Personality Correlates of Glycemic Control in Type 2 Diabetes

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OBJECTIVE — To determine whether traits of normal personality are associated with variations in glycemic control in patients with type 2 diabetes.

RESEARCH DESIGN AND METHODS — A longitudinal cohort study was conducted using data from 105 type 2 diabetic patients in a clinical trial of a stress management intervention. Before treatment assignment, patients completed the NEO Personality Inventory, Revised, which is a questionnaire inventory measuring 5 major domains of normal personality and 30 important traits that define these domains. Glycemic control was assessed by measures of HbA_{1c} and average blood glucose levels based on 7 days of self-monitoring at baseline and at 6 and 12 months. Relationships between personality traits and measures of glycemic control were examined by correlation and linear regression models that were adjusted for age, sex, race, duration of diabetes, medication status, and experimental treatment.

RESULTS — Lower average blood glucose values at baseline were associated with higher scores for the personality domain of neuroticism and several specific traits including anxiety, angry hostility, depression, self-consciousness, and vulnerability but were associated with lower scores for the trait of altruism. Results were similar for HbA_{1c} but were not as strong. Follow-up results were similar but were less consistent.

CONCLUSIONS — Personality traits may offer new insights into variations in glycemic control in patients with type 2 diabetes undergoing standard management. The relative tendency to experience fewer negative emotions and to focus on the needs of others instead of oneself could prove to be a risk factor for poor glycemic control.

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The Diabetes Control and Complications Trial and the U.K. Prospective Diabetes Study have shown that tight control of a patient's blood glucose levels can reduce, postpone, or perhaps prevent the costly microvascular complications of type 1 and type 2 diabetes (1–3). However, tremendous variability exists in patients' responses to programs of diabetes management, including regular glucose testing, controlled diet, exercise, and medication.

Because treatment requires constant adherence to a daily regimen of self-care behaviors, psychological factors may help to explain and predict clinical outcomes. We showed in previous studies that variations in personality traits related to curiosity and sociability could account for substantial proportions (up to 27%) of the variability in glycemic control assessed in school-aged children with type 1 diabetes (4–6). This observation has encouraged us to investigate a broader range of personality traits that may be related to blood glucose control in patients with diabetes.

A randomized clinical trial of a stress management intervention for patients with type 2 diabetes provided an opportunity to investigate the relationships between glycemic control and personality traits using an inventory (NEO Personality Inventory, Revised [NEO-PI-R]; Psychological Assessment Resources, Odessa, FL) that provides a comprehensive assessment of the multidimensional variations of normal personality (7). Measures of personality, demographic and health history variables, and measures of short- and long-term blood glucose control were obtained from the study sample before treatment randomization. Additional measures of glucose control were obtained from the follow-up data of the study, including measures 6 and 12 months after treatment. The goal of the present study was to assess the cross-sectional and prospective relationships between measures of personality traits and measures of glycemic control in patients with type 2 diabetes. This may provide new insight into the psychological factors that play a role in glycemic control and suggest new directions for improving the clinical management of diabetes.

RESEARCH DESIGN AND METHODS

Experimental design

The study used a longitudinal cohort design to determine the cross-sectional and prospective relationships between measures of personality domains and traits and measures of short- and long-term glycemic control. Regression analyses included statistical controls for other common predictors of blood glucose level in type 2 diabetes to eliminate their potential confounding effects.

Participants

The adult men and women in this study (n = 105) were participants in a year-long intervention study of the effects of stress management training on glycemic control. Volunteers were recruited by physician referrals and community advertisements placed in local newspapers and in Duke University Medical Center (Durham, NC) physician offices and clinics. All volunteers had type 2 diabetes but were not using

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Abbreviations: NEO-PI-R, NEO Personality Inventory, Revised; SMBG, self-monitoring of blood glucose.

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

Table 1—*The 5 personality domains and 30 facets represented by the NEO-PI-R inventory*

1. Neuroticism: anxiety, angry hostility, depression, self-consciousness, impulsivity, vulnerability
2. Extraversion: warmth, gregariousness, assertiveness, activity, excitement seeking, positive emotions
3. Openness: fantasy, aesthetics, feelings, actions, ideas, values
4. Agreeableness: trust, straightforwardness, altruism, compliance, modesty, tender-mindedness
5. Conscientiousness: competence, order, dutifulness, achievement striving, self-discipline, deliberation

insulin. None of the subjects had received treatment for psychiatric disorders or had taken psychoactive drugs, and all subjects had a personal physician or health provider who maintained responsibility for the participant's diabetes management during the 12-month course of the study.

