Isn't This Just Bedtime Snacking?

The potential adverse effects of night-eating symptoms on treatment adherence and outcomes in patients with diabetes

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OBJECTIVE — Night-eating syndrome is characterized by excessive eating in the evening and nocturnal awakening with ingestion of food. Psychosocial variables and emotional triggers may be associated with these behaviors. In patients with diabetes, such behaviors may lead to glucose dysregulation and contribute to obesity and complications.

RESEARCH DESIGN AND METHODS — In 714 tertiary care patients with type 1 and 2 diabetes, we determined the proportion of patients reporting eating >25% of their daily food intake after regular suppertime. We also screened patients for major depression, childhood maltreatment histories, nonsecure attachment styles, and emotional eating triggers. We examined whether patients reporting night-eating behaviors had greater psychosocial distress, higher HbA_{1c} (A1C) levels, more obesity, and more diabetes complications compared with patients without night-eating behaviors.

RESULTS — Night-eating behaviors were reported in 9.7% of patients. Compared with patients without night-eating behaviors, those with these behaviors were less adherent with diet, exercise, and glucose monitoring and more likely to be depressed, to report childhood maltreatment histories, to have nonsecure attachment styles, and to report eating in response to anger, sadness, loneliness, worry, and being upset. Controlling for age, sex, race, and major depression, patients with night-eating behaviors, compared with patients without night-eating behaviors, were more likely to be obese (odds ratio 2.6 [95% CI 1.5–4.5]), to have A1C values >7% (2.2 [1.1–4.1]) and to have two or more diabetes complications (2.6 [1.5–4.5]).

CONCLUSIONS — Night-eating behaviors are associated with adverse outcomes in patients with diabetes. Use of clinical screening tools may help identify patients with night-eating behaviors.

Diabetes Care 29:1800–1804, 2006

Several reasons for suboptimal adherence with self-care and treatment regimens in patients with diabetes have been described (1–3). Behavioral perturbations related to psychiatric or psychological conditions that significantly affect diabetes self-care are common (1,4) and potentially modifiable (5–7) but may not be recognized. For example, comorbid depression in patients with diabetes is associated with decreased adherence to dietary plans, exercise regimens, and smoking cessation and with lapses in refills of disease-controlling medications (oral hypoglycemic medications, lipid-lowering medications, and antihypertensive agents) (1). Eating disorders, such as binge eating, bulimia, and subthreshold eating disorders, have been shown to be more prevalent among patients with type 1 and 2 diabetes than among medical control subjects (8–10). The disturbed eating patterns associated with such eating disorders can have significant negative consequences in diabetic patients, including poorer dietary and glucose control and a greater likelihood of diabetes complications (4). A less studied, but potentially clinically significant and prevalent form of eating disorder, among diabetic patients is an eating pattern called night-eating syndrome (NES).

NES has been defined as a circadian delay in daily food intake distinguished by: *1*) >25% daily food intake after the evening meal and/or *2*) waking at night to eat at least three times per week (11). In addition to eating greater amounts of food in the evening hours, patients with NES often choose disproportionately large quantities of fat- and carbohydrate-rich foods nocturnally (12–14), thus further challenging self-care regimens that aim to regulate glucose and lipid levels. Additional clinical complexity in diabetic patients with NES results from the fact that patients with eating disorders, including NES, often have comorbid affective symptoms such as depression (15,16). As with most eating disorders or syndromes, an intense need for regulating negative emotions, often through impulsive eating, is exacerbated when there is comorbid stress (17). In this study, we examined night-eating symptoms and diabetes care management strategies of patients with type 1 or type 2 diabetes. We hypothesized that compared with diabetic patients without night-eating symptoms, those with such symptoms would have poorer adherence to diabetes regimens and more diabetes complications.

RESEARCH DESIGN AND METHODS

— This cross-sectional observational study was conducted at the University of Washington Diabetes Care Center in Seattle, Washington. Eligible participants included all English-speaking Diabetes Care Center patients, aged ≥18 years, who had at least two clinic appointments, the most recent within the past 6 months. Patients with severe cognitive or language deficits, which might prevent them from reason-

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Received for publication 7 February 2006 and accepted in revised form 28 April 2006.

