1417
25. Peyrot M, Rubin RR. Structure and correlates of diabetes-specific locus of control. Diabetes Care 1994;17:994–1001