

# The Relationship of Disordered Eating Habits and Attitudes to Clinical Outcomes in Young Adult Females With Type 1 Diabetes

ROBERT C. PEVELER, FRCPSYCH<sup>1</sup>  
KATHRYN S. BRYDEN, RN<sup>2</sup>  
H. ANDREW W. NEIL, FRCP<sup>2</sup>  
CHRISTOPHER G. FAIRBURN, FRCPSYCH<sup>3</sup>

RICHARD A. MAYOU, FRCPSYCH<sup>3</sup>  
DAVID B. DUNGER, FRCP<sup>4</sup>  
HANNAH M. TURNER, DCP<sup>1</sup>

**OBJECTIVE** — To describe the clinical outcomes of adolescent and young adult female subjects with type 1 diabetes in relation to the disturbance of eating habits and attitudes over 8–12 years.

**RESEARCH DESIGN AND METHODS** — Patients were recruited from the registers of pediatric and young adult diabetes clinics (including nonattenders) and interviewed in the community. A total of 87 patients were assessed at baseline (aged 11–25 years), and 63 (72%) were reinterviewed after 8–12 years (aged 20–38 years). Eating habits and attitudes were assessed by a semistructured research diagnostic interview (Eating Disorder Examination).

**RESULTS** — Clinical eating disorders ascertained from the interview and/or case note review at baseline or follow-up were found in 13 subjects (14.9% [95% CI 8.2–24.2]), and an additional 7 subjects had evidence of bingeing or purging, bringing the total affected to 26%. Insulin misuse for weight control was reported by 31 (35.6% [25.7–46.6]) subjects. Overall outcome was poor; serious microvascular complications were common and mortality was high. There were significant relationships between disordered eating habits, insulin misuse, and microvascular complications.

**CONCLUSIONS** — Although the cross-sectional prevalence of clinical eating disorders in young women with diabetes is modest, the cumulative incidence of eating problems continues to increase after young adulthood, and this is strongly associated with poor physical health outcomes. The combination of an eating disorder and diabetes puts patients at high risk of mortality and morbidity. Better methods of detection and management are needed.

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Patients with diabetes and an eating disorder pose formidable clinical problems. Early reports (1–4) suggested that eating disorders might be more common than expected by chance in young women with diabetes, but this has since been questioned (5,6). There is a

spectrum of severity of disturbance of eating habits and attitudes, and “subthreshold” eating problems, seen as relatively mild in nondiabetic patients, can give rise to clinically important disturbances of self-care and glycemic control. In particular, insulin under-use to control body

weight is common (7,8). Such patients are thought to be at increased risk of microvascular complications (9,10), but the extent of the risk has not been well characterized, as most studies have been cross-sectional. Clinical outcomes in terms of physical and psychological health are not known with certainty.

There have been two previous longitudinal studies of patients with diabetes and disordered eating. One study (11), using repeated clinical interviews over 9 years, found a low rate of clinical eating disorders (4%) and a relationship between eating problems and other psychiatric disorders. Another study (9), taking place over 4 years, found disordered eating behaviors to be common and persistent and associated with an increased risk of retinopathy. Both were limited in their conclusions by the selected clinic populations recruited, the restricted range of outcome measures, and small sample sizes.

In the late 1980s, two community cohorts of patients (aged 11–18 and 17–25 years) were recruited in Oxford, which were representative of the total population with type 1 diabetes (5,6). We have now undertaken follow-up studies of both cohorts at 8–12 years of follow-up (12,13), and this article reports the relationship between the eating habits and attitudes of the female patients and their clinical outcomes. The principal aims of the study were to assess the clinical course of disordered eating habits and attitudes in this sample and to evaluate their impact over time on glycemic control and microvascular complications.