Abbreviations: NES, night-eating syndrome; PHQ-9, Patient Health Questionnaire-9.

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

DOI: 10.2337/dc06-0315

ing and communicating, were excluded. In April 2003, 1,583 potential subjects were sent an approach letter briefly describing the study. Two weeks later, subjects received a questionnaire and consent form that fully explained the study and requested permission for a review of automated medical records. A reminder letter, consent form, and duplicate questionnaire were sent to nonrespondents after 3 weeks. Subjects received a $5 compensation for participating in the study. Study protocols were developed at the University of Washington Department of Psychiatry and Behavioral Sciences and reviewed and approved by the University of Washington institutional review board. All participants gave written informed consent.

Self-report instruments

Night-eating symptoms. We used a single question from O'Reardon et al. (11) to determine the amount of daily food intake that patients consumed after suppertime. Responses were stratified into 25% increments: 0% ($n = 163$), 1–25% ($n = 458$), 26–50% ($n = 52$), 51–75% ($n = 13$), and 76–100% ($n = 4$). We classified individuals stating that they consumed >25% of their daily intake after suppertime as having night-eating symptoms.

Depression. The Patient Health Questionnaire-9 (PHQ-9) was used to screen for depression. This questionnaire provides a dichotomous diagnosis of major depression. The PHQ-9 diagnosis of major depression has been found to have high sensitivity (73%) and specificity (98%) for the diagnosis of major depression by structured interview (18,19). The criteria for major depression required the patient to have at least 2 weeks of five or more symptoms present for more than half the days, with at least one of these symptoms being depressed mood or anhedonia. We also report the single PHQ-9 item assessing sleep to document proportion of patients reporting sleep disturbance.

Medical comorbidity. Based on the methods of Wells et al. (20), we estimated nondiabetes medical comorbidity by having patients check how many of 18 listed medical conditions they had.

Diabetes self-care. We used a brief, valid, self-report questionnaire, the Summary of Diabetes Self-Care Activities, to assess four diabetes self-care domains: diet, exercise, blood glucose testing, and foot care (21). Each domain consists of two items, which are averaged, and assesses adherence to self-care over the prior week. For diet, we used the general diet score. We also determined patients' categorical smoking status based on one item from the Summary of Diabetes Self-Care Activities.

Diabetes symptoms reporting. To assess diabetes symptoms, we used the Self-Completion Patient Outcome (22) instrument to measure the following eight diabetes symptoms: blurred vision, thirst, polyuria, excessive hunger, shakiness, fatigue, paresthesias, and feeling faint. Items were rated on a Likert scale, and we calculated the total number of symptoms that were experienced at least "several days" in the past month.

Diabetes complications. Patients were given a score from 0–5 to reflect the number of the following complications they experienced: retinopathy, neuropathy, nephropathy, cardiovascular disease, and peripheral vascular disease. Similar counts of checklists of diabetes complications have been shown to be highly correlated with ratings of severity of diabetes from independent physician assessment ($r = 0.72$, $P < 0.001$) (23).

Childhood Trauma Questionnaire. To screen for a history of childhood maltreatment, we used seven Childhood Trauma Questionnaire (24) items that have high item-total correlations with each of their respective subscales: physical, emotional, and sexual abuse and physical and emotional neglect (25).

Relationship style. Participants completed the four-item Relationship Questionnaire (26), which assesses four attachment styles (i.e., secure, dismissing, fearful, and preoccupied) categorically in response to four descriptive paragraphs and demonstrates convergent and discriminant validity with other self-report and interview ratings (26). Patients are asked to choose the attachment style category that suits them best. We report the percentage of patients who chose a nonsecure attachment style. Nonsecure attachment style is associated with less flexible interpersonal strategies of interacting, particularly at times of distress. For example, individuals with nonsecure attachment styles may be highly self-reliant, may be fearful of intimacy, or, conversely, may be excessively dependent on others.