The sample consisted of both men (56%) and women (44%) and included whites (87%), African-Americans (12%), and Asian-Americans (1%). Ages ranged from 31 to 82 years (means ± SD 56.9 ± 10.8). The duration of diabetes in sample patients ranged from 1 to 40 years (5.0 ± 6.3). Most participants (73%) were receiving medication for the treatment of their diabetes (44.3% sulfonylureas, 8.8% metformin, 0.9% precose, and 18.6% a combination of 2 or more drugs). The remainder (27%) were not taking medication.

Data collection procedures

Baseline data were collected in a single visit before randomized assignment to treatment condition. After giving informed consent, each participant provided a medical history and underwent a physical examination. A blood sample was drawn for measurement of HbA_{1c}. Each participant completed a battery of questionnaires, including the NEO-PI-R. Finally, participants were instructed in the use of a One Touch II blood glucose monitor (LifeScan, Milpitas, CA) for the self-measurement of blood glucose at home.

After the appointment, each person completed 7 days of self-monitoring of blood glucose (SMBG). Subjects were instructed to measure blood glucose 4 times daily (before each meal and before bed). The One Touch II monitor stored blood glucose readings in its memory along with the date and time of each measurement. After 7 days, the monitor was returned, and the glucose values were transferred from the monitor to a personal computer for data reduction and storage.

The intervention component of the parent study consisted of a series of 5 small-group classes held at weekly intervals. All classes included generic diabetes education presentations on the disease and its management (without detailed information on available treatments or specific treatment goals) that lasted 30–40 min. In addition, those individuals assigned to the stress management training condition received 60 min of instruction in the psychophysiology of stress and techniques for stress management, including a form of progressive muscle relaxation training using tape-recorded exercises. These participants were instructed to practice relaxation exercises twice daily and to use other stress management strategies as necessary.

At 6 and 12 months after behavioral treatment, study participants completed additional week-long periods of SMBG. They returned to the laboratory where recorded values were collected and a sample of blood was taken for assessment of HbA_{1c}.

Experimental variables

Glycemic control. Collected values from the 7 days of home SMBG were reduced to an average that represented short-term glycemic control. HbA_{1c} was measured with the IMx Boronate Affinity Method (Abbott Laboratories, Abbott Park, IL), and standardized HbA_{1c} (% HbA_{1c}) was used as an index of the time-averaged blood glucose concentration during the previous 12–16 weeks, which represented chronic glycemic control for the individual.

NEO-PI-R. The NEO-PI-R (Form S) was developed to operationally define the 5-factor model of personality, which represents the 5 basic dimensions that underlie the commonly accepted traits of normal personality (7). These 5 domains and the 6 facets or specific traits that are grouped in each domain are listed in Table 1. As this listing shows, the NEO-PI-R provides a comprehensive taxonomic framework for the study of normal personality traits. The inventory contains 240 descriptive statements that are completed by self-ratings on a 5-point scale and typically requires 30 min to complete. Raw scores for the personality domains and facets were used for regression analyses, and standardized T scores were calculated using adult mixed-sex norms for comparison of this patient sample with the general adult population.

Demographic and medical history data provided information on the age, race, and sex of each participant; duration of diabetes; and medication status (whether medications were used in the diabetes regimen). These variables were included in regression analyses so that potential confounding effects could be controlled statistically. Analyses of follow-up data also controlled for the effects of treatment group (stress management or education control).

Data analysis

Although this was an exploratory investigation, the evaluation of a large number of personality traits made the possibility of chance relationships (type 1 errors) an issue. To limit the overall number of statistical tests, the analysis proceeded in 3 stages. First, correlations of each NEO-PI-R domain and facet score with the baseline measures of SMBG and HbA_{1c} levels were determined. Significant correlations identified a subset of personality trait factors that were reanalyzed using multiple regression with statistical controls for the effects of age, race, sex, duration of diabetes, and medication status. These same traits were then examined in multiple regression analyses using measures of glycemic control at 6 and 12 months of follow-up to evaluate prospective associations. Statistical significance was declared when regression models revealed a P value <0.05.

