Insulin Omission in Women With IDDM

WILLIAM H. POLONSKY, PHD
BARBARA J. ANDERSON, PHD
PATRICIA A. LOHRER, BA
JENNIFER E. APONTE, BA
ALAN M. JACOBSON, MD
CHARLOTTE F. COLE, EDD

OBJECTIVE — To describe the extent of intentional insulin omission in an outpatient population of women with insulin-dependent diabetes mellitus (IDDM) and examine its relationship to disordered eating, attitudes toward diabetes, other psychosocial factors, long-term complications, and glycemic control.

RESEARCH DESIGN AND METHODS — Before their routinely scheduled clinic appointments, female IDDM patients who were 13–60 years of age completed a self-report survey (final $n = 341$). The survey included standardized questionnaires assessing disordered eating attitudes and behaviors, psychological functioning (general distress, diabetes-specific distress, and hypoglycemic fear), attitudes toward diabetes, and self-care behaviors. All subjects were assessed for glycosylated hemoglobin within 30 days of survey completion. Long-term complications were determined through chart review.

RESULTS — Approximately 31% of the subject sample, representing women of all ages, reported intentional insulin omission, but only 8.8% reported frequent omission. Compared with non-omitters, omitters reported more disordered eating, greater psychological distress (general and diabetes-specific), more hypoglycemic fear, poorer regimen adherence, and greater fears concerning improved diabetes management (which may lead to weight gain). Omitters evidenced poorer glycemic control, more diabetes-related hospitalizations, and higher rates of retinopathy and neuropathy. Multivariate examination revealed only two variables that independently predicted omission: diabetes-specific distress and fear of improved glycemic control ("because I will gain weight"). Of the omitters, approximately half reported omitting insulin for weight-management purposes (weight-related omitters). These subjects evidenced significantly greater psychological distress, poorer regimen adherence (including more frequent omission), poorer glycemic control, and higher rates of complications than did non–weight-related omitters as well as non-omitters. Non–weight-related omitters tended to fall between weight-related omitters and non-omitters on most measures of psychological functioning, adherence, and glycemic control.

CONCLUSIONS — These findings suggest that insulin omission is common, that it is not limited to younger women, and that the medical consequences of omission, especially frequent omission, may be severe. Although a strong association between omission and disordered eating was observed, these data suggest that this link may be complicated by important diabetes-specific factors. Patients preoccupied with eating and weight concerns may also become emotionally overwhelmed by diabetes and/or fearful of normoglycemia (and the associated weight-related consequences), thus reinforcing the desire to omit insulin and maintain elevated blood glucose levels.

From the Joslin Diabetes Center and Harvard Medical School, Boston, Massachusetts.

Address correspondence and reprint requests to William H. Polonsky, PhD, P.O. Box 2148, Del Mar, CA 92014.

Received for publication 4 January 1994 and accepted in revised form 28 April 1994.

IDDM, insulin-dependent diabetes mellitus; BULIT-R, Bulimia Test-Revised; BSI, Brief Symptom Inventory; GSI, Global Severity Index; HFS-W, Hypoglycemia Fear Survey-worry subscale; PAID, Problem Areas in Diabetes Survey; SCI, Self-Care Inventory; BG, blood glucose; MANOVA, multiple analysis of variance; ANOVA, analysis of variance; BMI, body mass index; ER, emergency room.

Diabetes self-care tasks are complex, demanding, and often frustrating, and they commonly lead to significant problems with long-term adherence. Of the self-care behaviors, omission or intentional underdosing of recommended levels of self-administered insulin is one of the most serious of adherence problems. Reasons for insulin omission may include fear of hypoglycemia, denial of the illness, needle phobia, attention from others (secondary gain), and direct purging of calories as a method for managing weight (1–3). Recent research suggests that insulin omission in insulin-dependent diabetes mellitus (IDDM) patients may be more common than clinicians previously assumed (3–11). In studies of population-based IDDM samples, insulin omission has been found to average 11–15% in women in young adulthood (5) and adolescence (9,11). Insulin omission was not apparent in young men (5,9). Similar findings have been reported from survey research (3,4,7,8,10). In total, these results suggest that young women with IDDM frequently omit insulin and that such omission is often associated with disordered eating behaviors.

This study was designed to address the many gaps in our understanding of this phenomenon, including the following.

