

# Optimal management of night eating syndrome: challenges and solutions

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**Abstract:** Night Eating Syndrome (NES) is a unique disorder characterized by a delayed pattern of food intake in which recurrent episodes of nocturnal eating and/or excessive food consumption occur after the evening meal. NES is a clinically important disorder due to its relationship to obesity, its association with other psychiatric disorders, and problems concerning sleep. However, NES often goes unrecognized by both health professionals and patients. The lack of knowledge regarding NES in clinical settings may lead to inadequate diagnoses and inappropriate treatment approaches. Therefore, the proper diagnosis of NES is the most important issue when identifying NES and providing treatment for this disorder. Clinical assessment tools such as the Night Eating Questionnaire may help health professionals working with populations vulnerable to NES. Although NES treatment studies are still in their infancy, antidepressant treatments and psychological therapies can be used for optimal management of patients with NES. Other treatment options such as melatonergic medications, light therapy, and the anticonvulsant topiramate also hold promise as future treatment options. The purpose of this review is to provide a summary of NES, including its diagnosis, comorbidities, and treatment approaches. Possible challenges addressing patients with NES and management options are also discussed.

**Keywords:** night eating, obesity, psychiatric disorders, weight, depression

## Introduction

Stunkard et al<sup>1</sup> first discussed Night Eating Syndrome (NES) in 1955, describing it as morning anorexia that is characterized by breakfast skipping, evening hyperphagia, and/or insomnia. NES is characterized by a delayed pattern of food intake in which the patient consumes at least 25% of his or her total daily calories after dinner and/or during nocturnal awakenings.<sup>2</sup>

The prevalence of NES is estimated to be 1.1%–1.5% in the general population<sup>3–5</sup> and 6%–16% in obese individuals (Table 1).<sup>6–8</sup> NES is also associated with several psychiatric disorders and sleep problems.<sup>9–14</sup> Despite the growing literature, NES often goes unrecognized in clinical settings, and management options are still in their infancy. The purpose of this review is to provide a summary of NES, including its diagnosis, comorbidities, and treatment approaches. Possible challenges of this unique disorder and management options are discussed.

## Diagnosis and assessment of NES

Over the past two decades, NES has been researched in various populations and under various definitions.<sup>4,13,15–19</sup> Lack of a standardized definition of NES has impeded recognition of the syndrome, and made it difficult to compare studies done on the disorder.<sup>20</sup> Recently, in 2010, diagnostic criteria for NES were proposed to address this limitation.<sup>21</sup> NES was also listed in the *Diagnostic and Statistical Manual of*

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**Table 1** Prevalence of night eating syndrome

Population	%
General population <sup>3-5</sup>	1.1–1.5
Obese individuals <sup>6-8</sup>	6–16
Bariatric surgery candidates <sup>1,40,67,105</sup>	17.7–64
Binge eating disorder <sup>38-40</sup>	15–44
Bulimia nervosa <sup>44,45,58</sup>	9–47.1
Anorexia nervosa <sup>38-40,44</sup>	9.4
Psychiatric outpatients <sup>13,55,56</sup>	12.4–22.4
Schizophrenia <sup>10</sup>	12
Major depression <sup>9,106</sup>	21.3–35.2
Diabetes mellitus <sup>14,35,79</sup>	3.8–12.4

*Mental Disorders* 5th edition (DSM-V).<sup>22</sup> Diagnostic criteria for NES include: 1) recurrent episodes of night eating, as manifested by eating after awakening from sleep or by excessive food consumption following the evening meal, 2) awareness of those eating episodes, and 3) significant distress or impairment caused by the disorder. Exclusion criteria are binge-eating disorder or another mental disorder, as well as medical disorders or medication that might better explain the disordered eating pattern.<sup>22</sup>

NES is not yet widely recognized by medical professionals.<sup>23,24</sup> NES shares some features with other psychiatric disorders, particularly with eating disorders and sleep disorders such as sleep related eating disorders (SRED). However, there are some important differences between NES and these disorders. Therefore, proper diagnosis of NES was suggested as the most important issue when identifying NES and providing optimal management for patients with NES.<sup>25</sup> The lack of knowledge of NES in clinical settings may lead to lack of recognition of the syndrome and inappropriate treatment approaches. In order to increase awareness and recognition of NES, Stunkard and Allison<sup>26</sup> suggest information campaigns.

