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Subjective and Objective Actigraphic Sleep Monitoring and Psychopathology in a Clinical Sample of Patients with Night Eating Syndrome, With and Without Binge Eating Behaviors

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Abstract

Introduction: Night Eating Syndrome (NES) is a phenomenon combining aspects of both sleeping disorders and Eating Disorders (EDs). To the best of our knowledge, few studies to date have examined NES among patients with EDs. None examined ED patients with and without NES in clinical settings by comparing their sleep disturbances using the new NES diagnostic criteria (1). This study aimed to compare subjective and objective sleep patterns and ED-related psychopathology among NES patients with and without binge eating (BE) behavior.

Method: The sample included 71 women, ages 19-62, referred for assessment to a hospital Eating Disorders Clinic. Measures included self-report questionnaires, psychiatric evaluation and actigraph recording for one week. Participants were divided into three subgroups: those with NES without BE behavior (NES-only, *n* = 17), with both NES and BE behavior (NES-BE, *n* = 22), and with BE behavior without NES (BE-only, *n* = 32).

Results: Regarding objective sleep monitoring, only one group difference emerged: significantly longer sleep duration for the NES-only group than the other groups. Subjectively, both NES-only and NES-BE groups described significantly more sleep disturbances than the BE-only group. Moreover, only one inter-group difference emerged in ED-related psychopathology: According to new NES diagnostic criteria, the NES-only and NES-BE groups reported significantly higher levels of NES symptoms than the BE-only group.

Conclusions: Groups' similarities in sleeping disturbances and psychopathology level and differences between objective and subjective sleep disturbances raise the question of whether NES should be considered part of the BE-only subgroup, calling for further research.

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Introduction

Night eating syndrome (NES) is a clinical phenomenon combining facets of both sleeping disorders and eating disorders (EDs). NES was first described by Stunkard in 1955 in a sample of obese patients (2). Core characteristics included morning anorexia nervosa (AN), Evening Hyperphagia (25% of daily food eaten after 7 p.m.), insomnia, deteriorating mood (worsening in the evening), and emotional distress (2). Diagnostic criteria for NES have been modified many times over the years, generating almost 20 different sets of criteria to date.

In an attempt to clarify this syndrome's diagnostic criteria, an international NES Working Group comprising sleep and ED experts convened in Minneapolis in 2008 and two years later published their consensual set of criteria (1). These diagnostic criteria were proposed and primarily accepted for inclusion in the American Psychiatric Association (APA) *DSM-5* edition (3), under "Other specified feeding and eating disorders."

For the current study, we used all proposed criteria published in 2010 (1), which include: significantly increased food intake in the evening (Evening Hyperphagia) and/or at night time (night ingestion) of at least 25% of daily food intake; at least two episodes like this per week; and awareness and recall of evening and nocturnal eating episodes. In addition, the daily pattern is manifested by at least three of the following features: morning anorexia; a strong urge to eat between dinner and sleep onset and/or during the night; insomnia; a belief that one must eat in order to sleep; and depressed or worsening mood in the evening. This syndrome is associated with significant distress, is maintained for at least 3 months, and is not secondary to any other medical or psychiatric disorder. These new criteria currently represent the most updated instrument for diagnosing NES.

Although few significant studies have investigated the prevalence of NES, all reports show that the syndrome is common among individuals who are overweight and/or obese. In the general population, approximately 1.5% of adults are affected by NES (4,5), but among individuals seeking weight loss treatment, the syndrome is significantly more prevalent (e.g., 8.9% in an obesity clinic) (4,5). Among patients seeking treatment for EDs, such as bulimia nervosa (BN), binge eating disorders (BED), and AN, the prevalence rates for NES were 9%, 16%, and 0%, respectively (6). In a psychiatric population, the prevalence rate is 12.3% for NES (7).

Only a few studies have examined NES among patients diagnosed with EDs (6,8), primarily in patients with BED (9,10) and minimally (mainly case studies) among patients with BN (9,11-18). Debate continues in the literature regarding the relations between NES and EDs. NES has been conceptualized as a subtype of obesity, a sleep-related eating disorder (SRED), a variant of other EDs, a separate syndrome among EDs, and a sleeping disorder (8).

One of the common symptoms in EDs, specifically among patients with BED and BN, is BE behavior, which is also a primary symptom of NES. BE behavior is characterized by eating a large amount of food, considered excessive, in a defined period of time. This behavior is accompanied by a sense of lack of control over one's eating throughout the episode. Such BE episodes are associated with: rapid eating, eating until uncomfortably full, eating large amounts when not hungry, solitary eating because of embarrassment, and feeling disgusted, depressed and guilty. These diagnostic symptoms and associated behaviors overlap across the range of EDs, especially among individuals with BED and BN; however, significant differences exist between the two (3,19). The main difference is that individuals with BN end their binges using compensatory behaviors such as self-induced vomiting, laxative abuse, diuretics, enemas, or excessive exercise – which are not

apparent among individuals with BED. Nevertheless, high psychiatric comorbidity exists among individuals who exhibit BE behavior, including both those with BN and BED (20,21), as well as among those with a diagnosis of NES (22). Studies indicate that NES and BE behavior commonly occur simultaneously in individuals who have been assessed for BED and NES (5, 23).