1. How pervasive is insulin omission in IDDM women in a clinic population? With a focus on eating disorders, most studies have limited their samples to adolescents (3) or young adults (5,6). Is insulin omission limited to these age groups? Although some survey studies have included older respondents (<45 years of age), age differences in insulin omission have not been examined (4,8).
2. Are there important differences in the frequency of insulin omission? Some patients may omit insulin very rarely (perhaps in response to an occasional eating binge), while others may omit daily, yet studies have rarely examined omission fre-

quency (5). Do such different frequencies of insulin omission represent different syndromes that may have markedly different glycemic consequences?

3. What is the relationship between insulin omission and disordered eating behaviors? Is weight management the sole (or even primary) reason for omission? Although anecdotal data point to a number of non–weight-related factors as potential contributors to insulin omission (2), empirical studies to date have examined omission only in association with disordered eating behaviors. Other possible functions of insulin omission have not yet been examined (e.g., hypoglycemic fear). Will investigating omission from a broader perspective (regardless of the underlying motivational strategy) result in a markedly higher prevalence?
4. Is insulin omission associated with markers of poor glycemic control and long-term complications? Surprisingly, only one study has reported an association between omission and elevated HbA_1 levels (6), and it has not yet been documented that such behaviors are associated with elevated rates of diabetic ketoacidosis and/or long-term diabetic complications. A few reports have suggested that eating disorders in IDDM may be associated with an elevated risk for long-term complications (12–13). Though it has not been investigated, it is possible that insulin omission (as a function of disordered eating) may be the major mediating factor in this relationship.

RESEARCH DESIGN AND METHODS

— Before their routinely scheduled medical appointments at the Joslin Diabetes Center in Boston, Massachusetts, female patients' case records were reviewed. Those who met the following criteria were deemed eligible for the study: diagnosis of diabetes, insulin-requiring for at least 1 year before the study, between 13 and 60 years of age, not currently pregnant, and no severe visual limitations.

Table 1 gives the characteristics of the patients studied. Eligible patients (n = 531) were approached at the time of their medical visit and asked to complete the survey. Twenty patients refused, 21 patients agreed but did not return the survey, and 9 patients returned incomplete surveys. In total, 481 completed surveys (91%) were returned. The majority of the survey sample was IDDM patients (n = 391). The current analyses were limited to those subjects with IDDM whose total HbA_1 level was measured on the day they completed the survey or within 30 days of survey completion (n = 341).

Mean age was 33.1 ± 12.4 years. A large proportion of subjects had completed college (41.1%). Mean duration of diabetes was 15.7 ± 10.7 years and ranged from 1 to 55 years. The self-report survey required ~40 min to complete and included instruments assessing psychological functioning, self-care behaviors, and health outcomes.

Psychological measures

Disordered eating was assessed with the Bulimia Test-Revised (BULIT-R) (14), which comprises 36 statements focusing on attitudes and behaviors central to bulimia nervosa (binge eating, purging behaviors, and weight preoccupation). Each item is rated by respondents on a 5-point scale, with higher summed scores indicating greater pathology. Internal reliability was high (α = 0.95). Although self-report instruments cannot be used for diagnostic purposes, the BULIT-R is believed to be an adequate screening instrument for bulimia nervosa (15).

General distress was assessed with the Brief Symptom Inventory (BSI) (16), which lists 53 psychological symptoms that respondents may or may not have experienced during the previous week. Each symptom is rated on a 5-point scale of distress, from 0 ("not at all") to 4 ("extremely"). Although nine primary symptom dimensions and three global indexes can be derived, this study focused on the Global Severity Index (GSI), the most sensitive of the global indexes, reflecting level of overall distress. Internal reliability of the BSI was high (α = 0.97).

Fear of hypoglycemia was assessed with the Hypoglycemia Fear Survey (17), which focuses on worries about hypoglycemia (17 items) and behaviors designed to avoid hypoglycemia (10 items). Each item is rated on a 5-point scale, from 1 ("never") to 5 ("very often"), with higher scores signifying greater fear. In this study, only the worry subscale was administered (HFS-W). Internal reliability of the HFS-W was high (α = 0.94).

Diabetes-specific distress was assessed with the Problem Areas in Diabetes Survey (PAID) (18), which comprises 24 items, each representing an area of diabetes-specific distress. These range from difficult feelings about diabetes (e.g., "feeling angry when you think about having and living with diabetes") to interpersonal distress (e.g., "feeling that your friends and family are not supportive of your diabetes management efforts") to frustration with aspects of the regimen (e.g., "not having clear and concrete goals for your diabetes care"). Each item is rated on a 6-point scale, indicating the degree to which the item is currently felt to be problematic, from 1 ("no problem") to 6 ("serious problem"). A total scale score is computed by averaging the total item responses. Internal reliability of the PAID was high (α = 0.95).

