Research report

Night eating in patients with type 2 diabetes. Associations with glycemic control, eating patterns, sleep, and mood ☆

Megan M. Hood [a,*], Sirimon Reutrakul [a,b], Stephanie J. Crowley [a]

[a] Rush University Medical Center, 1653 West Congress Pkwy, Chicago, IL 60612, USA
[b] Division of Endocrinology and Metabolism Faculty of Medicine, Ramathibodi Hospital Mahidol University, Bangkok, Thailand

ABSTRACT

Night eating is a complex behavior associated with disruptions in eating, sleep, and mood regulation. While night eating has been associated with alterations in neuroendocrine functioning, night eating and Night Eating Syndrome (NES) are not well understood in patients with prevalent metabolic conditions, such as diabetes. In this study, 194 adults with Type 2 diabetes completed questionnaires assessing night eating symptoms as well as eating, sleep, and depressive symptoms. Glycemic control data, as measured by hemoglobin A1c (HbA1c), were gathered from patient medical charts. Results indicated that 7% of participants met criteria for NES. Increased symptoms of night eating were associated with poorer glycemic control and disruptions in eating, sleep, and mood, including significantly increased likelihood of having HbA1c levels >7% and endorsing clinical levels of depressive symptoms. Increasing understanding of the relationship between night eating and metabolic and psychosocial functioning in patients with diabetes may provide new avenues for treatment of these patients.

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Introduction

Night eating, characterized by a circadian delay in daily food intake, has been associated with alterations in neuroendocrine functioning, including food regulatory rhythms such as leptin, ghrelin, and insulin, and as well as circadian melatonin and cortisol rhythms (Birketvedt et al., 1999; Goel et al., 2009; Milano, De Rosa, Milano, & Capasso, 2011). Despite these links between night eating and metabolic functioning, only a small number of studies have investigated night eating in patients with diabetes. As recent research suggests that night eating symptoms may be a modifiable behavior through the use of psychotherapy (Allison, Lundgren, Moore, O'Reardon, & Stunkard, 2010a; Pawlow, O'Neil, & Malcom, 2003) and/or pharmacotherapy (Allison & Tarves, 2011; O'Reardon et al., 2006; O'Reardon, Stunkard, & Allison, 2004; Stunkard et al., 2006; Vander Wal, Gang, Griffing, & Gadde, 2012), gaining a better understanding of the role of night eating in diabetes is warranted in order to identify potential factors that could improve metabolic functioning in patients with Type 2 diabetes.

Night eating behaviors are commonly studied in the context of Night Eating Syndrome (NES). NES is categorized as an "other specified eating or feeding disorder" in the DSM-V (American Psychiatric Association, 2013) and is characterized by recurrent night eating episodes manifested by consuming excessive amounts of food after the evening meal (evening hyperphagia, EH) or eating after awakening from sleep (nocturnal ingestion, NI). EH is typically defined as consuming greater than 25% of daily calories after the evening meal (Allison et al., 2010b). Additional diagnostic criteria include 1) the individual has awareness/recall of eating; 2) symptoms are not due to external influences (e.g. local social norms); 3) significant distress and/or impairment in functioning is experienced; and 4) symptoms are not explained by another mental or medical disorder (American Psychiatric Association, 2013). In addition to the cardinal symptoms of EH and NI, patients with NES may experience morning anorexia or breakfast skipping, an intense urge to eat at night, insomnia, a perceived need to eat to initiate or return to sleep, and depressed mood (Allison et al., 2010b). NES is therefore a complex syndrome that includes symptoms related to poor eating, sleep, and mood regulation.

In the few studies that have examined night eating symptoms in patients with diabetes, prevalence ranged from 8.4% to 12.4% (Allison et al., 2007; Morse, Katon, Ciechanowski, & Hirsch, 2006; Schwandt, de Zwaan, & Jager, 2012), with some variability attributable to differing definitions of night eating. For example, some studies (Morse et al., 2006; Schwandt et al., 2012) have defined night eating by the EH criteria alone, typically relying on participants' self-reported estimate of the percentage of calories they consume after

the evening meal. In the only study of diabetes patients to use the Night Eating Questionnaire (NEQ; Allison et al., 2007), the most commonly used self-report screening measure of night eating symptoms, 8.4% of participants met the cutoff for NES (Allison et al., 2007). These rates suggest higher prevalence than those found in the general population (1.1–1.5%; Rand, Macgregor, & Stunkard, 1997; Stunkard, Allison, & Lundgren, 2008) and are comparable with those found in obesity clinics (6–14%; Adami, Meneghelli, & Scopinaro, 1999; Ceru-Bjork, Andersson, & Rossner, 2001; Gluck, Geliebter, & Satov, 2001; Rand et al., 1997; Stunkard et al., 1996) and in patients with other medical conditions comorbid with obesity, such as obstructive sleep apnea (8.6%; Olbrich et al., 2009).