Some researchers suggest that although these behaviors may well overlap, NES and BED have different underlying behavioral constructs. Moreover, they propose that BED-only, BED with NES, and NES-only subgroups lie on a continuum of psychopathology, where BED-NES is considered the more extreme psychopathological form and NES-only is considered the less extreme form (5, 23-25).

In addition, these conditions may be differentiated by the nature of their binge episodes, concerns about weight, and loss of control over eating. During BE episodes, individuals with BED are more likely to consume a higher number of calories than individuals with NES and to report a greater sense of loss of control (11,26-30). Individuals with NES report fewer concerns about their body weight or shape than those with BED (24,31) and fewer instances of compensatory behaviors.

The few prior studies that documented the similarities and differences of individuals with BN versus NES mostly examined patients seeking treatment for sleep disorders at a sleep laboratory (6,9,10). Two case studies from the late 1980s provided initial reports on the clinical and psychological characteristics of patients with BN who also suffer from NES (17,18). Yet, the relations among SRED, NES, and daytime ED, in particular in patients with BN, remain unclear. The question of whether BN together with NES is a new subgroup of EDs and should be called BN with SRED or just BN with NES remains unanswered. NES among patients with BN without SRED has been described only in the last decade by groups of researchers in Israel and Missouri who are experts in eating and sleep disorders (6,8,10).

Despite their similarities, NES and BE (which includes BE in BN and BED) also have distinct features. Specifically, as opposed to NES, BE does not include sleep disturbances such as waking up in the middle of the night and having a binge episode (8). Some NES patients indicate full consciousness of their Night Ingestion episodes, while some indicate total amnesia (9,13,16-18,32-35). Few studies have examined the relations between sleep disorders, BE, and NES (35,36). Most research examined SRED classified according to the American Academy of Sleep Medicine's International Classification of Sleep Disorders (37).

According to sleep researchers, NES is a sleep-related disorder, in particular among those who wake up to eat during the night or who have Night Ingestion. According to the American Academy of Sleep Medicine, SRED represents a break in the night time, when a patient awakens from sleep to eat prior to the final morning awakening. The Academy suggested that a variety of underlying pathological processes lead to Night Ingestion. However, recent evidence suggests this pattern of eating in order to return to sleep bears a striking similarity to the motor restlessness of restless leg syndrome. Importantly, both Night Ingestion and motor restlessness frequently arise and exist simultaneously, suggesting that many cases of Night Ingestion represent a non-motor manifestation of restless leg syndrome (38). Some cases of Night Ingestion may also represent features similar to sleepwalking, where patients partially arouse from sleep and ambulate to the kitchen to eat (38).

Despite such research demonstrating that this population deserves a unique diagnosis, SRED was excluded from the new NES diagnostic criteria in the *DSM-5* because it is considered part of existing sleep disorders and not a separate ED (1). Nevertheless, most studies reported to date were conducted before the new diagnostic criteria of NES (1). To the best of our

knowledge, none of the studies conducted thus far have related to both populations of BN and BED patients, with and without NES, in clinical settings – to compare their sleep disturbances using the new diagnostic criteria.

Therefore, the two aims of the current study were to compare (a) the subjective (self-reported) and objective (actigraph) sleep patterns, and (b) the levels of ED-related psychopathology characterizing three groups of patients: NES with and without Binge Eating Behavior (NES-only; NES-BE (including those with BED and BN), and BE-only.

Materials and Methods

Participants

The sample consisted of 71 women, ages 19-62 years, who were referred to the Eating Disorders Clinic at Rambam Medical Center, Israel, for ED assessment between the years 2011-2013. They were recruited at admission to the clinic, prior to treatment. Male patients and any female patients with SRED, AN, or other severe psychiatric and medical illnesses were excluded from the study.

Participants were divided into three groups based on diagnoses of NES and EDs assigned through the full clinical psychiatric evaluation conducted at intake to the Eating Disorders Clinic. The **NES-only group** (*n* = 17) included patients with Evening Hyperphagia and/or Night Ingestion who were diagnosed with NES according to the new NES diagnostic criteria (1) but who did not receive any BE-related ED diagnosis (BN, BED) according to the *Diagnostic and Statistical Manual of Mental Disorders* (*DSM-IV*) criteria (39). The **NES-BE group** (*n* = 22) included patients who received a diagnosis of NES (Night Ingestion and/or Evening Hyperphagia) based on the new criteria as well as an ED diagnosis that included BE behavior (BN, BED,) based on the *DSM-IV*. The **BE-only group** (*n* = 32) included patients diagnosed with BN (n=17), BED (n=15), based on the *DSM-IV* but who did not receive an NES diagnosis using the new criteria.

Measures

Measures included demographic and clinical information, intake procedures for diagnosing NES and BE-related EDs, objective (actigraph) and subjective (self-report) measures of sleep disturbance, two self-reports on disordered eating pathology (ED-related psychopathology and eating attitudes), self-reported night eating and depression questionnaires.

Demographic and clinical questionnaire. Participants provided demographic data including age, and clinical data including height and weight.