In addition, five items were constructed to examine current attitudes toward insulin usage, weight and eating concerns, and glycemic control (e.g., "I am afraid of getting my blood sugars in good control because I will gain weight"). Each statement is rated on a 6-point scale, from 1 ("never") to 6 ("always").

Self-care measures

Regimen adherence was measured by the Self-Care Inventory (SCI) (19), which lists 14 diabetes self-care tasks (e.g., blood glucose [BG] testing). Each task item is rated on a 5-point scale, indicating how well the subject feels that she has

Table 1—*Clinical characteristics of the IDDM female sample*

	Total	Omitters	Non-omitters	Significance
n	341	104	237	
Age (years)	33.1 ± 12.4	31.3 ± 10.7	33.9 ± 13.1	NS*
Duration of diabetes (years)	15.7 ± 10.7	16.0 ± 9.4	15.5 ± 11.2	NS*
Percentage who completed college	41.1	41.4	40.9	NS†
BMI (kg/m^2)	24.2 ± 4.4	24.1 ± 4.2	24.3 ± 4.6	NS*
Insulin/kg	0.7 ± 0.3	0.6 ± 0.2	0.7 ± 0.3	NS*
Insulin injection frequency	2.2 ± 0.7	2.2 ± 0.7	2.2 ± 0.7	NS*

Data are means ± SD. Differences between omitters and non-omitters determined by *Student's *t* test or †χ^2 square test. NS, $P > 0.05$.

followed recommendations for this task during the past month, from 1 ("never do it") to 5 ("always do this as recommended without fail"). Selected items were combined into the following subscales: *1*) BG testing ("glucose recording" plus "glucose testing"), 2) use of insulin ("administering correct insulin dose," "administering insulin at right time," and "adjusting insulin intake based on blood glucose values"), 3) use of food ("eating the proper foods; sticking to a meal plan" and "eating meals on time"), and 4) use of exercise ("exercising regularly" and "exercising strenuously"). For each subscale, lower summed scores indicate poorer adherence in that particular area.

To examine differences in targeted ranges for BG values, subjects were asked to estimate the BG levels at which they felt they should begin treatment of hyperglycemia (maximally acceptable value) and of hypoglycemia (minimally acceptable value).

Four items were included that examined behaviors associated with regimen manipulation, especially those in the service of weight and eating concerns (e.g., "I take less insulin than I should," "I try to eat to the point of spilling ketones in my urine"). Each statement is rated on a 6-point scale, from 1 ("never") to 6 ("always").

Long-term complications

Medical records were examined by a research assistant who was blind to the survey responses of subjects. Where a diagnosis of retinopathy was documented in the patient's chart, the type and presence of retinopathy were recorded. Where a diagnosis of neuropathy was indicated and/or symptoms of neuropathy were documented in the patient's chart (e.g., chronic numbness or tingling in the extremities), the presence of neuropathy was assumed and so recorded. Of the 341 subjects, 280 records were examined.

BG control

Total HbA_1 was measured by an agar gel electrophoretic method (20); the normal range in our laboratory is 5.4–7.4%. The coefficient of variation is 4.42%.

Determination of insulin omission

In response to the survey statement, "I take less insulin than I should," all subjects who answered positively (indicating "always," "usually," "often," "sometimes," or "rarely") were categorized as insulin omitters (n = 104). Subjects who answered negatively (indicating "never") were categorized as non-omitters. We included as omitters those who responded "rarely" because published observations (2,21) as well as our own clinical experience suggest that such patients may underreport (or deny) such behaviors; thus, we decided to be as inclusive as possible. Among insulin omitters, those who reported omitting so that they could "overeat without gaining weight" (indicating "always," "usually," "often," "sometimes," or "rarely") were classified as weight-related omitters (n = 45), while those who denied omitting for this reason (reporting "never") were classified as non–weight-related omitters (n = 51). Following from the rationale described above, we chose to include those who responded "rarely" as weight-related omitters, again seeking to be as inclusive as possible. Of the 104 omitters, 8 did not respond to this weight-related item.

Statistical analysis

Differences between omitters and non-omitters were examined via Student's *t* tests and, where appropriate, χ^2 tests. As a pilot investigation, a correction factor was not used. Post-hoc analyses involved logistic regression, multiple analysis of variance (MANOVA), one-way analysis of variance (ANOVA), and pairwise comparison, and these are described below.