## RESEARCH DESIGN AND METHODS

This study was based on follow-ups of two cohorts of patients, each assessed at two time points. In 1987–1988, patients (aged 17–25 years) registered with the young adult diabetes clinic at the John Radcliffe Hospital, Oxford, U.K., were invited to participate in a

From the <sup>1</sup>Community Clinical Sciences Research Division, School of Medicine, University of Southampton, Southampton, U.K.; the <sup>2</sup>Division of Public Health and Primary Care, University of Oxford, Oxfordshire, U.K.; the <sup>3</sup>Department of Psychiatry, University of Oxford, Oxfordshire, U.K.; and the <sup>4</sup>Department of Pediatrics, University of Cambridge, Cambridgeshire, U.K.

Address correspondence and reprint requests to Professor Robert Peveler, University Mental Health Group, Royal South Hants Hospital, Southampton, SO14 0YG, U.K. E-mail: rcp@soton.ac.uk.

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**Abbreviations:** AN, anorexia nervosa; BN, bulimia nervosa; EDE, Eating Disorder Examination; EDNOS, eating disorder not otherwise specified.

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Table 1—Characteristics of study groups and clinical eating disorders diagnosed at an assessment interview using the EDE

	Adolescents			Young adults		
	Baseline	Follow-up	Total	Baseline	Follow-up	Total
n	33	26		54	37	
Age (years)	15.3 ± 1.9	23.9 ± 2.0		21.0 ± 2.7	33.1 ± 2.9	
Diabetes duration (years)	7.1 ± 2.9	15.7 ± 2.9		8.8 ± 5.3	20.8 ± 5.5	
BMI (kg/m <sup>2</sup> )	22.7 ± 3.7	24.7 ± 2.6		24.6 ± 4.7	27.3 ± 5.0	
BMI >25.0 kg/m <sup>2</sup>	5 (16)	12 (46)		13 (24)	14 (38)	
BMI >30.0 kg/m <sup>2</sup>	2 (6)	2 (8)		4 (7)	8 (22)	
HbA <sub>1c</sub> (%)	9.7 ± 1.8	9.3 ± 1.9		9.5 ± 2.5	8.8 ± 1.7	
EDE dietary restraint	0.60 (0.0–1.20)	1.55 (0.30–2.80)		1.20 (0.0–3.00)	1.20 (0.0–2.05)	
EDE shape concern	0.56 (0.13–1.63)	1.12 (0.59–1.88)		1.25 (0.25–2.94)	2.25 (0.63–3.13)	
EDE weight concern	0.80 (0.40–1.55)	1.80 (0.70–2.55)		1.10 (0.40–2.40)	1.40 (0.80–2.40)	
Number of cases						
AN	0	0	0	0	0	0
BN	0	0	0	1	0	1
BED	0	0	0	3	1	4
EDNOS	1	1	2	2	0	2

BED, binge eating disorder.

study of eating habits (5). In 1989–1990, adolescents (aged 11–18 years) registered with the pediatric diabetes clinic were similarly recruited (6). Patients were included only if they had been diagnosed with diabetes for at least 1 year and were excluded if they were pregnant or students resident only during academic terms. In 1997–1998, the adolescents (now aged 20–27 years) were invited to be reinterviewed (12). The following year (1999–2000), the young adult subjects (now aged 28–38 years) were recontacted (13).

Patients still registered with Oxford clinics were approached at routine clinic visits. Subjects who did not attend clinics or who had moved away from the area were contacted by letter and telephone. Research assessments took place in subjects' homes once informed consent had been obtained (from patients and, where applicable, parents). Both studies were approved by the Central Oxford Research Ethics Committee.

Eating habits and attitudes were assessed using the Eating Disorder Examination (EDE) (14–17) at both initial assessment and follow-up. This semi-structured research diagnostic interview of established reliability and validity assesses key features of eating disorders, and the current version generates diagnoses according to *Diagnostic and Statistical Manual of Mental Disorders*, Fourth Edition (DSM-IV) criteria (18). Diagnostic rates differ from our previously pub-

lished baseline data because DSM-IV diagnostic criteria have been applied at all time points to reflect current diagnostic practice. Diagnoses of bulimia nervosa (BN), anorexia nervosa (AN), binge eating disorder, and eating disorder not otherwise specified (EDNOS) were independently made by two experienced clinicians using clinical details from the EDE. An initial disagreement regarding two subjects was resolved by discussion. The interview was modified to allow distinctions to be made between behaviors deemed necessary for diabetes, such as the avoidance of sugary foods, and those attributable to an eating disorder. Interviewers were trained by the Oxford Eating Disorder Research Group. The follow-up interviewer was blind to the baseline assessments.