Psychiatric evaluation measures. EDs were evaluated through a psychiatric interview and diagnosed according to the *DSM-IV* (2000), and the Structured Clinical Interview for *DSM-IV* Axis I Disorders (Patient Edition; SCID-I/P Version 2.0) was used for *DSM-IV* diagnosis of comorbid psychiatric disorders (39,42). In addition, NES was evaluated and diagnosed using the new diagnostic criteria by Alison et al. (1).

Objective sleep evaluation: Actigraph. Sleep-wake patterns were monitored using an actigraph (AMI, Ardsley, NY), a small, solid-state, computerized movement detector that continuously registers body motility data for extended periods. It provides a unique opportunity for home sleep monitoring for both research and clinical purposes. Actigraphic sleep measures included: sleep onset time, wake-up time, sleep duration, and sleep efficiency.

Subjective sleep self-reports. Each participant completed the Mini-Sleep Questionnaire (MSQ) (41). Participants rated 10 items (e.g., Do you have difficulties falling asleep? Do you use sleep medications? Do you wake up during the night? Do you feel sleepiness without any specific reason?) on a 7-point Likert scale ranging from 1 (low) to 7 (high); Cronbach alpha = .71.

Disordered eating pathology. Participants

completed two ED-related self-report questionnaires, one tapping levels of ED symptomatology and the other tapping risk for ED based on eating attitudes.

ED-related psychopathology. The Eating Disorder Inventory (EDI) was first developed in 1983 (43) to evaluate cognitive and behavioral symptoms together with personality characteristics found in women with EDs. These traits may not relate directly to eating and body shape but were identified as basic characteristics of women with EDs. In 1991, the questionnaire was updated to a version that includes 91 items divided into 11 separate subscales (44). In the current study, to evaluate beliefs and behaviors related to eating and body shape, we utilized 3 core subscales found to be linked with BE psychopathology: body dissatisfaction (9 items, e.g., " I think that my stomach is too big."), drive for thinness (7 items, e.g., " I feel extremely guilty after overeating "), and bulimia (7 items, e.g., " I stuff myself with food "). Participants rated each item's relevance to their experience on the following 6-point Likert scale: *always* (6), *Usually* (5), *often* (4), *sometimes* (3), *Rarely* (2), *never* (1). After re-coding reversed items, Answers 1 -3 were coded 0, Answer 4 was coded 1, Answer 5 was coded 2, and Answer 6 was coded 3. Each item was attributed to one subscale only, and each subscale's total score was the sum of all its items. Many studies using the EDI reported good internal consistency (alphas of .62 to .90 for the different subscales), good test-retest reliability. The questionnaire was found to validly distinguish between participants with ED and healthy control participants in all subscales (45,45-50), and the Hebrew translation was tested on Israeli samples (51,52).

ED risk: Eating attitudes. The Eating Attitude Test (EAT-26) (53) is a standardized and validated screening self-report tool that can be considered a valuable aid in the cross-cultural diagnosis of ED risk among clinical and nonclinical populations, based on attitudes, feelings, and behaviors related to eating and ED symptoms. Participants rated the scale's 26 items relevance to their experience on the following 6-point Likert scale: *always* (6), *Usually* (5), *often* (4), *sometimes* (3), *Rarely* (2), *never* (1). Answers 1-3 were coded 0, Answer 4 was coded 1, Answer 5 was coded 2, and Answer 6 was coded 3, yielding a possible total score of 0-78 points. In line with the EAT-26 developers' recommendation (53), a cutoff score of <20 is used to identify cases of disturbed eating attitudes or individuals who may have an ED, who are recommended for further evaluation by a mental health professional. This scale was confirmed as a reliable and valid instrument in Hebrew (54).

Eating Disorder Examination Questionnaire (EDE-Q) The Eating Disorders Examination Questionnaire (55) is a widely used 36-item self-report questionnaire assessing eating disorders related attitudes, behaviors and symptoms over the past 28 days. The EDE-Q divided into two main data groups . The first one include 22 scaled items and one unscaled item (items 1-15 and 29-36) reflecting the severity the ED psychopathology. The second include 13 items (items 16-28) reflecting the present or absence, frequency and loss of control of EDs behavioral features. The EDEQ include 4 subscales: Restricting (EDE-Qr), Eating concern, (EDE-Qe), Shape concern (EDE-Qs) and Weight Concern (EDE-Qw). Participents rated each items to their experience on the following 7-point Likert-type scale (0: never; 6: every day). The subscale scores are obtained by calculating the average of the items forming each subscale, and the global score (EDE-Qg) is the average of the four subscale scores (56).

Depression symptoms. The 21-item self-reported Beck Depression Inventory (BDI) questionnaire (57) provides a quantitative evaluation of depression intensity over the past week (situational measure). This questionnaire addresses cognitive (e.g., decision making ability), affective (e.g., feeling sad), and physical (e.g., difficulty sleeping) aspects of depression. The BDI is one of the most popular instruments used to

evaluate severity of depression worldwide in ED and non -ED populations. Researchers who examined the inventory's psychometric characteristics found good reliability and validity (58,59).

