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Is night eating syndrome associated with obstructive sleep apnea, BMI, and depressed mood in patients from a sleep laboratory study?☆

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ABSTRACT

Purpose: The aim of this study was to assess night eating syndrome (NES) in patients referred for polysomnography and its association with obstructive sleep apnea (OSA). We also assessed whether participants with OSA were more likely to get up and eat at night, and whether these behaviors were associated with the apnea-hypopnea sleep index (AHI). We additionally examined whether NES and OSA were associated with BMI, and assessed depressed mood among participants with NES or OSA.
Methods: The Night Eating Diagnostic Questionnaire (NEDQ), Zung Depression Scale, and demographic and medical questionnaires were used to evaluate 84 qualified participants. Polysomnography was used to assess AHI, and therefore OSA.
Results: Thirty individuals met full or sub-threshold NES (NES[*St*]) criteria, and 54 had no night eating (Normal). Eighty-nine percent of the sample had OSA with AHI ≥ 5. Neither AHI nor BMI differed between NES(St) and Normal, $F(1,82) = 1.67$, $p = 0.20$ and $F(1, 82) = 2.2$, $p = 0.14$, respectively. Participants with NES(St) were, however, more likely than Normal to have depressed mood (mild, moderately, or severely depressed), $\chi^2 = 4.47$ $p = 0.03$. There was a positive correlation between AHI and BMI, $r = 0.37$, $p = 0.001$. Those with OSA were not more likely to eat at night, $F(1,82) = 0.04$, $p = 0.84$, or get out of bed more often, $F(1,13) = 0.23$, $p = 0.64$, and there was no correlation between AHI and eating at night ($r = -0.11$, $p = 0.31$). However, there was a positive correlation between AHI and the number of times participants got up out of bed ($r = 0.81$, $p < 0.001$).
Conclusions: We found that NES was not associated with BMI or AHI severity. The findings show that NES is primarily an eating disorder, rather than a sleep disorder, and that there is an association between NES and depressed mood.

1. Introduction

Night eating syndrome (NES) is an eating disorder that falls under the OSFED (Other Specified Feeding or Eating Disorder) criteria in the *Diagnostic and Statistical Manual of Mental Disorders* 5th edition (DSM-5). NES was initially characterized by morning anorexia, evening hyperphagia, and sleep disturbances (including waking up from sleep to ingest food) (Stunkard, Grace, & Wolff, 1955). The behavioral disorder is most likely to develop during stressful life events and can lead to weight gain and obesity (Stunkard et al., 1955; Cleator, Abbott, Judd, Sutton, & Wilding, 2012). NES was also associated with poorer weight reduction outcome in an outpatient program (Gluck, Geliebter, & Satov, 2001). However, in an inpatient weight loss program where food intake was controlled preventing night eating, there were no differences in weight loss following a 21-day program and also at 6 months follow-up after the program ended (Grave, Calugi, Ruocco, & Marchesini, 2011). Additionally, obese night eaters have higher rates of depression, lower self-esteem, and less hunger during the day than obese non-night eaters (Gluck et al., 2001). Although NES occurs among non-obese individuals, it is more common among the obese, and increases in prevalence with greater degree of obesity (Stunkard, Berkowitz, Stallings, & Schoeller, 1999; Cleator et al., 2012). Thus, NES is clinically important as it relates

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to obesity, disruptive eating patterns, psychological issues, and sleep related problems.

Sleep related eating disorder (SRED) is a parasomnia characterized by unconscious nighttime ingestion of food or non-food items. SRED is often confused with NES because a diagnostic criterion for both disorders includes eating during the night hours associated with sleep (Schenck, Hurwitz, Bundlie, & Mahowald, 1991; Thorpy, 1990; Winkelman, 2006). SRED differs from NES, however, in that it occurs while the person is still asleep (Howell, Schenck, & Crow, 2009). SRED has been shown to be positively associated with obstructive sleep apnea (OSA), and therefore raises the question of whether NES is also positively associated with OSA since both conditions are associated with night eating (Schenck et al., 1991). During OSA, there is increased likelihood of awakening, and it is therefore possible that getting up to eat is also more likely. NES and OSA have only been examined in one study (Olbrich et al., 2009), in which no association was found.

Individuals with OSA stop breathing repeatedly during their sleep, due to a partial or complete blockage of the upper airway, and in severe cases, hundreds of times during the night, often for a minute or longer (Thorpy, 1990; Marshall et al., 2008). OSA is usually defined as having an apnea-hypoapnea index (AHI), a measure of the number of apneas and hypopneas per hour of sleep, of ≥5 (Riha, 2015). Prevalence estimates for OSA vary depending on risk factors such as male sex, obesity, and age, but a population prevalence of 3–7% is generally accepted (Punjabi, 2008). In contrast, only 1.5% of the general population is estimated to have NES, although prevalence can reach 15.7% in the obese population (Adami, Campostano, Marinari, Ravera, & Scopinaro, 2002; Colles, Dixon, & O'Brien, 2007). OSA is a major contributor to daytime drowsiness and is associated with comorbid conditions, such as hypertension, cardiovascular disease, memory problems, weight gain, impotency, and headaches (Al Lawati, Patel, & Ayas, 2009).