Evidence of the relationship between night eating and glycemic control is mixed, possibly due to differences in symptom measurement and study samples. For example, Morse et al. (2006) (whose sample included both Type 1 and Type 2 diabetes patients) and Schwandt et al. (2012) found poorer glycemic control in patients with night eating, which was measured through self-reported EH. Allison et al. (2007) measured night eating symptoms using the more comprehensive Night Eating Questionnaire (Allison et al., 2008) and found no difference in HbA1c values, though their sample included patients meeting full criteria for NES and was combined with patients with binge eating disorder. Further studies assessing the role of night eating measurement (both subclinical night eating behavior and NES) are needed to clarify the association between night eating and glycemic control.

Morse et al. (2006) found that patients with diabetes who endorsed evening hyperphagia exhibited poorer adherence to diet, exercise, and glucose monitoring and reported more depression and emotional eating compared with participants without night eating symptoms. In addition, these patients had a higher relative risk of obesity, HbA1c values >7% (an indicator of inadequate glycemic control), and having two or more diabetes complications. Further investigation of this modifiable behavior and its associated eating, sleep, and mood symptoms in patients with diabetes is warranted in order to gain more detailed information about the relationships between night eating and metabolic and psychosocial functioning. This information may be particularly useful in informing treatment strategies that could improve functioning in these areas.

The aims of this exploratory study were 1) to assess the prevalence of night eating and associated eating, sleep, and mood components in patients with Type 2 diabetes and 2) to determine the associations between these constructs and relevant metabolic and psychosocial variables.

Methods

Participants and procedure

Participants were recruited from endocrinology clinics at Rush University Medical Center via fliers and direct contact from study staff during their medical appointments. Eligible participants were adults with Type 2 diabetes who were not pregnant, were able to read English, and were not dependent on others for feeding. All participants gave written informed consents. The study was approved by the Rush University Medical Center institutional review board and was carried out in accordance with *The Code of Ethics of the World Medical Association for experiments involving humans.*

Participants completed a packet of questionnaires and were weighed on a medical scale. Study staff reviewed questionnaires regarding diabetes history and food intake with participants to ensure validity of responses. Height and most recent hemoglobin A1c (HbA1c, a measure of average plasma glucose concentration) values were extracted from patient medical records.

Measures

Demographics

Participants self-reported their age and sex. Body mass index (BMI, kg/m^2) was calculated from the weight measured at the study visit and the height listed in the medical chart.

Diabetes and glycemic functioning

The most recent HbA1c recorded in the medical records was collected. The number of diabetes-related medical complications was calculated from the University of Chicago Diabetes/Quality of Life Survey (Meltzer, 2000), a structured interview that includes an item asking participants whether they have been diagnosed with any of the following conditions: neuropathy, nephropathy, retinopathy, peripheral vascular disease, or coronary artery disease.

Eating patterns

Participants completed a 24-hour food log of the previous day's intake, which was reviewed with participants by study staff to clarify entries (portion size, brand names, timing of intake, etc.) as much as possible. Participants classified each entry as breakfast, lunch, dinner, or snack and meals were categorized as "skipped" if no food entry was completed for that meal. An online dietary database (http://www.livestrong.com/) was used to calculate calorie consumption.

Night eating symptoms were assessed in multiple ways. Participants completed the Night Eating Questionnaire (NEQ; Allison et al., 2008), a 14-item self-report measure of night eating symptoms that results in a total score with higher scores reflecting more night eating pathology. One item, item 13, does not assess NES pathology but rather is used as a rule-out for sleep-related eating disorder, and it is therefore not included in the total score calculation. A cutoff of 25 has been used to screen for Night Eating Syndrome using this measure (Allison et al., 2008). In the standardization samples, mean total scores on the NEQ were 32.4 (SD = 6.8) for patients with NES and 16.0 (SD = 6.3) for obese patients without NES presenting for bariatric surgery (Allison et al., 2008). The NEQ is composed of four factors (nocturnal ingestions, evening hyperphagia, morning anorexia, and sleep/mood). Each factor is represented by three items, with the exception of the nocturnal ingestions factor, which has five items. Each item has five response options, which are coded from 0 to 4, with higher scores reflecting greater impairment. Given that the presence of evening hyperphagia (EH, consumption of greater than 25% of daily calories after the dinner meal) is a key diagnostic criteria for NES and has been used as a stand-alone measure of night eating in other studies (Morse et al., 2006; Schwandt et al., 2012), prevalence of EH specifically was also measured both subjectively (using item 5 of the NEQ: "How much of your daily food intake do you consume after suppertime?" with five response options: 0%, 1–25%, 26–50%, 51–75%, and 76–100%, which is consistent with single-item measurement of EH used in previous studies such as Morse et al., 2006), and objectively (percentage of daily calories consumed after the dinner meal derived from the 24-hour food log).

Sleep

The Pittsburgh Sleep Quality Index (PSQI; Buysse, Reynolds, Monk, Berman, & Kupfer, 1989) is a 10-item measure of sleep quality over the past month, with total scores greater than five indicating poor sleep quality. The respondents' typical wake and bed times on weekends and week days and their preferred weekday sleep duration (i.e. how many hours they would choose to sleep if their job, family, or other responsibilities did not limit the number of hours they slept) were also collected. Average sleep duration, wake time, and bed time were calculated using a weighted average of the self-reported sleep duration and wake and bed times [(weekday × 5 + weekend × 2)/