RESULTS

— A total of 99 of the 105 patients completed SMBG. These subjects collected an average of 25.1 ± 4.9 measurements in 7 days. Average blood glucose levels ranged from 4.35 mmol/l (79 mg/dl) to 19.12 mmol/l (347 mg/dl) with a group mean equal to 7.99 ± 0.22 mmol/l [145 ± 49 mg/dl]). HbA_{1c} values ranged from 5.2 to 15.7% (7.8 ± 1.9%) compared with a laboratory reference range of 4.3–6.0% for healthy nondiabetic individuals. As expected, the measures of short- and long-term blood glucose control were highly correlated in this sample ($r = 0.87$, $P < 0.0001$).

Preliminary regression models tested the effects of age, race, sex, duration of diabetes, and medication status on the 2 measures of glycemic control. Although these covariate models significantly predicted both measures of glycemic control, only 2 factors (race and medication status) were independent predictors. African-American subjects in the sample had higher average blood glucose levels (2.20 mmol/l or 40 mg/dl) and HbA_{1c} levels (1.6%) than white subjects. Patients receiving diabetes medication had higher average blood glucose (1.60 mmol/l or 29 mg/dl) and HbA_{1c} (0.75%) levels than those who did not. Although age, sex, and duration of diabetes were not independently related to glycemic control, these factors were retained as covariates in the regression analyses of personality traits to control for any confounding influences they may have.

Regression analyses revealed several personality variables that were related to both short-term and chronic measures of glycemic control at baseline (Table 2). The domain of neuroticism and most of the personality traits within this domain, including anxiety, angry hostility, depression, self-consciousness, and vulnerability, were significantly related to average SMBG. Neuroticism, angry hostility, and vulnerability were also significant predictors of HbA_{1c} levels at baseline. In each analysis, the regression coefficient was negative, which indicates that higher scores for the neuroticism traits were associated with lower levels of SMBG or HbA_{1c}, which indicate better glycemic control.

The NEO-PI-R facet of altruism (in the extraversion domain) was also related to SMBG and HbA_{1c} measures of glycemic control at baseline, but in this case, the relationship was positive. Higher scores for altruism were associated with higher levels of SMBG and HbA_{1c}, which indicate less successful control of blood glucose levels in people with higher scores for this personality trait.

Additional regressions were calculated for these personality traits using glycemic control data collected 6 and 12 months after baseline. The numbers of observations included in these prospective analyses were smaller because some individuals withdrew from the study. However, no differences were evident between individuals who withdrew and individuals who remained in the study on any of the personality, covariate, or baseline glycemic control variables with the exception of age, which averaged 54 years in the dropout group and 59 years in those who remained. These prospective analyses also included statistical controls for treatment group (stress management vs. education), although treatment effects were minimal.

Table 2—*Personality traits associated with cross-sectional and prospective measures of short-term and chronic blood glucose level*

NEO-PI-R personality domains and facets	SMBG (average of 7 days) Baseline (n = 95)	SMBG 6 Months (n = 68)	SMBG 12 Months (n = 66)	HbA_{1c} Baseline (n = 102)	HbA_{1c} 6 Months (n = 67)	HbA_{1c} 12 Months (n = 67)
Neuroticism domain	−0.354	−0.276	−0.283	−0.221		
Anxiety	−0.278		−0.299		−0.270	
Angry hostility	−0.278			−0.231		
Depression	−0.285					
Self-consciousness	−0.254	−0.273				
Vulnerability	−0.337	−0.277	−0.351	−0.257	−0.181	−0.182
Altruism	0.329	0.491	0.325	0.412	0.459	0.385

These standardized regression coefficients (slopes) are statistically adjusted for age, race, sex, duration of diabetes, diabetes medication status, and experimental group. Only statistically significant ($P < 0.05$) regression results are shown.