Self-report questionnaires and semistructured diagnostic tools including Night Eating Questionnaire (NEQ), Night Eating Syndrome Questionnaire (NESQ), Night Eating Diagnostic Questionnaire (NEDQ), Night Eating Symptom Scale (NESS), Eating Disorder Examination (EDE), and Night Eating Syndrome History and Inventory (NESH) can be used for the assessment of NES.<sup>27</sup> The NEQ is widely used and is a well-recognized self-assessment measure for NES screening.<sup>28</sup> The NEQ consists of 14 questions concerning morning anorexia, nocturnal ingestions, evening hyperphagia, mood, and sleep. The positive predictive value (PPV) of a score of 25 or greater is reported as 40.7%; the PPV of a score of 30 or greater is reported as 72.7%. The negative predictive value was high for cut scores of both 25

(95.2%) and 30 (94.0%).<sup>28</sup> The NEQ has been adapted to other languages including German,<sup>24</sup> Spanish,<sup>29</sup> Hebrew,<sup>30</sup> Arabic,<sup>31</sup> and Turkish.<sup>32</sup> The NEQ is also ideal for assessing symptom changes that may occur over the course of NES treatment.

Due to the high number of false positive rates associated with using the NEQ in special populations (such as in obese individuals and gastric bypass patients), use of additional interview tools to diagnose NES has been suggested.<sup>20</sup> The NESH is a semistructured interview, which also includes the NEQ in interview format. The NESH includes questions about the history of NES symptoms, the amount of food eaten per day, sleep patterns, mood symptoms, life stressors, weight and diet history, and previous treatment of NES.<sup>20,33</sup> Food and sleep records, dietary recalls, actigraphy, and polysomnography can also be used to document further information about eating and sleeping patterns.<sup>27</sup> Health professionals working with vulnerable populations, such as obese individuals and psychiatric patients, should be encouraged to use NES assessment tools.

## Night eating syndrome and eating disorders

NES is more common in patients with other eating disorders (ED), particularly in those with binge-eating disorder (BED) and bulimia nervosa (BN), than in the general population. Furthermore, individuals with NES are also more likely to have other EDs. The estimated prevalence of NES among patients with EDs ranges from 5% to 44%.<sup>8,34,35</sup>

Extensive research has been conducted to evaluate the relationship between NES and BED.<sup>8,21,36-38</sup> NES has been reported to exist in 15%–44% of patients with BED.<sup>38-40</sup> Previous studies reported that individuals with NES and BED experience more impairment on psychopathology, weight, and eating habits than individuals with NES or BED alone do.<sup>8,34,40,41</sup> There are, however, few studies that have investigated the relationship between NES and anorexia nervosa or BN.<sup>42-45</sup> The prevalence of NES was estimated to be 9%–47% in patients with BN.<sup>44,45</sup> Therefore, it is important to evaluate NES in patients with abnormal eating habits or other EDs.

High comorbidity rates and various degrees of symptom overlap between NES and other EDs have started a debate regarding the conceptualization of NES. Some researchers conceptualized NES as a subtype of other EDs, whereas others classified NES as a distinct disorder among EDs.<sup>46</sup> Despite similarities, NES can be differentiated from other EDs by eating pattern, calories consumed during day, absence of compensatory behavior, and impaired sleep.<sup>20</sup> For instance,

NES has a time pattern (nightly) whereas BED does not. Moreover, the food intake during binge episodes is greater than the amount of food consumed in NES.<sup>25</sup>

Overall, studies show that NES and other EDs have affected a large number of people. Therefore, the distinctions between these disorders and consequent treatments are needed. It is also suggested to use assessment tools, such as the NEQ, for basic evaluation of all patients with EDs. Further research is required to identify the clinical significance of symptom overlap between NES and EDs. Finally, patients with both NES and other EDs may also require more intensive treatment approaches. Cognitive-behavioral therapy (CBT) with selective serotonin reuptake inhibitors (SSRI) may be an effective treatment approach among patients with NES and other EDs. To our knowledge, the only CBT study was a case series of five patients with NES and BED. In this study, the CBT approach improved sleep habits, level of psychopathology, and weight.<sup>46,47</sup> Future clinical trials are essential for this challenging population.