NES symptoms. The Night Eating Questionnaire (NEQ) (60) is the most widely validated scale for assessing NES and can be administrated easily as a self-report. The total NEQ score comprised 14 items assessing: morning hunger and timing of first food consumption (2 items), food cravings and control over eating behavior both before bedtime (2 items) and during night-time awakenings (2 items), percentage of food consumed after dinner (1 item), initial insomnia (1 item), frequency of nocturnal awakenings and ingestion of food (3 items), mood disturbance (2 items), and awareness of nocturnal eating episodes (1 item). The latter item (number 15) was not included in the total NEQ score as an indicator of severity of NES, but rather used as a means of differentially diagnosing NES as compared to SRED. Therefore, scores ranged from 0 to 52.

The original English version of the NEQ (60) showed Cronbach alpha of .70, and three factors were identified: Nocturnal Ingestion, Evening Hyperphagia, and Morning Anorexia. The total NEQ score was calculated by reverse coding items 1, 4, and 14, and summing all items. Clinical cutoff points were also evaluated, with a score of 25 yielding a modest positive predictive value of 41% and a higher cutoff point of 30 yielding a positive predictive value of 73%. Using to the newly proposed NES diagnostic criteria (1), researchers recently cross-validated and tested the internal consistency of the Hebrew NEQ version and identified the optimal NEQ cutoff point when screening for the presence of NES (61). This recent study yielded a high internal consistency (alpha = .78) and a 5-factor structure. The cutoff score of 21 provided the best balance of true and false positive diagnoses (61).

Procedure

The study was approved by the Ministry of Health and Helsinki ethics committee, and all participants provided written informed consent. All patients who were approached to participate in the study gave consent after they were fully informed about the nature of the study and their right to exit at any stage.

Study procedures were conducted in three separate meetings. The first meeting comprised collection of demographic and clinical information and full psychiatric evaluation and diagnosis as part of general admission to the clinic. Those who met criteria for NES and/or a BE-related ED were recruited for the study. In the second meeting, those who agreed to participate received in-depth explanation about the study and procedures from the principal investigator , signed informed consent, and were given self-report questionnaires and a mini-actigraph to monitor sleep patterns. After one week, participants met again with the principal investigator and returned the completed actigraph and questionnaires. After the meeting researchers analyzed sleep patterns based on the mini-actigraph and provided an individual report to each participant with specific recommendations for further treatment as needed.

Data Analysis

One-way ANOVA was used to compare the three groups (BE-only, NES-only, NES-BE) on actigraphic data and on sleep and eating related psychopathology self-report questionnaires. To assess the contributions of sleep pathology and eating psychopathology variables to the NES assessment measure, block multiple linear regressions were performed for the total NEQ score, with sleep measures included in the first block and eating measures included in the second block.

Results

Participants' Age and BMI

Mean age for the NES-only group was 41.94 ± 12.52 years (range: 22-62), 39.55 ± 13.48 years for the NES-BE group (range: 19-59), and 25.91 ± 5.77 years for the BE-only group (range: 20-45). A significant group difference emerged for age (F=17.77, df=2, 70, $p < .000$), where the BE-only group was significantly younger than the other two groups. A similar age pattern emerged in each of the three groups, where those with BN were typically younger (20-45 years) than those with BED (30 years and up).

Body mass index (BMI) was calculated by dividing body weight in kilogram units by squared height in meters (40). Mean BMI for the NES-only group was 28.50 ± 7.06 (range: 17-39), 29.24 ± 5.89 for the NES-BE group (range: 19-40), and 24.95 ± 6.73 for the BE-only group (range: 17-44). A significant group difference emerged for BMI (F=3.18, df=2,70, $p < .048$), but Duncan post hoc test found no group differences. Regarding the diagnostic subtypes within the BE-only group (BN, BED), a significant difference between subtypes emerged for BMI, where the subgroup diagnosed with BN showed a BMI in the normal range (22.08 ± 3.28), which was significantly lower than the typically overweight to obese BMI range shown for the subgroup diagnosed with BED (30.4 ± 7.53), t (30) = 4.16, $p < .000$. Thus, the mean BMI for the BE-only group was lower than would be expected if the group consisted just of those with BED, and was higher than if the group consisted just of those with BN. It is important to note that the BE-only group was found to be within the normal weight range, whereas the NES-only and NES-BE groups were within the overweight range.

Disordered Eating Pathology, Night Eating Pathology, and Depression Measures

As seen in Table 1, General Linear Model (GLM) analysis revealed no significant differences among the three groups (NES-only, NES-BE, BE-only) regarding ED-related psychopathology measured by the total EDI, EAT26, BDI, and EDE-Q ($p < .20$, $p < .34$, $p < .15$, $p < .79$, respectively). However, significant group differences emerged for the NEQ measure of NES, F=49.23, df=2,70, $p < .000$). According to Duncan post-hoc the NES-only and NES-BE groups reported significantly higher levels of NES symptomatology (total NEQ score) compared to the BE-only group.

Objective and Subjective Sleep Measures

As seen in Table 2, the three groups (NES-only, NES-BE, BE-only) did not differ significantly regarding three of the objective sleep measures obtained through the actigraph**:** sleep-onset, wake-up time, and sleep efficiency ($p < .86$, $p < .37$, $p < .46$, respectively). A group difference at borderline significance level (*F-2.98, df=2, 70,* $p < .058$) was found for the fourth objective measure – sleep duration – indicating that the NES-only group tended to have a longer sleep duration than the other two groups.

