# Psychological Predictors of Glucose Control in Patients With IDDM

James D. Lane, PhD
Brian Stabler, PhD
Suzanne L. Ross, PhD
Mary Ann Morris, MD
Jean C. Litton, RN
Richard S. Surwit, PhD

Insulin-dependent diabetes mellitus (IDDM) patients vary considerably in response to conventional insulin therapy, and investigators have attempted to predict these individual differences in glycemic control using various psychological instruments. Although some modest predictors of glycosylated hemoglobin (GHb) have been identified (1), the observed correlations, although statistically significant, have been too small to be of practical clinical value in identifying IDDM patients who are likely to exhibit poor glucose control. We have conducted a series of studies to identify individual difference measures relevant to the potential role of stress reactivity in glycemic disregulation. Measurements of the type A behavior pattern (impatience, competitiveness) predicted glycemic responses to a laboratory stressor in a sample of school-aged IDDM patients (2). However, the same measure failed to predict chronic glucose regulation assessed by GHb (3).

This study continues this research. Additional questionnaire measures characterizing traits relevant to behavioral and physiological reactivity were collected from a group of IDDM patients and correlated with GHb levels. Attention focused on the temperamental traits of anger, anxiety, extraversion, and neuroticism (emotional lability), which were hypothesized to contribute to increased emotional reactivity in daily life. In addition, a subset of these subjects monitored blood glucose (BG) levels for 14 days at home using a glucose-monitoring instrument with memory that provided additional measures of chronic glucose regulation and information regarding adherence to the BG-monitoring regimen.

## SUBJECTS AND METHODS

A sample of 31 school-aged (12–19 yr, mean = 15.3 yr) IDDM patients (26 males, 5 females) was recruited from the Pediatric Endocrine Clinic of Duke University Medical Center. Patients with a history of psychiatric illness or mental retardation were excluded from the study. All subjects were under treatment with conventional insulin therapy, and an American Diabetes Association exchange diet was followed with BG monitored at least twice daily. Insulin was prescribed twice daily and adjusted to attain optimal glycemic control with avoidance of hypoglycemia.

Subjects were tested at the clinic during a regularly scheduled visit. Blood samples were drawn at the time of psychological testing and assayed for levels of GHb by use of affinity chromatography (4). The State-Trait Personality Inventory (STPI; 5) and the Eysenck Personality Inventory (EPI; 6) were administered to each subject after his/her voluntary informed consent was obtained. The STPI provides measures of trait anger, anxiety, and curiosity. The EPI provides measures of extraversion and neuroticism. In addition, the EPI extraversion scale provides subscores that reflect levels of impulsivity and sociability (7).

A subset of 18 subjects also recorded daily BG levels for 14 days. These subjects performed their normal daily BG measurements using a Glucometer M (Ames, Miles, Elkhart, IN), which automatically recorded the date, time, and BG level (mg/dl) of each measurement in a microprocessor memory.

## RESULTS

GHb levels in this sample ranged from 6.6 to 17.0% (mean 12.1%). These values compare with standard values from this assay (7.8–24%, mean 12.3% for IDDM patients, vs. 4–8.2%, mean 6.4% for healthy subjects). GHb levels were not related to subject age ($r = .17$, $P < .35$) or to the duration of IDDM ($r = -.02$, $P < .9$).

Analysis of the personality trait measures from the EPI and STPI questionnaires provided several significant predictors of GHb levels. EPI extraversion scores were negatively correlated with GHb levels ($r = -.36$, $P < .05$), although scores for the neuroticism scale were not ($r = .20$, $P < .27$). This relationship suggests that subjects who had higher levels of GHb, indicative of chronic poorer glycemic control, had lower EPI extraversion scores or were relatively more introverted. Examination of the sociability and impulsivity subscales of the EPI extraversion scale revealed that higher GHb levels were associated with lower sociability scores ($r = -.43$, $P < .02$), but GHb was unrelated to scores for impulsivity ($r = -.12$, $P < .52$). Analysis of the three STPI scales revealed a significant negative correlation between GHb levels and trait curiosity ($r = -.42$, $P < .02$) with higher levels of GHb associated with lower levels of curiosity. However, both trait anger and trait anxiety were unrelated to GHb levels ($r = -.24$, $P < .19$, and $r = -.02$, $P < .9$, respectively). The subjects' scores for STPI curiosity and EPI sociability were positively correlated ($r = .35$, $P < .05$) in this sample, and neither was significantly correlated with GHb after adjustment for the other, suggesting that curiosity and sociability did not explain completely unique portions of the variability in GHb. However, a regression model combining these two independent measures explained 27% of the variance of GHb, more than either alone.

The recorded home BG measurements provided a more detailed measure of glucose control over a shorter interval than GHb. Several variables were examined in these data: the mean BG level for the 14 days, the average number of BG measurements per day, the number of hypoglycemic measurements (BG <50 mg/dl, 2.8 mM), and the number of hyperglycemic measurements (BG >350 mg/dl, 19.6 mM). Average BG from the 14-day Glucometer M record was positively correlated with GHb in the 18 subjects who completed home monitoring ($r = .46$, $P < .06$).