## Night eating syndrome and psychiatric disorders

Research in patients with NES has also shown association between the syndrome and various psychopathologies, particularly depression.<sup>37,48–51</sup> In brief, patients with NES were shown to be more likely to meet lifetime criteria for major depressive disorders,<sup>52</sup> anxiety disorders,<sup>52</sup> and substance abuse.<sup>52,53</sup> Cross-sectional studies showed that patients with NES have higher depressive and anxiety symptoms than non-NES individuals do.<sup>7,9,54</sup> On the other hand, relatively less research has been conducted in patients with psychiatric disorders investigating NES. The estimated prevalence of NES in psychiatry patients was reported higher than in the general population: 12.4%–22.4% in psychiatric outpatients,<sup>13,55,56</sup> 25% in overweight patients with serious mental illness,<sup>12</sup> 12% in obese patients with schizophrenia and schizoaffective disorders,<sup>10</sup> and 21.3% in patients with depression.<sup>9</sup>

Psychiatric symptoms may also increase NES symptoms and complicate the management of NES. Given the link between NES and psychiatric disorders, it is important to identify psychiatric symptoms in patients with NES, and refer them to a psychiatrist if needed. In mental health settings, patients with psychiatric disorders who also have NES may be unaware of NES and not seek treatment.<sup>57</sup> Therefore, mental health professionals should be aware of the risk for NES in their patients. Screening and assessment tools for NES may help professionals identify these patients. For instance, individuals who meet criteria for major depressive disorder

and complain about abnormal eating behaviors should be evaluated for NES. To our knowledge, no treatment study has been conducted for the treatment of NES in psychiatric disorders. Clinicians should consider individualized treatment options such as SSRI medications, CBT, relaxation exercises, and lifestyle interventions.

## Night eating syndrome and sleep

NES may cause and/or trigger sleep disturbances. Likewise, insomnia and sleep disturbances may precede NES. Existing literature shows that patients with NES experience difficulties initiating and maintaining sleep. NES has also been associated with low sleep efficiency.<sup>6,9,10,58,59</sup> Possible moderators of sleep problems in patients with NES are disrupted sleep from nocturnal eating episodes and insomnia. NES patients with sleep problems respond to standard treatments of NES, particularly SSRIs. It should be noted that attempts to treat sleep problems with hypnotic medications may produce a confusional state during which NES symptoms may also occur.<sup>25</sup>

Sleep problems are also common among individuals with psychiatric disorders such as depression, anxiety, and schizophrenia. Recent literature suggests that the link between NES and sleep continues to emerge,<sup>60</sup> and primary sleep difficulties should thus be an important focus of clinical attention in psychiatric patients with NES.<sup>9,10</sup> In addition to evaluating eating patterns, it is recommended to take into consideration the presence of primary sleep difficulties among patients with NES. Besides utilizing treatment options such as SSRIs and CBT, establishing sleep hygiene may also improve sleep problems in patients with NES.

Although nocturnal eating episodes are an important feature of NES, these episodes are not solely occurring in NES. Sleep related eating disorder (SRED) is characterized as recurrent episodes of involuntary eating and drinking during sleep, and is considered as parasomnia rather than an eating disorder.<sup>61</sup> Like NES, SRED is associated with other sleep problems, depression, eating disorders, and obesity.<sup>42,61,62</sup> Furthermore, both disorders have a chronic course and may run in families. Despite these similarities, SRED can be differentiated from NES by the unawareness of nocturnal eating episodes, higher comorbidity with other sleep disorders such as sleepwalking and restless legs syndrome, and the association with sedative hypnotic medications such as zolpidem and triazolam. Unusual consumption of inedible foods and/or substances is also seen in patients with SRED, whereas the most common food choices in NES are breads, sandwiches, and sweets.<sup>61,62</sup> Different treatments are suggested for NES and SRED. NES is treated with SSRIs whereas SRED is treated

with benzodiazapines, mood stabilizers (eg, topiramate), or dopaminergic medications. Finally, it should be noted that some patients with nocturnal eating problems might be unable to differentiate between NES and SRED.<sup>63</sup> Therefore, a thorough sleep history is essential to differentiate NES from SRED. Complete medication and substance use history are required to rule out secondary causes of unawareness during nocturnal eating episodes.<sup>64</sup> Further sleep analysis such as polysomnography or videopolysomnography may be helpful in especially complicated cases.