RESULTS — Of the 341 IDDM subjects, 104 (30.5%) reported omitting insulin. As displayed in Table 1, no significant differences in age, diabetes duration, education, body mass index (BMI), prescribed insulin amounts, or number of injections were observed between omitters and non-omitters. Surprisingly, reports of insulin omission were apparent across the age range. Although rates of omission seemed to peak during late adolescence and early adulthood (i.e., between 15 and 30 years of age, 40.2% reported omitting insulin), they remained markedly elevated through adulthood (30.3% in ages 31–45, 19.7% in ages 46–60).

When subjects reported omitting insulin, it generally occurred on an infrequent basis. Only eight subjects reported that they "always" omitted insulin, and six subjects indicated "usually" omitting it. Sixteen subjects reported "often" omitting, 35 subjects "sometimes," and 39 subjects "rarely." In total, only 8.8% (n = 30) of the total subject sample reported frequent omission (indicating "always," "usually," or "often"). Frequent omission was most apparent during late adolescence and early adulthood (i.e., between

Table 2—*Differences in psychosocial factors between omitters and non-omitters*

	Total	Omitters	Non-omitters	*P*
n	341	104	237	
Hypoglycemic fear (HFS-W)	37.1 ± 13.9	41.7 ± 15.3	35.2 ± 12.9	<0.0005
General distress (GSI)	56.0 ± 11.7	59.7 ± 11.5	54.2 ± 11.4	<0.0005
Diabetes-specific distress (PAID)	66.1 ± 27.1	84.3 ± 23.2	57.9 ± 24.7	<0.0005
BULIT-R	53.2 ± 22.6	66.7 ± 26.9	47.0 ± 17.7	<0.0005
Beliefs about insulin and weight				
Fears that good BG control will lead to weight gain	1.9 ± 1.4	2.8 ± 1.8	1.5 ± 1.0	<0.0005
Taking insulin regularly makes me feel bloated	1.6 ± 1.3	2.3 ± 1.7	1.3 ± 0.9	<0.0005
Taking insulin makes me gain weight	2.1 ± 1.6	2.9 ± 1.8	1.7 ± 1.3	<0.0005
Feel bloated when BG in good control	1.6 ± 1.1	2.1 ± 1.4	1.4 ± 0.9	<0.0005
Good BG control will cause me to be fat	1.7 ± 1.2	2.5 ± 1.6	1.3 ± 0.8	<0.0005
Regimen adherence (SCI)				
Use of insulin	4.2 ± 0.9	3.7 ± 0.9	4.4 ± 0.8	<0.0005
Use of BG testing	3.2 ± 1.3	2.7 ± 1.2	3.4 ± 1.2	<0.0005
Use of food	3.4 ± 1.0	3.0 ± 0.9	3.6 ± 0.9	<0.0005
Use of exercise	2.6 ± 1.2	2.4 ± 1.2	2.6 ± 1.2	NS
Patient-targeted BG values				
Acceptable low	105 ± 28	115 ± 33	101 ± 24	<0.0005
Acceptable high	173 ± 41	189 ± 39	166 ± 41	<0.0005
Regimen manipulation behaviors				
Adjusts insulin dose to control weight	1.6 ± 1.1	2.2 ± 1.4	1.3 ± 0.9	<0.0005
Tries to eat to the point of spilling urine ketones	1.2 ± 0.8	1.6 ± 1.2	1.1 ± 0.4	<0.0005
Avoids testing BG so that won't feel the need to adjust insulin	1.8 ± 1.4	2.7 ± 1.6	1.5 ± 1.0	<0.0005

Data are means ± SD. Differences determined by Student's *t* test. NS, $P > 0.05$.

15 and 30 years of age, 15.9% reported frequent omission), with fewer cases in later adulthood (4.2% in ages 31–45, 6.1% in ages 46–60).

As shown in Table 2, omitters reported more disordered eating attitudes and behaviors (higher scores on the BULIT-R) than did non-omitters. Also, omitters more strongly endorsed diabetes-specific disordered eating attitudes than did non-omitters, e.g., fearing that improved glycemic control would lead to weight gain and feeling that taking insulin regularly would lead to feeling bloated. In addition, omitters reported significantly more hypoglycemic fear (HFS-W), general distress (GSI), and diabetes-specific distress (PAID) than did non-omitters.

Omitters aimed for significantly higher ranges of BG levels than did non-omitters (Table 2). They reported targeting higher acceptable minimal values and maximal values. Omitters scored significantly lower than non-omitters on three of the four SCI subscales, indicating poorer adherence to insulin usage, BG testing, and following a meal plan. Omitters were also more likely than non-omitters to manipulate their regimen directly: adjusting their insulin dose to control their weight, promoting the spilling of ketones through eating, and avoiding BG testing to ignore necessary insulin adjustments.