Other assessments. In addition, we assessed demographic characteristics (age, sex, race, education level, and marital status) and clinical characteristics (duration of diabetes, diabetes treatment, smoking status, and BMI) from self-report questions. Patients were classified as having type 1 diabetes if age of onset of diabetes was <30 years, insulin was the first treatment prescribed, and they were currently receiving insulin. We also used automated data to determine mean A1C values for each subject from the preceding 12 months. The mean number of A1C tests in this population was 2.5 per year (range 1–14). To analyze A1C levels, the University of Washington Diabetes Care Center uses a Bayer DCA2000 analyzer, which is certified by the National Glycohemoglobin Standardization Program as having documented traceability to the Diabetes Control and Complications Trial reference method. The inter- and intra-assay coefficients of variation were 3.0 and 3.7%, respectively.

Statistical analysis

With SPSS 11.0 (SPSS, Chicago, IL), we used χ^2 analyses and two-tailed t tests to examine differences between night-eating symptom groups (presence or absence of night-eating symptoms) on baseline demographic, clinical, and psychosocial characteristics. To determine whether the presence of night-eating symptoms was associated with A1C >7%, obesity (BMI >30 kg/m^2), or having two or more diabetes complications, we conducted three logistic regression analyses and controlled for potential confounders that also showed differences between night-eating symptom groups in bivariate analyses.

RESULTS — Of 1,583 patients, 714 (45%) responded to the survey. There were no significant differences between respondents and nonrespondents on age. There were, however, more women among respondents compared with nonrespondents ($n = 399$ [56%] vs. $n = 382$ [44%], $P < 0.001$).

Among respondents to the survey, 69 (9.7%) reported having night-eating symptoms (i.e., more than 25% of food intake after suppertime). Table 1 demonstrates that compared with patients without night-eating symptoms, those with night-eating symptoms were younger, were less likely to be married or living as married, and were less likely to be Caucasian. Table 2 shows that compared with patients without night-eating symptoms, those with night-eating symptoms were significantly less likely to be adherent with diet, exercise, and glucose monitoring; reported significantly more sleep disturbance and diabetes symptoms; and

Table 1—*Demographic characteristics by night-eating symptom status*

	All patients	Night-eating symptoms	No night-eating symptoms	Test statistics (χ^2)
n	714	68 (9.7)	645 (90.3)	
Female sex	399 (56.0)	42 (60.9)	357 (55.4)	0.39
Caucasian race	615 (88.5)	52 (77.6)	563 (89.6)	8.61*
Married or living as married	459 (65.3)	35 (51.5)	424 (66.8)	6.34†
At least 1 year of college	621 (88.7)	58 (85.3)	563 (80.4)	0.35
Age tertiles (years)				9.24*
18–39	242 (33.9)	31 (44.9)	211 (32.7)	
40–56	233 (32.6)	26 (37.7)	207 (32.1)	
≥57	239 (33.5)	12 (17.4)	227 (35.2)	

Data are *n* (%). *$P < 0.01$; †$P < 0.05$.

were significantly more likely to report having neuropathy.

In Table 3, it is demonstrated that night-eating symptoms are associated with psychosocial variables. Compared with patients without night-eating symptoms, those with night-eating symptoms were significantly more likely to have major depression, to eat in response to emotions (anger, sadness, loneliness, worry, or being upset), and to report childhood maltreatment (e.g., sexual abuse and coercion, physical abuse, or parental neglect) and were more likely to have a nonsecure attachment style.

Logistic regression models controlling for age, sex, race, and major depression status demonstrated that compared with patients without night-eating symptoms, those with night-eating symptoms were significantly more likely to have A1C values >7% (odds ratio 2.2 [95% CI 1.1–4.1]), to be obese (2.6 [1.5–4.5]), and to have two or more diabetes complications (2.6 [1.5–4.5]) (Table 4).