## Night eating disorders and obesity

Since NES was first described, studies have reported inconsistent findings regarding the relationship between NES and obesity. Some epidemiological<sup>3,65</sup> and cross-sectional studies that were mainly conducted in obese or psychiatric populations reported no connection between NES and obesity.<sup>6,7,40,56,67</sup> Conversely, there are studies that showed a positive relationship between NES and obesity.<sup>5,9,34,67</sup> Longitudinal studies showed significant weight gain among night eaters, which supports the argument that NES may be a risk factor for obesity development in the future.<sup>68,69</sup> There is also evidence that the relationship between NES and obesity is moderated by some demographical factors such as age and sex.<sup>20,50,68,70</sup> Contradictory findings may be due to the use of varied diagnostic criteria for evaluating NES, narrow body mass index (BMI) ranges within homogeneous populations, and small sample sizes. Nonetheless, although some previous studies supported the relationship between NES and obesity, the nature of the relationship still remains unclear.<sup>71</sup> Therefore, future studies are needed to augment our understanding about the possible relationship between NES and obesity.

Another main concern of NES is its impact on weight loss management. Given the relationship between NES, sleep problems, and depressive symptoms, patients with NES may have difficulties managing weight loss. In fact, NES was first described among individuals with unsuccessful weight loss management.<sup>1</sup> Limited research has produced inconsistent results on the influence of NES on weight loss management.<sup>7,54,72,73</sup> Research performed on bariatric surgery patients showed no association between NES and weight loss.<sup>72,73</sup> Conversely, research conducted with overweight individuals entering a weight loss program showed that NES impaired weight loss management among obese individuals.<sup>7</sup> In this study, it is reported that patients with NES struggle with caloric restriction in the context of weight loss.<sup>7</sup> It should be noted that these samples also included high rates

of BED comorbidity. BED comorbidity might also lead to challenges in weight loss management among patients with NES. Recently, it has been shown that higher emotional eating behaviors moderate the relationship between NES, BED, and body mass index. It is suggested that the differences in emotion regulation between the individuals with NES might lead to an inconsistent result.<sup>74</sup>

Available data from cross-sectional and longitudinal studies provide an unclear picture of the effects of NES on weight loss management. Recent behavioral and clinical trials showed that the treatment of NES symptoms leads to significant weight loss in patients with NES.<sup>75–78</sup> These findings suggest the presence of deleterious effects of NES on weight loss management. Therefore, it is important to address NES symptoms in weight loss approaches.

## Night eating syndrome and diabetes

There are few studies that have examined the relationship between NES and diabetes mellitus (DM). Depending on the applied diagnostic criteria for NES and on the study samples, NES was estimated to exist in among 3.8%–12.4% of patients with DM.<sup>14,35,79</sup> Previous studies provided mixed results on the relationship between NES and glycemic control among patients with DM. There is some evidence that night eating was associated with poorer diet control, poorer glucose monitoring, and obesity in individuals with DM.<sup>80</sup> Some studies showed higher HbA1C levels in patients with NES and DM than in those with only DM,<sup>79,80</sup> whereas others found no difference in HbA1C levels between these groups.<sup>35</sup> These mixed results do not allow any conclusions to be drawn about the relationship between NES and DM. More study is clearly required regarding the influence of NES in DM management.

## Treatment of night eating syndrome

As awareness of NES has grown, research has focused on treatment options for NES. Although treatment studies of NES are still in their early stages, various treatment approaches have been applied to NES, including pharmacologic treatment, cognitive-behavioral therapy (CBT), light therapy, and muscle relaxation strategies (Table 2).<sup>30,47,51,75–78,81–89</sup> These studies aimed to improve NES symptoms, especially evening hyperphagia and nocturnal eating episodes, but also mood symptoms and weight loss.

## Pharmaceutical treatment of NES

Previous studies suggested that the serotonin system, with its role in appetite, food intake, and circadian rhythms,<sup>90,91</sup> might