With regard to subjective sleep data, as seen on Table 2, the mean score on the MSQ self-report indicated a significant group difference (*F=5.75, df=2,70,* $p < .005$). Duncan post hoc test revealed that the BE-only group showed significantly lower subjective sleep pathology than the other two groups. Of the 10 items on the MSQ questionnaire, 3 items revealed significant group differences, as shown on Table 2: taking sleeping pills, waking up during the night, and restless sleep.

Block Multiple Linear Regressions

As seen in Table 3, to assess the contributions of sleep pathology and eating psychopathology to the assessment of NES, multiple linear regression analyses

Table 1: Means (± Standard Deviations) of Disordered Eating Pathology (EDI, EAT26), Depression (BDI), Level of ED Symptomatology (EDE-Q), and Night Eating Questionnaire (NEQ) by Group

Variable	Group			*p*
	NES-only (*n* = 17)	NES-BE (*n* = 22)	BE-only (*n* =32)	
Eating Disorder Inventory (EDI)	74.23±38.17	95.74±29.88	93.35±37.51	*ns*
Eating Attitude Test (EAT-26)	25.07±13.7	30.15±11.18	32.43±18.76	*ns*
Beck Depression Inventory (BDI)	18.2±10.32	25.32±8.66	22.06±11.36	*ns*
Eating Disorder Examination Questionnaire (EDE-Q)	3.53±1.52	3.69±.94	3.85±1.29	*ns*
Night Eating Questionnaire (NEQ)	38.73±4.77	38.64±7.62	21.81±7.48	$p < .000$ NES-only = NES-BE > BE-only

Table 2: Means (± Standard Deviations) of Objective and Subjective Sleep Data by Group

Variable	NES-only (*n* = 17)	NES-BE (*n* = 22)	BE-only (*n* =32)	*p*
Objective: Actigraph				
Sleep onset (hr)	23:43±1:20	24:12±1:05	23:49±4:12	*ns*
Wake-up time (hr)	7:38±1:28	7:20±1:11	7:53±1:20	*ns*
Sleep duration (min)	475±71	430±58	437±53	$p < .058$
Sleep efficiency (%)	89.25±11.19	91.83±6.1	92.72±9.3	*ns*
Subjective: Mini-Sleep Questionnaire (MSQ)				
Mean MSQ	3.97±1.07	3.85±0.96	3.08±0.89*	$p < .005$
"Do you use sleeping medications?" (q3)	2.88±2.36*	3.82±2.87	1.77±1.87*	$p < .01$
"Do you wake occasionally during the night?" (q7)	6.38±1.26	5.95±1.01	3.97±1.68*	$p < .000$
"Do you sleep restlessly?" (q10)	4.2±2.02	4.24±2.02	3.0±1.98	$p < .064$

**= Significant group according to Duncan post hoc.*

Table 3: Block Multiple Linear Regression Models with Total NEQ Score as the Dependent Variable

Block	Predictions	R^2	Standard coefficient (β)	Std. error	*p*
1: Sleep measures	Mini-Sleep Questionnaire (MSQ) total	0.225	0.471	1.905	0.006
	Actigraphic sleep duration		0.300	0.026	0.052
2: Eating pathology measures	Eating Attitude Test (EAT-26)	0.345	0.406	0.126	0.059
	Eating Disorder Inventory (EDI)		-0.120	0.061	0.602
	Eating Disorder Examination Questionnaire (EDE-Q)		-0.183	1.735	0.402
	Beck Depression Inventory (BDI)		-0.261	0.215	0.240

were conducted with the sleep and eating measures as the independent variables and with the total NEQ score as the dependent variable. The prediction variables were separated into two blocks. Block 1 included two sleep measures: subjective reports on sleep disorders (MSQ mean) and objective sleep duration. Block 2 included four eating psychopathology variables: EAT26, EDI, EDE -Q, and BDI. Sleep measures (Block 1) significantly accounted for 22.5% of the variance, $F(2, 35) = 5.07$, $p < .012$, and the eating psychopathology variables (Block 2) added an additional 12% to the explanation of the variance, $F(4, 31) = 2.72$, $p < .031$, yielding a total of 34.5% explained variance.

Discussion

To the best of our knowledge, this study is the first systematic investigation comparing sleep-wake patterns and ED psychopathology among patients with BED and BN, with and without NES. In addition, most of the studies reported to date were conducted in community samples and used different diagnostic criteria for NES. In the current study, we assessed patients from a clinical setting who sought treatment for EDs and used the new NES diagnostic criteria (1). This is also the first study using the new diagnostic criteria that continuously monitored this population's sleep patterns via actigraph for a full week. Actigraph monitoring enables recording in a natural environment and reveals sleep-wake patterns that cannot be demonstrated under normal laboratory conditions. Therefore, the aims of this study were to compare sleep patterns, both subjective and objective, and level of ED-related psychopathology among patients with NES with and without BE behavior (including BED and BN).