Prospective results were similar to the cross-sectional results but were less consistent (Table 2). Scores for the domain of neuroticism did predict SMBG at 6 and 12 months but did not predict HbA_{1c}. In this domain, only the facet of vulnerability was a significant predictor of both SMBG and HbA_{1c} at both time points. Other facets were inconsistently related or unrelated to later measures of glycemic control. However, altruism remained a significant predictor of both SMBG and HbA_{1c} at both 6 and 12 months. As in the cross-sectional analyses, higher scores on the measures of neuroticism were associated with better glycemic control, and higher scores for the altruism trait were associated with worse glycemic control.

CONCLUSIONS

— These results offer preliminary evidence that common personality traits may help to explain variations in glycemic control achieved by patients with type 2 diabetes under conditions of standard diabetes management. In these data, higher levels of blood glucose (poorer glycemic control) were associated with lower scores for neuroticism and the associated personality facets of anxiety, angry hostility, depression, self-consciousness, and vulnerability. Higher altruism scores were also linked to poorer glycemic control.

People with higher neuroticism scores are more prone to experience negative emotions, which include a greater tendency to worry; experience anger and frustration; experience guilt, sadness, and hopelessness; feel self-conscious; and feel less able to cope with stress. In contrast, people with lower neuroticism scores are usually described as “calm, even-tempered, and relaxed,” and “able to face stressful situations without becoming upset or rattled” (7). Stronger tendencies to worry and experience other negative emotions may provide increased motivation for a patient with diabetes to follow the necessary self-care regimen and achieve a better clinical outcome. Fawzy et al. (8) offered a similar interpretation when they found that higher levels of total mood disturbance (experience of negative moods) were associated with better survival after surgery for melanoma. These authors suggested that individuals who presented with lower levels of distress may have minimized the importance and threat of cancer to their well-being. Lacking a sense of distress, they lacked the motivation to mobilize the coping resources needed to deal with the psychological and physical adjustments required by the disease. The same may be true in type 2 diabetes. Patients who report low levels of neuroticism may lack the emotional distress necessary to motivate them to maintain proper self-care. They may minimize the long-term consequences of failing to maintain control and the severe health impact that diabetes complications will have on their future well-being. As a result, their glycemic control can suffer.

People with high scores for altruism are described as having “an active concern for others' welfare as shown in generosity, consideration of others, and a willingness to assist others in need of help.” Those with low altruism scores are described as being “somewhat more self-centered and…reluctant to get involved in the problems of others.” The link between higher altruism and worse glycemic control may also be explained by the mechanism of self-care. People who are more concerned about the needs of others than their own needs may tend to neglect their own self-care in serving the needs and interests of friends and family members. Proper diabetes management may require a modest degree of self-centeredness to overcome social and familial barriers to regimen adherence.

These interpretations are tentative given the exploratory nature of this investigation. Furthermore, this stress management intervention study lacked adequate measures of diabetes self-care that could provide a test of this hypothetical mechanism. Whether regimen adherence and self-care provide links between personality traits and glycemic control in patients with type 2 diabetes remains to be determined.

Although the observed relationships between personality traits and glycemic control must be replicated, good reason exists to do so. The differences in glycemic control associated with these personality variations are sufficient to be of clinical interest. We calculated estimates of the values of SMBG and HbA_{1c} for high and low values of each personality trait in Table 2 (90th and 10th percentiles) from the regression equations. The differences between high and low scores on the 7 traits (Table 2) ranged from 1.76 to 2.41 mmol/l (32–44 mg/dl) in average SMBG. Estimated HbA_{1c} values differed by 1.1–1.7% when high and low scores for neuroticism, angry hostility, vulnerability, and altruism were compared. Furthermore, the variability of personality trait scores in this sample of patients with type 2 diabetes is within the limits of normal variation. We converted raw NEO-PI-R scores to standardized scores and compared them with adult combined sex norms for these scales (7). Although individual scores were distributed across the 5 standard summary categories from very low to very high, the average values of domain and trait scores for this sample were all within the range defined as "average," and the SDs of the standardized scores were similar to those of the normative sample. Thus, the effects observed in this study are associated with normal variations in personality.