**Table 2** Treatment trials for night eating syndrome

Study	Design	Treatment	Duration	Sample characteristics	Comments
<b>Case reports</b>					
Spaggiari et al <sup>81</sup>	Case series	Fenfluramine, 15–30 mg/day	6–15 months	Seven patients with NES	One patient recovered completely. NES symptoms were improvement >50% in five patients.
Friedman et al <sup>82</sup>	Case report	Light therapy, 10,000-lux for 30 min	14 days	51-year-old obese woman (MD+NES)	NES and depressive symptoms improved with treatment. Relapse of NES symptoms one month after the treatment discontinued.
Friedman et al <sup>83</sup>	Case report	Light therapy, 10,000-lux for 30 min	14 days	46-year-old non obese man (MD+NES)	NES and depressive symptoms improved with treatment.
Miyaoka et al <sup>84</sup>	Case series	Paroxetine (3 cases), 20–30 mg/day Fluvoxamine (1 case), 25 mg/day		Four patients with NE/DS	2 weeks after paroxetine treatment NE/DS recovered.  3 weeks after fluvoxamine treatment NE/DS recovered.
Winkelman et al <sup>97</sup>	Case report	Topiramate, 75 to 125 mg/day		2 patients with NES	Nocturnal eating decreased/eliminated with medication. Patients lost weight (15 and 33 lbs). Relapse of NES symptoms one month after the treatment discontinued.
Tucker et al <sup>85</sup>	Case report	Topiramate, 100 mg/day	9 months	40-year-old obese woman, (PTSD+NES+sleep walking)	Improvement of PTSD, NES and sleep walking symptoms. Patient lost a total of 70 pounds.
Cooper-Kazaz et al <sup>30</sup>	Case report	Topiramate, 75 mg/day	3 months	54-year-old woman (MD+NES)	NES symptoms improved.
Milano et al <sup>86</sup>	Case report	Agomelatine, 50 mg/day	3 months	39-year-old woman (MD+NES)	NES and depressive symptoms improved with treatment. Patient lost 5.5 kg with the treatment.
Milano et al <sup>87</sup>	Case series	Agomelatine, 50 mg/day	10 weeks	Five patients with NES	NES and depressive symptoms improved with treatment. An average weight change was –3.6 kg.
<b>Clinical trials</b>					
O'Reardon et al <sup>51</sup>	Open label	Sertraline, mean dose: 188 mg/day	12 weeks	12 women, 5 men	NES and depressive symptoms improved with treatment. 27% of the ITT sample had remission and 47% had responded to the treatment. Patients who achieved remission of NES lost a mean weight loss of 4.8±2.6 kg.
Stunkard et al <sup>78</sup>	Uncontrolled telemedicine study	Sertraline, mean dose: 122.5 mg/day	8 weeks	39 women, 11 men	NES, mood symptoms, and quality of life improved with treatment. Among the overweight and obese individuals weight was decreased by a mean of 3.0±7.1 kg.
Allison et al <sup>75</sup>	Open label	Escitalopram, mean dose: 13.2 mg/day	12 weeks	21 women, 10 men	NES and depressive symptoms improved with the treatment. 58% of the sample had remission. Weight was decreased from 90.2±3.5 to 88.6±3.5 kg. Eight participants lost more than 2 lb, eight maintained their weight (within 2 lb), and 13 gained more than 2 lb.
O'Reardon et al <sup>77</sup>	DBR, placebo controlled	Sertraline, mean dose: 126.5 mg/day	8 weeks	Sertraline, n=17; placebo, n=17	NES symptoms and quality of life improved with the treatment. Sertraline group had significant weight loss at week 8 (mean weight loss with sertraline 2.9±3.8 kg; with placebo 0.3±2.7 kg).

(Continued)

**Table 2** (Continued)

Study	Design	Treatment	Duration	Sample characteristics	Comments
Vander Wal et al <sup>88</sup>	DBR, placebo controlled	Escitalopram, 10–20 mg/day	12 weeks	Escitalopram, n=20; placebo, n=20	Improvement of NES symptoms was not significant between escitalopram and placebo groups. At 12 weeks escitalopram group lost a mean weight loss of $-0.43\pm 0.7$ kg, which is not significantly different from the weight change among placebo group (mean weight loss of $1.12\pm 0.6$ kg).
<b>Psychotherapy/behavioral interventions</b>					
Pawlow et al <sup>89</sup>	Randomized controlled	PMR	1 week	PMR, n=10; control, n=10	PMR had a significant reduction in evening appetite and significant increase in morning appetite.
Allison et al <sup>76</sup>	Uncontrolled	CBT, 10-hour session <sup>103</sup>	12 weeks	19 women, 6 men	NES and depressive symptoms improved with CBT. Patients lost a mean weight loss of 3.10 kg with CBT.
Edelstein et al <sup>47</sup>	Uncontrolled	CBT + (two sessions for sleep hygiene)		5 patients diagnosed with NES+BED	Sleep habits, level of psychopathology, and weight outcomes improved with CBT.
Vander Wal et al <sup>100</sup>	Randomized controlled	Education (E), PMR, Exercise (Ex)	3 weeks	E, n=14; E+PMR, n=15; PMR+Ex, n=15	All three interventions reduced NES symptoms. 32% of the sample achieved remission.