Subjects were also asked about their histories of eating disorder symptoms at both assessments. An estimated cumulative incidence of disordered eating behavior was calculated using information from all available sources, including EDE clinical eating disorder diagnoses, diagnoses made by clinicians and recorded in clinical notes, and interview data about past binge eating and purging. Binge eating was defined as 12 or more episodes of significant overeating associated with a sense of loss of control over eating over a 3-month period.

Subjects' height and weight were recorded, and current glycemic control was assessed (HbA<sub>1c</sub>) from either the clinic

visit nearest the assessment interview (for subjects attending Oxford clinics) or a capillary blood sample obtained at interview and brought back to the laboratory. At follow-up, three consecutive overnight or early morning urine specimens were collected for measurement of the urinary albumin-to-creatinine ratio. Records of diabetes complications were extracted from case notes. Serious microvascular complications were defined as laser-treated or proliferative retinopathy, renal failure or proteinuria, or peripheral or autonomic neuropathy. U.K. normal population BMI (age- and sex-matched) data were available from the U.K. Statistics Office (19).

## RESULTS

### Characteristics of the sample

At baseline, 54 young adult female subjects were assessed (90% of those eligible), and, of these, 37 (69%) were reinterviewed. Among those not reinterviewed, four (7%) had died (two from renal failure, one from a congenital heart condition, and one by suicide). An additional subject died from renal failure shortly after the second interview. Seven subjects declined to take part and we were unable to contact six. Thirty-three of the adolescent female subjects were assessed at baseline (88% of those eligible), and 26 (79%) were reinterviewed. Among subjects not reinterviewed, one had died (cause unrelated to diabetes), one was

**Table 2—Cumulative incidence of eating disorders and features of disordered eating behavior, including all clinical diagnoses from EDE assessment and data from other sources\***

	Adolescents			Young adults		
	Baseline	Follow-up	Total	Baseline	Follow-up	Total
<i>n</i>	33	26		54	37	
AN	0	0	0	1	1	2
BN†	0	1	1	3	1	4
BED	0	0	0	3	1	4
EDNOS‡	0	1	1	1	0	1
Insulin misuse	5 (15)	10 (39)	10 (39)	20 (37)	21 (57)	21 (57)
Vomiting	2 (6)	4 (15)	4 (15)	6 (11)	7 (19)	7 (19)
Laxative use	0 (0)	2 (8)	2 (8)	6 (11)	8 (22)	8 (22)

Data are *n* (%). \*Includes patients' history and clinical notes. †Excludes the subject who progressed from AN to BN (young adult). ‡Excludes the two subjects who progressed from EDNOS to BN (one adolescent and one young adult). BED, binge eating disorder.

cognitively impaired after a severe hypoglycemic episode, two declined to participate, two could not be traced, and the general practitioner refused permission to contact one. Table 1 shows the characteristics of both study groups at each assessment.

### Clinical eating disorders

Of 87 subjects interviewed at baseline, 7 (8%) had a current DSM-IV clinical eating disorder (Table 1). Four of these seven subjects were reinterviewed; none had a continuing eating disorder. Of three subjects not reinterviewed, one (with BN) had died from renal failure, one declined to be reinterviewed, and one was abroad. Two additional subjects were diagnosed with a current eating disorder at follow-up, making a total of nine (10%) with a current DSM-IV disorder at either assessment.

One subject with documented BN at baseline gave a past history of AN. Two subjects with EDNOS at baseline received treatment for BN between assessments. Three subjects reported symptoms of BN before baseline; one had recovered fully and two were not sufficiently symptomatic at baseline assessment to obtain an eating disorder diagnosis. One of these subjects went on to receive treatment for BN and died of renal failure shortly after the second interview; a second subject also underwent renal transplantation. One subject was documented between assessments as having AN by a clinician but refused psychiatric referral. Thus, on the basis of the current state assessed at the interview plus eating disorder history and clinical diagnoses, a cumulative total of

13 (15%) subjects were judged to have had a probable clinical eating disorder (Table 2).