In contrast with the present findings, other studies have reported that neuroticism is associated with poorer health outcomes in patients with diabetes. Wiebe et al. (9) reported that "negative affectivity," which was also described as a tendency to experience negative emotions, was related to worse glycemic control in a sample of adolescents with type 1 diabetes. The evidence was an observed interaction between measures of trait anxiety and "internal focus" based on a brief self-report measure of how much attention was paid to internal versus external cues for information about blood glucose levels. Although the interaction did not predict average SMBG and the trend for HbA_{1c} did not reach statistical significance, the interaction did predict variability in SMBG. Brickman et al. (10) investigated the interaction of neuroticism and conscientiousness in determining the length of time before renal deterioration as an index of successful management in a sample of patients with type 1 diabetes with end-stage renal disease. The combination of high levels of conscientiousness and moderate neuroticism was associated with slower renal deterioration than the combination of lower levels of conscientiousness with either high or low levels of neuroticism. However, neither neuroticism nor conscientiousness was itself related to the clinical outcome, and no measure of actual glycemic control was available. The evidence provided by these 2 studies raises questions about the role of neuroticism suggested by the present results. Perhaps the inconsistencies are related to the known differences between type 1 and type 2 diabetes or to the differences in how neuroticism and clinical outcome were evaluated in the studies. Given the limitations of present empirical data, lack of consensus about the role of neuroticism in diabetes is not especially troubling.

The absence of links between the conscientiousness domain and glycemic control in the present data is noteworthy. Other investigators have suggested that higher levels of conscientiousness should be associated with better outcomes in chronic diseases because conscientious people would adhere more thoroughly to treatment regimens (10–12). Again, however, the role of conscientiousness in health outcomes and adherence has not been well established empirically. The NEO-PI-R domain of conscientiousness has been related to self-reports of positive health behaviors in healthy young adults in the armed services (11), to compliance with only 1 of 2 major components of the self-care regimen for patients on renal dialysis (12), and to a slower rate of renal deterioration in patients with type 1 diabetes (10). Thus, the present body of evidence is clearly limited. Furthermore, conscientiousness, as defined by the NEO-PI-R, may be less relevant to self-care than common understanding would suggest. It is described as an aspect of what is commonly called "character" and the "will to achieve" (7). Most of the specific personality traits included in this domain (Table 1) seem to have little relevance to understanding adherence to self-care regimens or health behaviors with the exception of "self-discipline," which is characterized as the "ability to motivate oneself to get the job done despite boredom and distraction," and perhaps "order," which is described as "neat, tidy, and well organized." Clearly, the role of conscientiousness in health and disease needs to be examined further before conclusions can be drawn.

The present results must be considered with a caveat. Because of its exploratory nature, the study included a large number of personality traits and multiple measures of glycemic control that were examined independently. We did control the number of statistical tests by using a multistage procedure and did not perform all possible regressions. However, we have not included corrections for the number of tests that we did perform, and the possibility of chance significance must be recognized. This approach is consistent with the current state of research on personality and diabetes, which is in need of observations that may guide the development of new hypotheses for testing. The results herein are suggestive but not conclusive.

Normal variations in personality traits may contribute substantially to the relative success of clinical efforts in diabetes management. A better understanding of these relationships could improve diabetes management in at least 2 ways. Our data suggest that simple personality assessment techniques may be useful in identifying individuals at risk for poor glycemic control. This information may be helpful in planning diabetes education programs for patients who are newly diagnosed, especially if it can identify specific areas where difficulties are likely. In addition, research on personality traits in diabetes may offer new insights that can enhance diabetes management. Even though modifying personality traits through clinical interventions may not be possible, a clearer understanding of their influence will suggest specific behaviors that should be modified to achieve optimum glycemic control. Our results suggest, for example, that a little worry and a little selfishness may benefit patients with diabetes. Diabetes educators may need to overcome the risk minimization present in patients with low neuroticism and motivate these patients to understand and accept the realistic threats to their health that are associated with poor glycemic control. Other patients may need to become more assertive about their own self-care when faced with the needs of family members and friends. Recognizing these personality traits and changing the associated attitudes and behaviors may contribute to improved diabetes management.

The roles that personality may play in diabetes management will only be determined by further investigation. However, the preliminary evidence provided by this study suggests that continued efforts to understand how personality traits affect glycemic control in diabetes can lead to new insights into the disease and its management.

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