**Abbreviations:** NE/DS, night eating/drinking syndrome; PTSD, posttraumatic stress disorder; ITT, Intent-to-treat; DBR, double blind randomized; CBT, cognitive-behavior therapy; PMR, progressive muscle relaxation training; MD, major depression; NES, night eating syndrome; BED, binge eating disorder.

have an active role in the pathophysiology of NES.<sup>51,78,92</sup> Lundgren et al<sup>93</sup> reported higher levels of serotonin transporter in the temporal lobe of the midbrain in night eaters. Elevations in serotonin transporter levels have been shown to lead to dysfunctions in postsynaptic serotonin transmission.<sup>91</sup> These dysfunctions may impair satiety and circadian rhythms, thus leading to NES.<sup>94</sup>

Based on the relationship between NES and the serotonin system, clinical trials mainly focused on antidepressant medications, particularly SSRIs, in the treatment of NES. One case series<sup>81,84</sup> reported improvements in night eating symptoms with paroxetine, and fluvoxamine treatments. Effects of sertraline and escitalopram on NES have been tested in two double blind randomized (DBR) placebo-controlled<sup>77,88</sup> and three open label clinical trials.<sup>51,75,78</sup> Uncontrolled studies with sertraline showed that the treatment improved NES symptoms, mood symptoms, and quality of life in patients with NES. Both, caloric intake after the evening and weight reduced with sertraline treatment in these studies.<sup>51,78</sup> Similar to the uncontrolled studies, in an 8-week DBR clinical trial,<sup>77</sup> sertraline treatment significantly improved NES symptoms and quality of life and decreased caloric intake after the evening meal when compared to placebo. There were two clinical trials conducted with escitalopram.<sup>75,88</sup> In a 12-week DBR placebo-controlled study of escitalopram conducted

with 31 patients with NES, improvements in night eating symptoms were reported. Patients on escitalopram had also lost a modest  $0.43\pm 0.7$  kg at week 12. However, these improvements were not significant between the drug and placebo groups.<sup>88</sup> A lack of significant findings between the placebo and escitalopram groups may be partly attributed to differential response rates by race<sup>88</sup> and the small sample size.<sup>75</sup> Recently, an open label escitalopram study reported significant improvements in NES symptoms and depressive symptoms in patients with NES.<sup>75</sup> Although mean weight loss was around 2 kg in the whole sample, 13 out of 31 patients gained more than 0.9 kg during the study. Even though we have a limited theoretical basis for using SSRI medications for NES, at this point, these findings suggest that sertraline and escitalopram can be used as first-line treatment approaches for NES. Future randomized controlled studies using other SSRIs and selective noradrenaline reuptake inhibitors are essential.

Previous studies showed that patients with NES experience attenuation of the nocturnal rise in plasma melatonin levels.<sup>48</sup> Although this finding was not replicated later,<sup>92</sup> two case studies reported the beneficial effects of agomelatine, a selective melatonin agonist, on NES and depressive symptoms without the presence of adverse side effects.<sup>86,87</sup> Agomelatine is also a weak serotonin 5-HT<sub>2C</sub> receptor antagonist.

While its melatonin agonism is considered to normalize the sleep–wake cycle, synergistic effects of melatonin agonism and serotonin antagonism are believed to reduce depressive and anxious symptoms.<sup>95,96</sup> This dual action mechanism was suggested to improve NES by reducing nocturnal eating episodes, and also by improving sleep problems and depressive symptoms.<sup>86,87</sup> Considering the low side effect profiles, melatonin and other melatonin agonists such as agomelatine and ramelteon can be options for NES treatment. Future controlled trials with melatonin agonists are required.

Three case reports have shown the beneficial effects of topiramate, a GABA agonist and glutamatergic antagonist, in treatment of NES.<sup>30,85,97</sup> In these case reports, it was shown that adding topiramate treatment to ongoing treatments improved NES symptoms and led to significant weight loss. However, after dose reduction or treatment discontinuation, NES symptoms had returned in these patients. The mechanism of action by which topiramate is beneficial for night eating is unclear, but it was attributed to the well-known anorexigenic effect of topiramate.<sup>97</sup> Topiramate has prominent side effects such as cognitive impairment and kidney stones, and thus should be used with caution.