### Body weight, purging behavior, and eating habits and attitudes

BMI increased with age in both cohorts (Table 1). Compared with the U.K. normal population data (19), the proportion who were overweight (BMI >25.0 kg/m<sup>2</sup>) at follow-up was much greater in both samples with diabetes (46 vs. 17% in adolescents; 38 vs. 27% in young adults). The rates for obesity (BMI >30.0 kg/m<sup>2</sup>) were similar (8 vs. 10%) for adolescents but greater for the young adults with diabetes (22 vs. 15%).

In addition to those with a probable clinical eating disorder, seven subjects gave accounts of regular self-induced vomiting (4) and/or laxative misuse (5) to control their weight. An additional three subjects described past objective bulimic episodes but without purging. In total, we estimate 23 (26%) subjects had a history of some form of disordered eating or weight control behavior over the course of follow-up. The EDE subscale scores are shown in Table 1. Scores on all subscales rose with age.

### Insulin misuse and glycemic control

Thirty-one subjects (36%) reported intentionally reducing or omitting their insulin dose to control their weight. There was a significant difference in baseline EDE scores for shape concern, weight concern, and dietary restraint between subjects with and without a history of insulin misuse (Mann-Whitney test,  $z = 4.09, 5.18, \text{ and } 4.40$ , respectively,  $P <$

0.001 in all cases), which was independent of actual body weight. Of 23 subjects with a history of disordered eating, 14 (61%) reported insulin misuse compared with 11 (26%) of 43 subjects without disordered eating ( $\chi^2 = 7.9, \text{ df } 1, P = 0.005$ , odds ratio [OR] 4.5 [95% CI 1.5–13.4]).

Glycemic control (mean HbA<sub>1c</sub>) at each assessment is shown in Table 1. The seven subjects with definite eating disorders at baseline had a higher baseline mean HbA<sub>1c</sub> (11.9 ± 1.7 vs. 9.4 ± 2.2 [±SD],  $t = 2.7, \text{ df } = 76, P = 0.009$ ); however, there was no significant relationship between glycemic control at follow-up and eating disorder status.

### Physical complications and episodes of ketoacidosis

The cumulative prevalence of microvascular complications in the two cohorts is detailed in Table 3. Of those who developed serious microvascular complications, 4 (21%) had a probable clinical eating disorder, 9 (47%) had a history of disordered eating behavior, and 11 (48%) had a history of insulin misuse. There was a significant relationship between the development of two or more serious complications and the presence of a probable clinical eating disorder ( $\chi^2 = 4.7, \text{ df } 1, P = 0.03$ , OR 4.8 [95% CI 1.1–21.8]), history of disordered eating ( $\chi^2 = 9.0, \text{ df } 1, P = 0.003, 9.6 [1.8–51.3]$ ), and insulin misuse ( $\chi^2 = 5.3, \text{ df } 1, P = 0.022, 4.8 [1.2–20.2]$ ).

Eight (24%) adolescent subjects and six (11%) young adults had two or more hospital admissions with episodes of ketoacidosis. There was a strong relationship between admission and probable clinical eating disorder ( $\chi^2 = 8.5, \text{ df } 1, P = 0.004, \text{ OR } 7.7 [95\% \text{ CI } 1.7–34.7]$ ), history of disordered eating ( $\chi^2 = 4.7, \text{ df } 1, P = 0.03, 4.7 [1.1–21.0]$ ), and history of insulin misuse ( $\chi^2 = 12.1, \text{ df } 1, P = 0.004, 19.1 [2.3–159.0]$ ). Furthermore, there were significant differences in baseline measures of shape concern, weight concern, and dietary restraint between those with and without an admission (Mann-Whitney test,  $z = 2.92, 2.27, \text{ and } 2.22$ , respectively,  $P < 0.03$  in all cases). Of the total six subjects who died, one had BN at baseline and one had received treatment for BN during the course of follow-up.

