Subclinical and Clinical Eating Disorders in IDDM Negatively Affect Metabolic Control

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OBJECTIVE — To characterize the relationship of subclinical and clinical eating disorders to HbA_{1c} values in women with IDDM.

RESEARCH DESIGN AND METHODS — Ninety women with IDDM (18–46 years of age) were recruited from diabetes clinics throughout Connecticut and Massachusetts. Subjects were categorized into one of three groups according to the *Diagnostic Statistical Manual of Mental Disorders* (DSM-III-R) criteria for eating disorders as follows: the clinical group (n = 14), the subclinical group (partially fulfilling the diagnostic criteria; n = 13), and the control group (n = 63). Group differences in the degree of dietary restraint, binge eating, and bulimic behaviors and weight, shape, and eating concerns were assessed with the Eating Disorder Examination (EDE) and the Bulimia Test Revised (BULIT-R).

RESULTS — Women with subclinical and clinical eating disorders had clinically elevated HbA_{1c} results and more diabetes-related complications, compared with the control subjects. The severity of bulimic behaviors, weight concerns, reduced BMI, and decreased frequency of blood glucose monitoring were associated with elevated HbA_{1c}.

CONCLUSIONS — HbA_{1c} may have clinical utility in the identification of eating disorder behavior in females with IDDM. Health care professionals should be aware of the potent effect of subclinical and clinical eating behaviors including insulin misuse in weight-conscious women with IDDM who have poor glycemic control.

Recent research suggests that young adult women with IDDM are at excess risk of poor glycemic control (1–3). Women with IDDM and coexisting eating disorders have been shown to have HbA_{1c} levels that are ~2% above those documented in similarly aged women with IDDM without eating disorders (4–8). The intentional omission or reduction of a prescribed insulin regimen may be one primary reason for this altered glycemic control. Studies have shown that 15–39% of females with IDDM have omitted or reduced insulin doses in an effort to control weight (1–4).

To date, most research has emphasized the relationship of clinical eating disorders to glycemic control. However, less extreme eating behaviors (subclinical eating disorders), although failing to meet the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-IV) criteria for a clinical eating disorder (because one of the essential diagnostic features is missing) (9), may nevertheless be risky in individuals with IDDM. The little research that has examined the relationship between subclinical eating disorders and glycemic control has relied on self-report measures and unstandardized clinical interviews for which the reliability and validity are unknown in the diabetes population (5,10). Moreover, this research did not investigate which factors might have contributed to poor metabolic control. Therefore, our knowledge of the potential effects of subclinical but disordered eating behavior on glycemic control remains limited.

This article reports on the insulin use and glycemic control of 90 young women with IDDM. Using standardized psychometric instruments validated for a population with diabetes, women were categorized into three groups: a clinically eating-disordered group, a subclinical group, or a control group. Our analyses investigate group differences in several dimensions, including HbA_{1c} concentrations, past and present insulin misuse, and diabetes-related hospital admissions. A multiple regression model was used for our analysis, since it considers the combined effects of several behaviors and conditions on HbA_{1c} concentrations. The potential effect of subclinical disordered behaviors on diabetes care is briefly explained.

The two hypotheses tested were the following: *1*) based on the severity of the eating disorder, there will be significant differences in eating-disordered and purging behaviors, as well as insulin misuse, in women with IDDM who have clinical and subclinical eating disorders, compared with those women with IDDM without eating disorders; and 2) higher HbA_{1c} concentrations will be associated with subclinical and clinical eating disorders.

RESEARCH DESIGN AND METHODS

— Ninety subjects with IDDM were recruited from diabetes clinics throughout Connecticut and Massachusetts. Pregnant or lactating subjects were excluded from the study. The diagnosis of eating disorders was based on DSM-III-R criteria using the Eating Disorder Examination (EDE) (14). Women were classified into one of three groups: the clinical group (n = 14), women with IDDM who fulfilled the DSM-III-R criteria for anorexia nervosa (n = 4) and bulimia nervosa (n = 10); subclinical (n = 13), women with IDDM who

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BULIT-R, Bulimia Test Revised; DSM, *Diagnostic Statistical Manual*; EDE, Eating Disorder Examination.