Omitters manifested poorer glycemic control than non-omitters (higher mean HbA_1), higher rates of retinopathy and neuropathy, and more diabetes-associated hospitalizations during the previous year (Table 3). There were no significant differences in frequency of hypoglycemic episodes.

Given the large number of psychological variables found to differentiate

Table 3—*Differences in medical factors between omitters and non-omitters*

	Total	Omitters	Non-omitters	*P*
n	341	104	237	
Mean HbA_1 (%)	10.7 ± 2.1	11.7 ± 2.3	10.3 ± 1.8	<0.0005*
Recent hospitalizations	0.3 ± 1.1	0.6 ± 1.7	0.2 ± 0.7	<0.005*
Recent ER visits	0.4 ± 1.3	0.5 ± 1.6	0.3 ± 1.1	NS*
Neuropathy (%)	22.4	34.4	16.6	<0.0005†
Retinopathy (%)	54.6	64.5	49.8	<0.05†
Hypoglycemic events in past month	6.9 ± 7.3	7.5 ± 9.4	6.5 ± 6.1	NS*

Data are means ± SD. For HbA_1, recent hospitalization, recent ER visits, and hypoglycemic events, differences were examined by *Student's *t* test. For neuropathy and retinopathy, differences were examined by †χ^2 (for omitters, $n = 93$; for non-omitters, $n = 193$). NS, $P > 0.05$.

Table 4—*Differences in psychosocial factors between non-omitters, weight-related omitters, and non–weight-related omitters*

	Omitters			
	Weight-related	Non–weight-related	Non-omitters	*P*
n	45	51	237	
Hypoglycemic fear (HFS-W)	46.6 ± 15.0	39.6 ± 14.7	35.2 ± 12.9	<0.0005*
General distress (GSI)	64.0 ± 10.4	56.1 ± 11.6	54.2 ± 11.4	<0.0005*
Diabetes-specific distress (PAID)	96.9 ± 19.7	74.2 ± 20.5	57.9 ± 24.7	<0.0005†
BULIT-R	80.4 ± 27.1	55.4 ± 21.1	47.0 ± 17.7	<0.0005†
Beliefs about insulin and weight				
Fears that good BG control will lead to weight gain	3.9 ± 1.7	2.0 ± 1.4	1.5 ± 1.0	<0.0005†
Taking insulin regularly makes me feel bloated	3.3 ± 1.8	1.5 ± 1.2	1.3 ± 0.9	<0.0005*
Taking insulin makes me gain weight	4.0 ± 1.8	2.2 ± 1.5	1.7 ± 1.3	<0.0005*
Feel bloated when BG in good control	3.0 ± 1.5	1.4 ± 0.8	1.4 ± 0.9	<0.0005*
Good BG control will cause me to be fat	3.4 ± 1.7	1.9 ± 1.3	1.3 ± 0.8	<0.0005†
Regimen adherence (SCI)				
Use of insulin	3.3 ± 1.0	3.9 ± 0.7	4.4 ± 0.8	<0.0005†
Use of BG testing	2.4 ± 1.0	2.9 ± 1.3	3.4 ± 1.2	<0.0005*
Use of food	2.7 ± 1.0	3.2 ± 0.8	3.6 ± 0.9	<0.0005†
Use of exercise	2.5 ± 1.3	2.3 ± 1.1	2.6 ± 1.2	NS
Patient-targeted BG values				
Acceptable low	123 ± 39	107 ± 26	101 ± 24	<0.0005*
Acceptable high	191 ± 35	185 ± 44	166 ± 41	<0.0005‡
Regimen manipulation behaviors				
Adjusts insulin dose to control weight	2.7 ± 1.5	1.7 ± 1.2	1.3 ± 0.9	<0.0005†
Tries to eat to the point of spilling urine ketones	2.3 ± 1.6	1.1 ± 0.5	1.1 ± 0.4	<0.0005*
Avoids testing BG so that won't feel the need to adjust insulin	3.5 ± 1.7	2.2 ± 1.4	1.5 ± 1.0	<0.0005†

Data are means ± SD. Differences were determined by one-way ANOVA, and pairwise comparisons were investigated by Tukey's test. For pairwise comparisons, *weight-related omitters are significantly different from non–weight-related omitters and non-omitters; †weight-related omitters are significantly different from non–weight-related omitters and non-omitters and non–weight-related omitters are significantly different from non-omitters; ‡non–weight-related omitters are significantly different from non-omitters and weight-related omitters are significantly different from non-omitters. NS, $P > 0.05$.