Individuals with NES are more likely to have depressed mood compared to normal individuals (Birketvedt et al., 1999; Gluck et al., 2001; Allison, Grilo, Masheb, & Stunkard, 2005; Allison et al., 2006; Lundgren, Allison, O'Reardon, & Stunkard, 2008; Olbrich et al., 2009; Fischer, Meyer, Hermann, Tuch, & Munsch, 2012; Hood, Reutrakul, & Crowley, 2014; Kucukgoncu, Tek, Bestepe, Musket, & Guloksuz, 2014; Runfola, Allison, Hardy, Lock, & Peebles, 2014). The relationship between OSA and depression is less clear (Saunamaki & Jehkonen, 2007) as some studies have found that OSA is associated with higher rates of depression (Aloia et al., 2005; Haba-Rubio, 2005; Ishman, Cavey, Mettel & Gourin; Schroder & O'Hara, 2005), while others have found no relationship (Andrews & Oei, 2004; Baran & Richert, 2003; Sateia, 2003). Thus, it has been shown that NES, SRED, and OSA share some common characteristics.

A better understanding of NES and possible associated conditions, such as OSA, could lead to better prevention and treatment strategies. We, therefore, recruited 100 individuals, who were referred to the hospital sleep laboratory for polysomnography, to assess whether there was an association between NES and OSA, and between NES and BMI, given excessive eating in the evening. More specifically, we examined whether or not those with OSA, who wake up frequently, were more likely to get up at night, and therefore perhaps also more likely to engage in nighttime eating, and whether these behaviors were correlated with AHI. Lastly, we assessed whether those with NES or OSA had higher rates of depression when compared to those without NES or OSA.

We hypothesized that: 1) participants with NES would have a higher AHI than those without NES; 2) participants with a higher AHI would have a higher BMI than those with a lower AHI; 3) participants with NES would have a higher BMI than those without NES; 4) participants with both NES and OSA would have a higher BMI than those without NES and OSA; 5) participants with NES or OSA would be more depressed than those without NES or OSA; 6) participants with OSA would report getting up from bed at night and eating at night more often than those without OSA; and 7) AHI would be correlated with getting up from bed and eating at night.

2. Method

2.1. Participants

Participants were referred by their physicians for polysomnography at the Sleep Disorders Institute at St. Luke's/Roosevelt Hospital Center in New York City. One hundred patients undergoing polysomnography were approached on the same day as their sleep lab test and agreed to take part in the current study. Seven participants who had incomplete questionnaires, were excluded from analysis. We also excluded nine participants who worked evening, night, or rotating shifts, since nighttime eating was likely a part of their normal daily routine. The final sample, $n = 84$, comprised 34 females and 50 males, 18–81 years of age (mean 43.2 years ± 13.3 SD).

Five participants (6%; 2m, 3f) met the criteria for full NES (NES). Given the low number of full diagnosis of NES, we analyzed the data with participants who met both full and sub-threshold NES criteria NES(St). Twenty-five participants (30%; 16m, 9f) met the sub-threshold criteria, which include mild and moderate night eaters (although none were moderate night eaters). Therefore, there were a total of 30 participants who met the criteria for NES(St) (36%;18m, 12f). Seventy-five (89%; 45m, 30f) of the 84 participants met the criteria for OSA. Medical charts were used to obtain age, measured weight and height, smoking habits, alcohol use, and dieting status. Subjects were paid $50 for their participation.

2.2. Measures

2.2.1. OSA diagnosis

Polysomnography was used to diagnose OSA, using a threshold criterion of AHI of ≥5, which includes mild to severe OSA categories (Riha, 2015). Polysomnography was conducted according to standard methodology in an accredited sleep disorders center, and included the measurement of left and right electrooculograms, submental electromyogram (EMG), four channels of electroencephalogram (C3, C4, O1, O2) referenced to the mastoid, one channel of electrocardiographic (ECG) activity, and left and right anterior tibialis EMGs. Respiration was measured by assessment of airflow at the level of the nose and mouth, and thoracic and abdominal effort. Oxygen saturation was determined by pulse oximetry. The electrical potentials were obtained with a Grass-Telefactor with visual display, and assessed by a diagnostician.

2.2.2. Night Eating Diagnostic Questionnaire (NEDQ)

Participants completed the NEDQ to diagnose full and sub-threshold NES (Geliebter, 2001; Gluck et al., 2001; Nolan & Geliebter, 2012) upon arrival at the sleep lab, based on the most recent proposed diagnostic criteria (Allison et al., 2010). The 2010 version of the NEDQ is attached (**Supplemental material**).

NES was diagnosed based on the most recent proposed diagnostic criteria (Allison et al., 2010). Diagnosis of full NES was made if the patients had evening hyperphagia (criteria I) as indicated by consumption of at least 25% of daily caloric intake after the evening meal (criteria IA) and/or at least two nocturnal awakenings per week with ingestions of food (criteria IB), had awareness and recall of evening/nocturnal eating episodes (criteria II) along with at least three of the following features (criteria III): (A) morning anorexia, (B) a strong desire or urge to eat between dinner and sleep initiation and/or upon awakening at night from sleep, (C) sleep onset and/or maintenance insomnia, (D) the belief that one must eat in order to get to sleep, and (E) depressed mood or lowering of mood in the evening and nighttime. Other remaining criteria also include distress and/or impairment in functioning (criteria IV), night eating has been present for at least three months (criteria V), and the disorder is not secondary to substance abuse or dependence, medical disorder, medication, or another psychiatric disorder (criteria VI). Criteria VI cannot be assessed using the NEDQ alone.