Table 1—*Demographic and clinical data for women with IDDM and eating disorders based on DSM-III-R classification*

Variable	Control group	Subclinical group	Clinical group	*P* value
n	63	13	14	—
Education (years)	15.0 ± 7.6	14.1 ± 2.1	13.5 ± 1.7	0.05*
Marital status				
Single	58.7	69.2	92.9	0.05*
Married	39.7	23.1	7.1	
BMI (kg/m^2)	24.3 ± 3.4	24.4 ± 5.7	24.8 ± 8.9	NS‖
Glucose concentration (mg/dl)	192.3 ± 92.0	276.9 ± 137.0	295.4 ± 183.7	0.05†
HbA_{1c}	8.3 ± 1.6	10.0 ± 1.5	10.4 ± 2.6	0.05†
Prescribed insulin (U)	41.7 ± 14.6	49.6 ± 23.6	44.3 ± 17.8	NS
Daily testing over past month	3.3 ± 2.1	2.3 ± 1.9	2.2 ± 2.0	NS
No testing over past month	6.35	23.0	35.7	0.007†
Diabetes admissions	0.38 ± 1.15	0.30 ± 0.85	2.0 ± 2.0	0.0002‡
Major reactions	0.15 ± 0.3	0.35 ± 0.86	1.15 ± 1.06	0.0046‡
Presence of complications	0.60	1.23	1.28	0.03†
Present insulin misuse	0	15.4	71.4	0.0002§
Past insulin misuse	17.5	76.9	78.6	0.00001†

Data are *n*, means ± SD, or %. Control group, women with IDDM without eating disorders; subclinical group, women with IDDM with partial eating disorders; and clinical group, women with IDDM with clinical eating pathology. *Control group > clinical group; †subclinical and clinical groups > control group; ‡clinical group > control group; §clinical group > subclinical and control groups; ‖no significance at $P < 0.05$.

met partial criteria for an eating disorder; and the control group (n = 63), women with IDDM without subclinical or clinical eating-disordered behavior. All subjects gave their written informed consent according to the relevant institutional review boards at the University of Connecticut and all participating diabetes clinics.

Study measures

The EDE interview was used to diagnose insulin misuse and clinical and subclinical anorexia nervosa and bulimia nervosa (11–14). Insulin misuse was defined as the intentional reduction or omission of prescribed insulin to induce glycosuria for the purpose of weight control. To provide additional descriptive data on subjects' attitudes and behaviors toward insulin misuse, the EDE was augmented with the interview schedule of Polonsky et al. (4). The Bulimia Test Revised (BULIT-R) inventory was used to assess severity of binge eating (15,16).

Whole blood was analyzed for HbA_{1c} by affinity chromatography (17) and serum for glucose by Diagnostic Medical Laboratory (Branford, CT). The normal reference range for HbA_{1c} for that laboratory was 4.4–6.4%. Diabetes self-care was assessed through the clinical interview. Information was obtained on the self-monitoring of blood glucose, the frequency of minor and major insulin reactions, hospital admissions, usual exercise habits, insulin administration, and dietary patterns. Diabetes-related complications were obtained (i.e., nephropathy, neuropathy, retinopathy) by self-report and/or medical record review. BMI was calculated from anthropometric data.

Statistical analyses

Analysis of variance and multiple (Tukey) comparisons were used to examine the differences among the three study groups, and where appropriate, χ^2 or Kruskal-Wallis analyses were performed. Multiple regression using the maximum R^2 selection method was employed to identify the regression model that explained the greatest variance in HbA_{1c}.