Table 2—*Clinical characteristics by night-eating symptom status*

	All patients	Night-eating symptoms	No night-eating symptoms	Test statistics (χ^2)
n	714	68 (9.7)	645 (90.3)	
Type 2 diabetes	303 (42.4)	33 (47.8)	270 (41.9)	0.34
Smoking status	74 (10.6)	11 (16.4)	63 (10.0)	2.62
Use of insulin	595 (84.5)	58 (85.3)	537 (84.4)	0.04
Use of oral hypoglycemic medications	217 (30.8)	16 (23.5)	201 (31.6)	1.88
Medical comorbidity (mean number of medical conditions)	2.0 (2.0)	2.3 (2.4)	1.9 (1.9)	1.64
Diabetes complications				
Retinopathy	227 (32.4)	28 (41.2)	199 (31.5)	2.63
Neuropathy	235 (33.8)	31 (45.6)	204 (32.5)	4.71*†
Nephropathy	117 (16.9)	15 (22.1)	102 (16.3)	1.44
CVD	89 (12.7)	9 (13.2)	80 (12.7)	0.02
PVD	65 (9.3)	8 (11.8)	57 (9.0)	0.54
Treatment adherence				
Diet	5.0 (1.8)	4.0 (1.9)	5.1 (1.7)	4.91†‡
Exercise	2.9 (2.1)	2.3 (1.9)	3.0 (2.1)	2.61†§
Glucose monitoring	5.9 (1.8)	5.1 (2.3)	6.0 (1.7)	4.39†‡
Foot care	2.6 (2.2)	2.9 (2.3)	2.6 (2.2)	0.87
Diabetes duration (years)	16.3 ± 12.1	15.1 ± 13.4	16.4 ± 12.0	0.83
Sleep disturbance more than half days in past 2 weeks	221 (31.7)	35 (52.2)	186 (29.5)	14.5†‡
Total number diabetes symptoms (of eight)	1.7 ± 1.7	2.6 ± 2.1	1.6 ± 1.6	4.64‖

Data are *n* (%) or means ± SD. *$P < 0.05$; †significant after Bonferroni adjustment for multiple comparisons within category; ‡$P < 0.001$; §$P < 0.01$; ‖$F(2,711)$. CVD, cardiovascular disease; PVD, peripheral vascular disease.

CONCLUSIONS — In evaluating 714 patients with type 1 and 2 diabetes in a large tertiary care clinic, 9.7% of patients reported eating >25% of their daily food intake after their evening meal. In this large sample, a single questionnaire item about nocturnal food intake discriminated patients who had significantly more depression, childhood maltreatment, and maladaptive interpersonal interactions and who reported eating in response to commonly experienced emotional triggers such as anger, sadness, loneliness, worry, or being upset. In examining patients with NES and those without, there was no difference in the proportion of subjects who used insulin, which can stimulate the appetite, versus those who did not. Our results also indicated a significant association between night-eating symptoms and obesity, elevated A1C, and number of complications. Caution in interpreting these cross-sectional results is required, but these findings suggest that adverse diabetes self-management and outcomes may be associated with night-eating behaviors.

Limitations of this study include its cross-sectional nature and the fact that we only used a single, albeit cardinal, item for screening for night-eating behaviors. In this population-based study, we did not formally administer complete questions from diagnostic questionnaires or from proposed NES criteria to establish what is currently determined to be NES (7,11,12,17). Also, although this tertiary care sample was large, the results may not be generalizable to diabetic patients in primary care. The response rate was 45%, and we were not able to characterize nonrespondents demographically or clinically other than by age and sex. Strengths of this study include its large sample size, availability of automated laboratory data (A1C), and relatively extensive examination of psychosocial variables (depression, childhood maltreatment, and interpersonal styles).

Future studies are necessary to further explore the relevance of NES as a potentially common clinical condition in patients with diabetes. Studies will benefit from using examination of the most up-to-date established NES criteria, from longitudinal sampling to better under-

Table 3—*Psychosocial characteristics by night-eating symptom status*

	All patients	Night-eating symptoms	No night-eating symptoms	Test statistics (χ^2)
n	714	68 (9.7)	645 (90.3)	
Major depression	66 (9.5)	13 (19.7)	53 (8.4)	8.83*
Emotional eating triggers				
Anger	138 (19.3)	21 (34.8)	114 (17.7)	11.7†‡
Sadness	286 (40.1)	38 (55.1)	248 (38.4)	7.17*‡
Loneliness	287 (40.2)	44 (63.8)	243 (37.7)	17.66†‡
Worry	253 (35.4)	41 (59.4)	212 (32.9)	19.21†‡
Being upset	217 (30.4)	31 (44.9)	186 (28.8)	7.63†‡
Childhood Trauma Questionnaire				
Family was a source of strength	440 (64.0)	33 (50.8)	407 (65.3)	5.41§
Frightened of being hurt	136 (19.8)	26 (38.2)	110 (17.7)	16.23†‡
Someone in family hated individual	88 (12.9)	19 (27.9)	69 (11.2)	15.25†‡
Sexual abuse	74 (10.9)	15 (22.4)	59 (9.6)	10.19*‡
Sexual coercion	23 (3.4)	7 (10.3)	16 (2.6)	11.16†‡
Physical abuse	83 (12.1)	16 (23.5)	67 (10.8)	9.27*‡
Parental neglect	46 (6.7)	11 (16.4)	35 (5.6)	11.27†‡
Nonsecure attachment style	382 (53.5)	46 (66.7)	336 (52.1)	5.32‡§