Correlations of home BG variables with personality measures were similar in magnitude to those with GHb, although the reduced sample size limited their statistical significance. Trait curiosity was negatively correlated with average BG ($r = -.42$, $P < .08$) at the same level of association as it was with GHb. The number of hyperglycemic episodes was negatively correlated with trait curiosity ($r = -.36$, $P < .15$) and positively correlated with trait anger ($r = .40$, $P < .10$). Patients with less curiosity or more anger had a somewhat greater frequency of hyperglycemic episodes.

The subjects' responses to the individual questionnaire items from the sociability subscale and the curiosity scale were examined as predictors of glycemic control to provide a closer view of these relationships. These findings must be interpreted cautiously because they may capitalize on chance effects. Scores of two similar items of the ten on the STPI curiosity scale correlated significantly with GHb, indeed more strongly than the curiosity scale did as a whole. A weaker endorsement of the statements concerning feeling curious or feeling inquisitive was associated with higher GHb levels ($r = -.47$, $P < .007$, and $r = -.52$, $P < .002$, respectively). This contrasts with two items independent of GHb levels, where subjects reported feeling disinterested or feeling mentally active ($P > .60$). Two of the thirteen EPI sociability items were also significantly correlated with GHb. Responding "false" to statements expressing a personal liking for going out frequently ($r = -.42$, $P < .02$) or an ability to "let go" and enjoy a lively party ($r = -.52$, $P < .003$) was associated with higher GHb levels.

As with GHb, several STPI curiosity items predicted both the average BG and the number of hyperglycemic episodes. Weaker endorsement of items regarding feeling curious, feeling interested, and being in a questioning mood were all significantly associated ($P < .05$) with a higher average BG and more hyperglycemic episodes. Responses to the "I feel curious" item were the strongest predictor of average BG ($r = -.62$, $P < .007$).

The recorded number of BG tests per day could be seen as a measure of compliance with the treatment regimen. However, the average number of BG tests conducted per day was not correlated with any of the home BG control measures ($P > .20$) or with GHb levels. In addition, none of the personality measures was significantly associated with the number of BG tests per day. Only trait curiosity yielded a correlation with a significance value $P < .2$ ($r = .33$, $P < .18$).

## DISCUSSION

The results do not support our original hypothesis that measures related to behavioral or physiological reactivity, assessed in terms of emotional lability or the tendency for higher levels of anger and anxiety, will predict which school-aged IDDM patients show poor BG control. The unexpected predictors of BG control, curiosity and sociability, suggest a different potential association linking personality or temperament and chronic BG regulation.

The curiosity and sociability findings of this study are not unique. Orr et al. (8) reported a similar difference between school-age IDDM patients in good and poor glycemic control, based on interviews with the patients and their families. Although the focus of that study was on family interactions, the authors noted that many of the patients in poor control had poorly developed social skills, reported few or no close friends, did not date, and avoided parties due to shyness and inability to converse with peers. Such descriptions closely parallel self-reports of low sociability from the EPI in this study and, in some respects, the relative absence of curiosity.

Our findings were also similar to those of a recent study on the correlation between temperament and IDDM (9), which reported that IDDM children with poor glycemic control are hypoactive compared with those in better control or with healthy subjects. Better glycemic control was also associated with greater predictability or regularity of routine, lower intensity of response to stimuli, greater distractibility, and more negative moods. Curious and sociable children might be expected to be both more active and distractible, although the link to other characteristics, especially negative mood, is less clear.

It has been suggested that individual differences in BG control generally have effects only through differences in compliance with the prescribed treatment regimen (10). However, our results derived from home BG monitoring demonstrate an independence of the psychological predictors of BG regulation and, from our simple measure of regimen adherence, the number of BG measurements completed each day. Furthermore, this compliance measure did not predict GHb levels or any of the home BG variables.

Together, curiosity and sociability may reflect greater adaptability or flexibility that improves the school-age IDDM patient's ability to cope with the difficulties and responsibilities of diabetic management. However, possible interactions of these traits with environmental and family interaction variables must not be disregarded (3).

The results of this study are suggestive but preliminary. In particular, the examination of specific questionnaire items can only indicate a direction for future investigations. However, this study demonstrates that chronic BG control can be predicted from psychological questionnaires and provides support for continued investigations into personality variables that predict glycemic disregulation. Identification of such variables, ob-

tainable by brief questionnaire, will help clinicians identify IDDM patients who are at the greatest risk for poor BG control with standard management and will provide clues for the enhancement of the clinical management of IDDM in these patients.

From the Departments of Psychiatry and Pediatrics, Duke University Medical Center, Durham; and the Departments of Psychiatry and Pediatrics, School of Medicine, University of North Carolina, Chapel Hill, North Carolina.

Address correspondence and reprint requests to James D. Lane, PhD, Department of Psychiatry, Box 3926, Duke University Medical Center, Durham, NC 27710.

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