**CONCLUSIONS**— This is the first occasion, to our knowledge, that a cohort

**Table 3 —Cumulative prevalence of microvascular complications\***

	Adolescents		Young adults	
	Baseline	Follow-up	Baseline	Follow-up
n	33	29	54	49
Background retinopathy	0	5 (17)	7 (13)	17 (35)
Preproliferative retinopathy	0	3 (10)	0	2 (4)
Laser-treated retinopathy	0	5 (17)	1 (2)	16 (33)
Microalbuminuria	0	4 (14)	1 (2)	3 (6)
Proteinuria	0	4 (14)	1 (2)	3 (6)
Dialysis	0	0	0	1 (2) (has since died)
Transplant	0	0	0	2 (4)
Died from renal failure	0	0	0	2 (4)
Peripheral neuropathy	0	1 (3)	0	10 (20)
Autonomic neuropathy	0	0	0	5 (10)
One serious complication only†	0	6 (21)	2 (4)	7 (14)
Two serious complications	0	2 (7)	0	6 (12)
Three or more serious complications	0	1 (3)	0	6 (12)

Data are n (%). \*Includes data on subjects not reinterviewed where available, including those subjects who died. †Serious complications defined as laser-treated retinopathy, preproliferative retinopathy, proteinuria, renal failure, peripheral neuropathy, or autonomic neuropathy.

of young female subjects with insulin-dependent diabetes, representative of a total population with type 1 diabetes, has been followed over 8–12 years, with eating disorder features assessed at both baseline and follow-up, using a research diagnostic interview, case note review of physical complications, and a good ascertainment rate. These features represent considerable methodological advances, and the findings are therefore likely to be robust. The only likely error is a conservative bias with two possible sources: 1) some subjects may not have reported eating disorder features to the interviewer at either time point, and 2) subjects with eating problems may have been particularly likely to have been lost to follow-up. There is also a risk that insulin misuse has been underascertained due to self-representational bias. The validity of the interview findings is supported by the routine clinical data. The study sample was small, and, as a result, the estimates of risk have wide CIs, but the effects proved to be large enough to be readily identified even in such a small study. This follow-up cohort was restricted to female subjects, as no male subjects presented with features of interest at baseline. Further work in larger patient groups would be valuable in confirming these preliminary findings.

The important conclusions of the work are 1) that the cumulative incidences of eating problems continue to increase after young adulthood and are

markedly higher than earlier cross-sectional studies would tend to suggest, 2) that the clinical outcomes of young female subjects with type 1 diabetes are generally poor, and 3) that there is a strong relationship between disturbed eating habits and attitudes, insulin misuse, poor glycemic control, and development of microvascular complications. Although these associations have been suggested before, this is the first study to demonstrate them conclusively. Previous cross-sectional studies have perhaps underestimated the scale of the problem due to the unstable nature of the diagnostic assignment (5,6), a phenomenon that has also been observed in the nondiabetic population (20). Our findings suggest that as many as 25% of young females with type 1 diabetes may develop clinically important disturbances of eating habits and attitudes at some point, and the prognosis of these patients is very poor, with high mortality and morbidity. While full cases of AN, BN, and EDNOS are relatively stable, milder degrees of eating disorder psychopathology (which have important effects on self-care and glycemic control) are more labile. It is clear that insulin misuse for the purpose of weight control is not confined to subjects with a clinical eating disorder. Body weight gain is demonstrably a problem for large numbers of females in this age-group with type 1 diabetes. There was a tendency for glycemic control to improve as subjects got older.

The clinical implications of this study are that disturbances of eating habits and attitudes in adolescence and young adulthood are of major clinical importance, and more effort is required to address these if mortality and significant physical morbidity a decade later are to be prevented. Many of the subjects in the present cohorts who had eating problems did receive treatment directed at the eating problem, but it appears to have been relatively ineffective in preventing the development of complications. Better methods of detection and treatment which are acceptable to patients are required.

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