Our results indicated that objective sleep monitoring revealed no significant differences between the three study groups of NES-only, BE-only, and NES-BE, except a borderline significant difference in sleep duration. On average, the NES-only group slept about 30 minutes longer than participants in the other two groups, according to the actigraphic monitoring. One explanation why the NES-only group's actigraph reports showed longer sleep duration could be related to the phenomenon of multiple nighttime waking incidents among individuals who demonstrate Night Ingestion. In order to compensate for their disturbed sleep, they may sleep for a longer duration. Another explanation for excessive daytime sleepiness could be related to the possibility of breathing problems during sleep in the NES -only group and for BED, which may be linked to their higher BMI. The lack of significant group differences in sleep onset time may be related to the higher prevalence of BE episodes that occurs mainly during the late evening time among patients with BN, with BED, and with NES associated with Evening Hyperphagia (19). However, it is important to note that all three groups suffered from an objectively slightly lower level of sleep efficiency relative to the norms for the healthy population (6).

These results are in line with previous research examining sleep-wake cycles and associated characteristics of Night Ingestion in BN and BED patients (6). In prior research, these patients' actigraph results showed no significant differences in nocturnal ingestion between the BN and BED patients. However, these researchers' sample included patients whose primary concern was Night Ingestion symptoms and did not include patients with Evening Hyperphagia (6).

Beyond high lighting objective sleep data, the current findings yielded significant group differences in subjective sleep patterns based on the MSQ self-report. The NES-only and NES-BE groups subjectively described more sleep disturbance symptoms than the BE-only group. This result may be explained by the fact that patients with NES, in particular those with Night Ingestion, tend to wake up several times during the night in order to eat. As mentioned above, these multiple nighttime waking incidents may cause sleep deprivation that can lead to a sense of sleepiness during

the day. These results are in line with previous research demonstrating high levels of sleep disturbances among BED and BN patients with NES (6).

These differences between groups in subjective sleep patterns may also be a function of weight-related physical discomfort manifested in breathing problems while sleeping. The NES-only and NES-BE groups demonstrated higher BMI in comparison to the BE-only group, which imply weight problems that may affect breathing, which in turn would be reflected in objective actigraphic sleep measurements. In this context, the differentiation between the BN and BED subgroups within the BE-only group may be relevant. As found in our study and supported by the literature, patients with BN are in the normal range weight whereas patients with BED and or NES are usually overweight (19). Thus, the significant differences may be related specifically to the BED and/or NES groups who present overweight and obesity that may result in breathing problems during sleep. Furthermore, these subjective sleep discrepancies may indicate that the NES-only and NES-BE groups have higher levels of psychiatric comorbidity than the BE-only group. Additionally, these results might indicate traumatic life events that precipitated BE episodes in the NES-only and NES-BE groups, as found in previous studies (6,51,36, 62-67).

No significant differences were found in level of psychopathology between the three groups in this study. This results contrast with previous research outcomes indicating higher levels of psychopathology among patients who demonstrate NES together with BE (25). Thus, it is still unclear whether prevalence of psychiatric comorbidity and traumatic life events is higher among patients with EDs together with NES versus patients with just EDs.

This study is the first using the new diagnostic criteria of NES and applying them to a group of ED patients. Our results show that NES in ED patients, in-particular in Evening Hyperphagia, may represent an ED subgroup (of BN and / or BED) as opposed to a separate entity. Further research must be conducted to clarify this hypothesis.

Several limitations of this study should be considered. First, the small sample size reduces statistical power for detecting group differences and for generalizing the findings overall. A larger sample size would also permit differentiation between BN and BED patients to identify possible differences in psychopathology levels, instead of combining these subgroups into one BE behavior group as needed for statistical analysis of the current sample. Second, future research is necessary to further clarify the definition of NES, which currently includes both Night Ingestion and Evening Hyperphagia subsyndromes. That is as Evening Hyperphagia is very similar to BED, it is important to separate these two subsyndromes in the ED population to determine if Evening Hyperphagia in fact constitutes its own ED subgroup rather than constituting a part of NES. Third, the present clinical sample included only patients with high levels of psychopathology who were seeking treatment for an ED. Such individuals usually tend to exhibit greater levels of psychopathology than those seeking treatment for weight loss or eating-related issues in nonclinical samples. Further research in a nonclinical community sample of individuals with NES may elucidate the differences between ED patients with NES and patients whose primary diagnosis is NES. It may also clarify where NES lies on the continuum of psychopathology. More extensive research is necessary to determine psychological characteristics and comorbidity associated with NES. Finally, we used actigraphic data to measure the sleep-wake cycle. However, these measurements cannot describe all disturbances; hence, further study in a sleep laboratory setting is necessary to understand similarities and differences in sleep-wake cycles between groups.

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References

1. Allison, K.C., Lundgren, J.D., O'Reardon, J.P., Geliebter, A., and Gluck, M.E., et al. (2010) Proposed diagnostic criteria for night eating syndrome. Int J Eat Disord, 43(3):241-247.

2. Stunkard, A.J., Grace, W.J., and Wolff, H.G. (1955) The night-eating syndrome: a pattern of food intake among certain obese patients. Am. J. Med,. 19:78-86.

3. American Psychiatric Association. Diagnostic and statistical manual of mental disorders 5th ed ed.: Arlington: American Psychiatric Association; 2013.