Collectively, limited pharmaceutical studies suggested that SSRI medications, (particularly sertraline and escitalopram), melatonergic medications, and topiramate may be effective for the treatment of NES. Finally, to date there are no guidelines or data on the duration of the therapeutic benefit of medications on NES.<sup>98</sup> It is recommended that a medication treatment be used for no fewer than 8 weeks before determining if it is either successful or unsuccessful in treating NES. If effective, the medication should be continued for at least a year before trying to phase it out over the course of 2–3 months.<sup>99</sup>

## Psychological interventions for NES

Besides pharmacological treatments, psychological interventions have also been applied in NES treatment.<sup>47,76,89</sup> In a randomized controlled trial, it is reported that 1-week abbreviated progressive muscle relaxation training (PMR) decreased self-reported levels of state anxiety, perceived stress, evening appetite, and morning anorexia. Recently, Vander Wal et al<sup>100</sup> have tested the effectiveness of PMR, education, and exercise therapy for the treatment of NES. In this randomized study, all three interventions (educational, educational + PMR, PMR + exercise) reduced the symptoms of NES. These findings suggest that PMR may be beneficial in the treatment of NES.<sup>89,100</sup>

CBT has been demonstrated as an effective treatment for many psychiatric disorders, including depression, eating disorders, and insomnia. Anecdotal notes and experiments in patients with NES revealed that NES is associated with some cognitive distortions such as believing one is unable to sleep unless eating beforehand, specific food cravings, and feeling anxious or agitated.<sup>101–103</sup> Recently, Allison et al<sup>76,101</sup> introduced a cognitive behavioral treatment by adapting the CBT protocols for BED and behavioral weight loss.<sup>25</sup> Core components of CBT can be summarized as follow: 1) psychoeducation about NES and healthy eating, 2) eating modification, 3) relaxation strategies, 4) establishing sleep hygiene, 5) cognitive restructuring, 6) improving physical activity, and 7) establishing social support.<sup>20</sup> The primary aim of CBT in the context of NES is to correct the delay in circadian eating rhythms, while simultaneously interrupting the relationship between erroneous cognitions and night eating and sleep.<sup>25</sup>

Recently, clinical outcomes of CBT for NES have been reported.<sup>47,76</sup> In a preliminary study, five patients with NES and BED received 10 sessions of CBT and 2 sessions of sleep related intervention.<sup>47</sup> Three out of the five patients finished the CBT sessions in this study. Preliminary results indicated improvements in sleep habits, level of psychopathology, and weight. Thus far, only one uncontrolled CBT trial has been conducted in patients with NES.<sup>76</sup> In this trial, 14 out of 25 patients received 10 hours of CBT sessions over 12 weeks. CBT treatment produced significant reductions in evening hyperphagia, number of nocturnal eating episodes, total caloric intake, and depressive symptoms. Interestingly, CBT reduced the amount of eating most significantly during nocturnal ingestions, but not during the period after dinner. This finding suggests that CBT treatment for NES may be more effective in reducing nocturnal ingestions than evening hyperphagia.<sup>104</sup> Overall, CBT for NES appears to be a promising treatment. However, it should be noted that previous CBT studies were conducted with small sample sizes. There is need for future randomized controlled trials with larger samples. Comparison studies of CBT with other treatment strategies are needed, and the effectiveness of combining pharmaceutical treatments with CBT should also be tested in future studies. Although the aforementioned CBT treatments showed improvements in mood symptoms, the effect of psychiatric comorbidities on CBT outcome is unknown in patients with NES. Therefore, studies of the impact of comorbidity on treatment response may be necessary. Given the complexity of diagnosis and accompanying mood and

sleep problems, treatment of NES should be individualized to the patient.

## Conclusion

NES is a unique disorder that has complex associations with obesity, psychiatric disorders, endocrine and metabolic disturbances, and sleep problems. Recognizing NES and identifying comorbid conditions is important in providing relevant treatments, and thus preventing the deleterious effects of this disorder in the long-term. It is suggested that health professionals working with high-risk individuals, such as individuals with eating concerns, obesity, depressive symptoms, or sleep problems, apply screening tools for NES in clinical settings. Pharmaceutical treatment options (eg, SSRIs, melatonergic medications) and/or psychological interventions (eg, CBT, behavioral interventions, relaxation exercises) can be considered as treatment options for NES. Finally, further research is essential to elucidate the assessment, conceptualization, comorbidities and, most importantly, the treatment for NES.

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