omitters and non-omitters, logistic regression was used to identify the major psychological factors associated with insulin omission in a multivariate context. The following were selected as possible predictors of omission: disordered eating (BULIT-R), hypoglycemic fear (HFS-W), general distress (GSI), diabetes-specific distress (PAID), and the five attitude items (examining attitudes toward insulin usage, weight and eating concerns, and glycemic control). Only two variables were found to independently predict insulin omission: diabetes-specific distress ($\chi^2 = 15.28$, $P < 0.0001$) and a single item assessing attitude toward glycemic control, "I am afraid of getting my blood sugars in good control because I will gain weight" ($\chi^2 = 5.43$, $P < 0.05$).

Considering the importance of weight-related concerns in the determination of insulin omission, we decided to examine this issue more thoroughly. Of the total sample, 13% were weight-related omitters (reporting that they omitted so that they could "overeat without gaining weight") and 15% were non–weight-related omitters. A series of one-way ANOVAs revealed that the three groups (weight-related omitters, non–weight-related omitters, and non-omitters) did not differ in age, diabetes duration, or BMI. Group differences in omission rates, however, were apparent. Specifically, 49% of weight-related omitters versus only 14% of non–weight-related omitters reported frequent omission ($\chi^2 = 17.13$, $P < 0.002$). Three one-way MANOVAs were computed to examine whether the three groups differed in markers of glycemic control, regimen adherence, and psychological factors. In all three cases, the main effect for omission type was significant ($P < 0.0001$); thus, one-way ANOVAs (or, where necessary, χ^2) were then computed for each variable, followed by appropriate pairwise comparisons.

As seen in Table 4, weight-related omitters were at the greatest psychological risk, scoring significantly higher than non–weight-related omitters and non-omitters on measures of disordered eating, diabetes-specific distress, general distress, hypoglycemic fear, and diabetes-specific weight concerns (all five attitude items). In turn, non–weight-related omit-

Table 5—*Differences in medical factors between non-omitters, weight-related omitters, and non–weight-related omitters*

	Omitters			
	Weight-related	Non–weight-related	Non-omitters	*P*
n	45	51	237	
Mean HbA_1 (%)	12.3 ± 2.6	11.1 ± 2.0	10.3 ± 1.8	<0.0005*
Recent hospitalizations	1.0 ± 2.4	0.3 ± 0.8	0.2 ± 0.7	<0.0005†
Recent ER visits	0.9 ± 2.3	0.3 ± 0.6	0.3 ± 1.2	<0.005†
Neuropathy (%)	46.5	18.2	16.6	<0.0005†
Retinopathy (%)	72.1	54.6	49.8	<0.05†
Hypoglycemic events in past month	8.1 ± 9.6	7.6 ± 9.9	6.5 ± 6.1	NS

Data are means ± SD. For HbA_1, recent hospitalizations, recent ER visits, and hypoglycemic events, differences were examined by one-way ANOVA. For neuropathy and retinopathy, differences were examined with χ^2 (for weight-related omitters, $n = 43$; for non–weight-related omitters, $n = 44$; for non-omitters, $n = 193$). Pairwise comparisons were investigated by Tukey's test. For pairwise comparisons, weight-related omitters are significantly different from non–weight-related omitters and non-omitters, and non–weight-related omitters are significantly different from non-omitters; †weight-related omitters are significantly different from non–weight-related omitters and non-omitters. NS, $P > 0.05$.

ters appeared to be at moderate risk, evidencing significantly higher scores than non-omitters on measures of disordered eating, diabetes-specific distress, and diabetes-specific weight concerns (focusing on worries about improved glycemic control, but not specific concerns about insulin usage). Differences in general distress and hypoglycemic fear were not apparent.

In addition, weight-related omitters adhered significantly more poorly than did non–weight-related omitters and non-omitters, scoring lower on three of the four SCI subscales, targeting a higher minimal BG value, and more frequently adjusting their insulin dose to manage their weight, promoting the spilling of ketones through eating, and avoiding BG testing to avoid possible insulin adjustments. In turn, an intermediate level of regimen adherence was apparent among non–weight-related omitters, who scored significantly lower than did non-omitters on two of the four SCI subscales (insulin usage and following a meal plan) and reported more frequent insulin adjustment for weight management as well as more frequent avoidance of BG testing.

As seen in Table 5, weight-related omitters appeared to be at the greatest medical risk, evidencing significantly poorer glycemic control, more frequent diabetes-related hospitalizations and emergency-room (ER) visits, and higher rates of retinopathy and neuropathy than did non–weight-related omitters and non-omitters. In turn, non–weight-related omitters manifested significantly poorer glycemic control than non-omitters, though no other differences were apparent.