4. Rand, C.S., Macgregor, A.M., and Stunkard, A.J. (1997) The night eating syndrome in the general population and among postoperative obesity surgery patients. Int J Eat Disord , 22(1):65-69.

5. Stunkard, A., Berkowitz, R., Wadden, T., Tanrikut, C, and Reiss, E. (1996) Young L. Binge eating disorder and the night-eating syndrome. Int J Obes Relat Metab Disord, 20(1):1-6.

6. Tzischinsky, O., and Latzer, Y. (2004) Nocturnal eating prevalence, features and night sleep among Binge Eating Disorders and Bulimia Nervosa patients in Israel. European Eating Disorders Review, 12:101-109.

7. Lundgren, J.D., Newberg, A.B., Allison, K.C., Wintering, N.A., Ploessl, K., et al. (2008) 123I-ADAM SPECT imaging of serotonin transporter binding in patients with night eating syndrome: a preliminary report. Psychiatry Res, 15;162(3):214-220.

8. Latzer, Y., and Tzischinsky, O. (2012) Night Eating Syndrome and Other Eating Disorders. In: Lundgren JD, Allison KC, Stunkard AJM,J.E., editors. Night Eating Syndrome: Research, Assessment, and Treatment. NY, USA: Guilford Press.

9. Winkelma, J.W. (1998) Clinical and polysomnographic features of sleep-related eating disorder. J Clin Psychiatry, 59(1):14-19.

10. Lundgren, J.D., McCune, A., Spresser, C., Harkins, P., Zolton, L., et al. (2011) Night eating patterns of individuals with eating disorders: Implications for conceptualizing the night eating syndrome. Psychiatry Res, 30;186(1):103-108.

11. Birketvedt, G.S., Florholmen, J., Sundsfjord, J., Osterud, B., Dinges, D., et al. (1999) Behavioral and neuroendocrine characteristics of the night-eating syndrome. JAMA, 18;282(7):657-663.

12. Gupta, M. (1991) Sleep-related eating in bulimia nervosa. An under-reported parasomnia disorder. Sleep Res, 20:182.

13. Winkelman, J., Herzog, D., and Fava, M. (1999) The prevalence of sleep-related eating disorder in psychiatric and non-psychiatric populations. Psychol Med, 29(06):1461-1466.

14. Lundgren, J.D., Rempfer, M.V., Brown, C.E., Goetz, J., and Hamera, E. (2010) The prevalence of night eating syndrome and binge eating disorder among overweight and obese individuals with serious mental illness. Psychiatry Res, 175(3):233-236.

15. Williamson, D.A., Lawson, O.D., Bennett, S.M., and Hinz, L. (1989) Behavioral treatment of night bingeing and rumination in an adult case of bulimia nervosa. J Behav Ther Exp Psychiatry, 20(1):73-77.

16. Gupta, M.A. (1991) Sleep related eating in bulimia nervosa—an under-reported parasomnia disorder. Sleep Research, 20:182.

17. Guirguis, W.R. (1986) Sleepwalking as a symptom of bulimia. Br Med J (Clin Res Ed) 6;293(6547):587-588.

18. Roper, P. (1989) Bulimia while sleepwalking, a rebuttal for sane automatism? Lancet , 30;2

(8666):796.

19. Treasure, J., Claudino, A.M., and Zucker, N. (2010) Eating disorders. The Lancet 375(9714):583-593.

20. de Zwaan, M., Mitchell, J.E., Seim, H.C., Specker, S.M., Pyle, R.L., et al. (1994) Eating related and general psychopathology in obese females with binge eating disorder. Int J Eat Disord, 15(1):43-52.

21. Faith, M.S., Butryn, M., Wadden, T.A., Fabricatore, A., and Nguyen, A.M. (2011) Evidence for prospective associations among depression and obesity in population-based studies. Obes Rev, 12 (5):e438-53.

22. Dingemans, A.E., Bruna, M.J., and van Furth, E.F. (2002) Binge eating disorder: a review. Int J Obes Relat Metab Disord, 26(3):299-307.

23. Napolitano, M.A., Head, S., Babyak, M.A., and Blumenthal, J.A. (2001) Binge eating disorder and night eating syndrome: psychological and behavioral characteristics. Int J Eat Disord, 30(2):193-203.

24. Allison, K.C., Grilo, C.M., Masheb, R.M., and Stunkard, A.J. (2005) Binge eating disorder and night eating syndrome: a comparative study of disordered eating. J Consult Clin Psychol, 73(6):1107-1115.

25. Roer, S., Latzer, Y., and Gelipter, A. (in press) Negative Emotional Eating among Obese individuals with and without Binge Eating behavior and Night Eating Syndrome. Israel Journal of Psychiatry.

26. Spaggiari, M.C., Granella, F., Parrino, L., Marchesi, C., Melli I., et al. (1994) Nocturnal eating syndrome in adults. Sleep 1994 Jun;17(4):339-344.

27. Greeno, C,G., Wing, R.R., and Marcus, M.D. (1995) Nocturnal eating in binge eating disorder and matched-weight controls. Int J Eat Disord 1995 Dec;18(4):343-349.

28. Grilo, C.M., Shiffman, S., and Carter-Campbell, J.T. (1994) Binge eating antecedents in normal-weight nonpurging females: Is there consistency? Int J Eat Disord 1994;16(3):239-249.