RESULTS — Among the clinical, subclinical, and control groups, there were no significant differences in the duration of diabetes, age at diabetes onset, current age, ethnicity, occupation, the prescribed number of insulin units, daily injections, or BMI. The mean age of the sample was 28.8 years, and the mean duration of diabetes was 14.8 years. The sample was predominately Caucasian. Table 1 shows the demographic, clinical data, and diabetes self-care behaviors for women in all three groups. The control group had more women who were married and that group also had a higher level of education, compared with the clinical group. Although there were no statistically significant differences among the study groups in the prescribed number of insulin units or daily injections, women with clinical and subclinical eating disorders reported not always injecting the amount prescribed. In addition, women with clinical eating disorders had more diabetes-related admissions to the hospital over the past year and more major diabetes reactions, compared with the subclinical and control groups. Women with clinical and subclinical eating disorders reported a significantly greater number of occasions where they intentionally did not test their blood glucose level. The clinical and subclinical groups had a significantly higher HbA_{1c}, more diabetes-related complications, and more past insulin misuse, compared with the controls ($P < 0.05$). Seventy-one percent of the clinical group were misusing insulin at the time of the study versus 15% of the subclinical group ($P < 0.0002$).

To examine the relationship between adherence to diabetes self-care behaviors and eating pathology and metabolic control, multiple regression analyses were conducted to identify the best (the largest R^2) set of predictors for HbA_{1c}. Higher HbA_{1c} was associated with a lower body weight, a lower frequency of self-monitoring of blood glucose, greater bulimic symptoms, and negative attitudes toward correct insulin use (Table 2).

CONCLUSIONS — The findings of the current study corroborate those of Wing et al. (5) who reported a positive correlation between the frequency of binge eating and HbA_{1c} concentration. Further, our research shows that subclinical eating disorders, in addition to clinical disorders, are associated with patient noncompliance and poor metabolic control. Importantly, a history of insulin misuse was evident in a large majority of subclinical group subjects, which may explain in part the increased rate of diabetes-related complications in this group compared with the control subjects. This research demonstrates that women with IDDM and either subclinical or clinical eating disorders reported using insulin omission or reduction currently as a primary method of purging calories. Both clinical

Table 2—*Predictors of HbA_{1c} in women with IDDM*

Independent variable	Parameter estimate	*T* for Ho	Probability *T*	Standardized estimate
Intercept	2.32	24.52	0.0001	0.00
BMI	−0.01	−3.69	0.0004	−0.35
Frequency of testing	−0.01	−2.17	0.03	−0.19
BULIT-R	0.002	2.56	0.01	0.32
Attitudes and behaviors regarding insulin	0.002	2.39	0.01	0.28

R^2 = 0.3915; n = 89. Ho, null hypothesis.

and subclinical groups had a significantly higher HbA_{1c} concentration compared with the control subjects. These increases were of a magnitude similar to that reported in the Diabetes Control and Complications Trial (18). Furthermore, the increased HbA_{1c} levels were associated with eating-disordered behaviors and greater diabetes-related complications, which has been reported by other investigators (19,20).

Important factors that may account for the elevated HbA_{1c} levels were identified by this investigation. Subjects in the clinical and subclinical groups reported less frequent monitoring of blood glucose, greater insulin misuse, and more frequent bulimic behaviors. These behaviors were associated with a greater number of major hypoglycemic events, more total diabetes-related hospitalizations, and a higher percentage of diabetes-related complications. Specifically, poorer glycemic control was associated with lower body weight and the presence of a range of negative attitudes toward correct insulin use. These findings point to an increased risk for the development of diabetes-related complications in individuals with IDDM and an eating disorder.

This study has a number of limitations. In particular, the sample sizes were modest for the clinical and subclinical groups. Because IDDM comprises only 10% of the total diabetes population and eating-disordered individuals represent a modest proportion of these individuals, clinical studies of eating-disordered patients with IDDM are logistically challenging. Clearly, future efforts should be made to conduct collaborative multicenter studies that can capture larger samples of these highly select clinical subgroups for further characterization of the health consequences of eating-disordered behaviors in women with IDDM.

Overall, our findings have implications for the clinical management of young women with IDDM. These data support routine early screening for attitudes and behaviors associated with subclinical disordered eating and insulin misuse. Such screening would be useful in identifying patients at risk for poor metabolic control and higher rates of diabetes-related complications. The diabetes health care team should be aware of the potential for presence of both subclinical and clinical eating disorders when treating young adult women who present with elevated HbA_{1c} concentrations.

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