Data are *n* (%). For Childhood Trauma Questionnaire items, 25% of cells had counts of <5, so Fisher's exact test was used. *$P < 0.01$; †$P < 0.001$; ‡significant after Bonferroni adjustment for multiple comparisons within category; §$P < 0.05$.

stand causal relationships between night-eating behaviors and diabetes outcomes, and from sampling of primary care populations. Such measures will improve the generalizability of findings to patients with diabetes in the general population. Past efforts to understand NES have included neuroendocrine studies, which can be particularly relevant in a diabetic population. Allison et al. (14) have investigated leptin, a satiety peptide hormone, in NES patients and showed no significant difference in its levels in NES patients versus control subjects. Further research on the roles of endogenous satiety peptides and neuroendocrine hormones in relation to NES may possibly elucidate options for treating NES, given the relatively new medications, exenatide and pramlintide acetate, which mimic other satiety hormones, respectively, glucagon-like peptide 1 (27) and amylin (28).

These results indicate that a significant proportion of patients with diabetes have disturbances of dietary intake characterized by emotionally triggered eating at night. These patients often have greater sleep disturbance, and their behavior is potentially associated with poorer dietary adherence and diabetes outcomes. Treatment of this comorbid condition may be best approached in several stages. We believe patients who screen positive to the single item used in this current study may benefit from further comprehensive assessment of NES criteria as well as assessment of related eating disorders (e.g., bulimia or binge eating) and depression and anxiety symptoms. Treatment of comorbid psychiatric disorders through psychotherapeutic or pharmacotherapeutic means may not only be helpful but also may be essential in appropriately addressing maladaptive eating patterns (29). Providing alternative strategies for coping with painful emotions, including the capacity to process stressors and feelings through a safe therapeutic alliance, may allow a patient to regulate affect without resorting to disturbed eating patterns (29). A second step may be to directly address eating patterns and sleep disturbance through relaxation training and cognitive and behavioral strategies, which have been shown to be helpful in the treatment of NES (5,29). Selective serotonin reuptake inhibitors may also decrease nocturnal eating (7,30). Pharmacotherapeutic aids for sleep disturbance may decrease the opportunities for nocturnal eating in response to emotions. We believe that education about diabetes self-care and the interrelationships between self-care behaviors, affect, and diabetes outcomes will provide patients with an essential understanding of the behavioral, psychological, and physiological mechanisms underlying the clinical manifestations of these eating patterns.

Table 4—*Clinical characteristics and outcomes by night-eating symptom status*

Clinical characteristic	All patients	Night-eating symptoms	No night-eating symptoms	Odds ratio (95% CI)
n	714	68 (9.7)	645 (90.3)	
A1C >7%	429 (64.0)	53 (77.9)	376 (62.5)	2.2 (1.1–4.1)
BMI >30 kg/m^2	229 (32.1)	33 (47.8)	196 (30.4)	2.6 (1.5–4.5)
Complications (two or more)	194 (27.2)	28 (40.6)	166 (25.7)	2.6 (1.5–4.5)

Odds ratio represents the odds of having the clinical characteristic in patients with night-eating symptoms compared with those without night-eating symptoms. Logistic multivariate models control for age, sex, race, and major depression status. A 95% CI >1.0 represents a significance level of $P < 0.05$.

Acknowledgments— This study was supported by National Institute of Diabetes and Digestive and Kidney Diseases Grant K23 DK60652-01 (to P.S.C.).

We thank Dr. Kelly C. Allison and Dr. Gayle Reiber for their contributions to this article.

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