DISCUSSION — These data suggest that insulin omission in IDDM women is not unusual, occurring in ~31% of respondents. Remarkably, although omission is commonly considered to occur only in young women, examination of these results indicate that such behaviors occur across the life span. Among omitters, however, the majority reports that they omit only rarely. Yet, 9% of respondents report frequent omission of insulin. Not surprisingly, frequent omission appears to be most common among young women, ages 15–30, affecting 16% of these respondents. Insulin omission was found to be strongly associated with added medical risks. Consistent with the findings of LaGreca et al. (6), omitters evidenced significantly poorer glycemic control than did non-omitters. Importantly, omission was also linked to higher rates of retinopathy and neuropathy, diabetes-related hospitalizations, and diabetes-related ER visits. These results support and extend recent findings indicating that young, eating-disordered women with IDDM (many of whom are, presumably, omitting insulin) may be at higher risk for the development of long-term complications (12–13).

Not surprisingly, omission was also associated with poor adherence to a wide range of diabetes self-care behaviors, including omitters' aiming for an elevated range of BG levels. Although causal connections cannot be made, these results suggest that omission may represent a much more pervasive failure of diabetes self-care and may be very costly to the individual (and the health-care system) in the short and long term.

As observed in previous studies, there was a strong association between omission and disordered eating attitudes and behaviors. Attitudes toward insulin usage and glycemic control also figured prominently; for example, omitters reported being more fearful than non-omitters that improved glycemic control would lead to weight gain. These data suggest that the link between omission and disordered eating may be complicated by important diabetes-specific factors and that patients preoccupied with eating and weight concerns may also become fearful of normoglycemia (and the associated weight-related consequences), thus reinforcing the need to omit insulin and maintain elevated BG levels. In addition, insulin omission was also linked to fear of hypoglycemia, general emotional distress, and diabetes-specific distress. Among this large group of predictors, only diabetes-specific distress and fear of improving glycemic control ("because then I will gain weight") emerged as independent predictors. Again, although direction of causality cannot be determined, these data suggest that diabetes-

specific attitudes, especially those associated with weight preoccupation and with feeling emotionally overwhelmed by diabetes, may be the strongest determinants of insulin omission.

These findings also indicate that there may be different types of omitters. First, approximately half of the omitters, or 13% of the total subject sample, were identified as omitting primarily for reasons related to weight management. This percentage is consistent with earlier findings that documented weight-related insulin omission, from a variety of samples of young IDDM women, in 11% (5,11) and 15% (9) of subjects. However, an additional group of omitters were identified in our study, representing approximately half of the omitters or 15% of the total subject sample, who denied omitting insulin for weight-related reasons. For this latter group, feelings of being emotionally overwhelmed by diabetes seemed the most paramount in promoting insulin omission.

Examination of these data suggest that weight-related omission is markedly more pathological in nature than is non–weight-related omission, with weight-related omission likely to be the major contributor to the deleterious medical effects noted above. Indeed, weight-related omission was strongly linked to increased medical risks, with this subject group characterized by the poorest glycemic control and the highest rates of retinopathy and neuropathy, diabetes-related hospitalizations, and diabetes-related ER visits. These increased risks may be due to the group's poorer adherence to self-care behaviors, especially to their significantly higher rate of insulin omission. Although non–weight-related omitters may appear less pathological, it must be emphasized that they remain at risk, demonstrating significantly poorer glycemic control than non-omitters.

Although considerable excitement has followed the recent release of the Diabetes Control and Complications Trial results (22) and the hope of translating these findings into improved diabetes management, it must be noted that for many patients, as these current data indicate, improved glycemic control may not be an exclusively positive therapeutic goal. A substantial number of IDDM women may be engaged in balancing, often covertly, their needs for optimal self-management with weight concerns and/or with issues concerning diabetes-focused distress. These findings suggest that insulin omission is not uncommon, that it is not limited to younger women, and that the costs of omission, especially frequent omission, may be severe. These data suggest that it is important that clinicians recognize, acknowledge, and respect the importance of weight issues in their IDDM patients. The health-care team should prepare the patient for the temporary weight gain that often accompanies improving glycemic control, initiate discussions about their patients' potential weight concerns, take time to listen to their patients' worries, and refer overweight patients to weight-loss programs that have been successful with IDDM patients. Because insulin omission may become a habit that is not easily abandoned, especially when in the service of weight management, referral to a mental-health practitioner who is knowledgeable about diabetes and disordered eating should be considered as a potentially important component of the treatment plan.

Acknowledgments— This study was supported by grants from the National Institute of Diabetes and Digestive and Kidney Diseases to the Diabetes Education and Research Center of Joslin Diabetes Center and from the Herbert Graetz Fund.

References

1. Brink SJ: Pediatric and adolescent nutrition issues. In *Pediatric and Adolescent Diabetes Mellitus*. Brink SJ, Ed. Chicago, New Book Medical, 1987, p. 273–303
2. Chase HP, Rainwater NG: Missed insulin injections. *Pract Diabetology* 8:20–23, 1989
3. Rodin GM, Craven J, Littlefield C, Murray M, Daneman D: Eating disorders and intentional insulin undertreatment in adolescent females with diabetes. *Psychosomatics* 32:171–176, 1991
4. Birk R, Spencer M: The prevalence of anorexia nervosa, bulimia, and induced glycosuria in diabetic females (Abstract). *Diabetes* 36 (Suppl. 1):88A, 1987
5. Fairburn CG, Peveler RC, Davies B, Mann JI, Mayou RA: Eating disorders in young adults with insulin-dependent diabetes mellitus: a controlled study. *Br Med J* 303: 17–20, 1991
6. LaGreca AM, Schwarz LT, Satin W: Eating patterns in young women with IDDM: another look. *Diabetes Care* 10:659–660, 1987
7. Marcus MD, Wing RR, Jawad A, Orchard TJ: Eating disorders symptomatology in a registry-based sample of women with insulin-dependent diabetes mellitus. *Int J Eating Disord* 12:425–430, 1992
8. Marcus MD, Wing RR, McDermott MD, Dodge BA: Disordered eating is related to glycemic control in a population-based sample of women with IDDM (Abstract). *Diabetes* 39 (Suppl. 1):9A, 1990
9. Peveler RC, Fairburn CG, Boller I, Dunger D: Eating disorders in adolescents with IDDM: a controlled study. *Diabetes Care* 15:1356–1360, 1992
10. Stancin L, Link DL, Reuter JM: Binge eating and purging in young women of with IDDM. *Diabetes Care* 12:601–603, 1989
11. Striegel-Moore RH, Nicholson TJ, Tamborlane WV: Prevalence of eating disorder symptoms in preadolescent and adolescent girls with IDDM. *Diabetes Care* 15: 1361–1368, 1992
12. Colas C, Mathieu P, Tchobroutsky G: Eating disorders and retinal lesions in type 1 (insulin-dependent) diabetic women. *Diabetologia* 34:288, 1991
13. Steel JM, Young RJ, Lloyd GG, Clarke BF: Clinically apparent eating disorders in young diabetic women: associations with painful neuropathy and other complications. *Br Med J* 294:859–861, 1987
14. Thelen MH, Farmer J, Wonderlich S, Smith M: A revision of the bulimia test: the BULIT-R. *Psychol Assessment* 3:119–124, 1991
15. Welch G, Hall A: The reliability and discriminant validity of three potential measures of bulimic behaviors. *J Psychiatr Res*

23:125–133, 1989
16. Derogatis LR, Melisaratos N: The brief symptom inventory: an introductory report. *Psychol Med* 13:595–605, 1983
17. Cox DJ, Irvine A, Gonder-Frederick L, Nowacek G, Butterfield J: Fear of hypoglycemia: quantification, validation, and utilization. *Diabetes Care* 10:617–621, 1987
18. Polonsky WH, Anderson BJ, Lohrer PA, Schwartz C: Assessment of diabetes-specific distress. Presented at the Invitational Conference for Behavioral Research in Diabetes, Miami, Florida, 1991
19. Greco P, LaGreca AM, Ireland S, Wick P, Freeman C, Agramonte R, Gutt M, Skyler JS: Assessing adherence in IDDM: a comparison of two methods (Abstract). *Diabetes* 39 (Suppl. 1):165A, 1990
20. Hayes EJ, Gleason RE, Soeldner JS, Wacks M, Blankstein L: Measurement of hemoglobin A1 by liquid chromatography and by agar gel electrophoresis compared. *Clin Chem* 27:467–479, 1981
21. Szmukler GI: Anorexia nervosa and bulimia in diabetics. *J Psychosom Res* 28: 365–369, 1984
22. The Diabetes Control and Complications Trial Research Group: The effect of intensive treatment of diabetes on the development and progression of long-term complications in insulin-dependent diabetes mellitus. *N Engl J Med* 329:977–986, 1993