29. Rosen, J.C., Leitenberg, H., Fisher, C., and Khazam, C. (1986) Binge-eating episodes in bulimia nervosa: The amount and type of food consumed. Int J Eat Disord, 5(2):255-267.

30. Rossiter, E.M., and Agras, W.S. (1990) An empirical test of the DSM-III-R definition of binge. Int J Eat Disord 1990;9(5):513-518.

31. Lundgren, J.D., Allison, K.C., O'Reardon, J.P., and Stunkard, A.J. (2008) A descriptive study of non-obese persons with night eating syndrome and a weight-matched comparison group. Eat Behav, 9 (3):343-351.

32. Mancini, M.C., and Aloe, F. (1994) Nocturnal eating syndrome: a case report with therapeutic response to dexfenfluramine. Sao Paulo Med J, 112(2):569-571.

33. Kavey, N.B., Whyte, J., Resor, S.R., and Gidro-Frank, S. (1990) Somnambulism in adults. Neurology, 40 (5):749-752.

34. Schenck, C.H., Hurwitz, T.D., Bundlie, S.R., and Mahowald, M.W. (1991) Sleep-related eating disorders: polysomnographic correlates of a heterogeneous syndrome distinct from daytime eating disorders. Sleep, 14(5):419-431.

35. Schenck, C.H., Hurwitz, T.D., O'Connor, K.A., and Mahowald, M.W. (1993) Additional categories of sleep-related eating disorders and the current status of treatment. Sleep, 16(5):457-466.

36. Schenck, C.H., and Mahowald, M.W. (1994) Review of nocturnal sleep-related eating disorders. Int J Eat Disord, 15(4):343-356.

37. American Academy of Sleep Medicine.(2005) The international classification of sleep disorders: Diagnostic and coding manual. 2nd ed. ed.: West-chester, IL.

38. Vinai, P., and Howell, M. (2013) Sleep-Related Eating Disorders: A Separate Entity or Part of the NES Clinical Spectrum? Parasomnias: Springer; p. 303-325.

39. American Psychiatric Association editor. (2000) Diagnostic and statistical manual of mental disorders, 4th ed. Text revised DSM-IV-TR. Washington, DC: APA;

40. Bray, G.A. (1992) Pathophysiology of obesity. Am J Clin Nutr, 55(2 Suppl):488S-494S.

41 Zomer, J., Peled, R., Rubin, A.H., and Lavie, P. (1985) Mini-Sleep Questionnaire (MSQ) for screening large populations for EDS complaints. In: Koella WP, editor. Sleep Basel: Karger, p. 467-470.

42. Sheehan, D.V., and Lecrubier, Y. (2001) M.I.N.I - Mini International Neuropsychiatric Interview, DSM-IV.

43. Garner, D.M., Olmstead, M.P., and Polivy, J. (1983) Development and validation of a multidimensional eating disorder inventory for anorexia nervosa and bulimia. Int J Eat Disord 1983;2(2):15-34.

44. Garner, D.M. (1991) EDI2: Eating disorder inventory -2, professional manual. Psychological Assessment Resources. Florida: Odessa.

45. Nevonen, L., and Broberg, A. (2001) Validating the eating disorder inventory-2 (EDI-2) in Sweden. Eating and Weight Disorders-Studies on Anorexia, Bulimia and Obesity, 6(2):59-67.

46. McCarthy, D.M., Simmons, J.R., Smith, G.T., Tomlinson, K.L., and Hill, K.K. (2002) Reliability, stability, and factor structure of the Bulimia Test-Revised and Eating Disorder Inventory-2 scales in adolescence. Assessment, 9(4):382-389.

47. Tachikawa, H., Suzuki, T., Kawanishi, Y., Hori, M., Hori, T., et al. (2000) Tardive dystonia provoked by concomitantly administered risperidone. Psychiatry Clin Neurosci, 54(4):503-505.

48. Tachikawa, H., Yamaguchi, N., Hatanaka, K., Kobayashi, J., Sato, S., et al. (2004) The Eating Disorder Inventory-2 in Japanese clinical and non-clinical samples: psychometric properties and cross-cultural implications. Eating and Weight Disorders-Studies on Anorexia, Bulimia and Obesity, 9(2):107-113.

49. Nevonen, L., Clinton, D., and Norring, C. (2006) Validating the EDI-2 in three Swedish female samples: Eating disorders patients, psychiatric outpatients and normal controls. Nordic Journal of Psychiatry, 60(1):44-50.

50. Castro-Fornieles, J., Gual, P., Lahortiga, F., Gila, A., Casulà, V., et al. (2007) Self-oriented perfectionism in eating disorders. Int J Eat Disord, 40(6):562-568.

51. Latzer, Y., Gur, E., Stein, D. Editorial: (2005) Eating disorders: update, controversies, and the Israeli perspective. Isr J Psychiatry Relat Sci, 42(3):141-145.

52. Niv, N., Kaplan, Z., Mitrani, E., Shiang, J. (1998) Validity study of the EDI-2 in Israeli population. Isr J Psychiatry Relat Sci, 35(4):287-292.

53. Garner, D.M., Olmsted, M.P., Bohr, Y., and Garfinkel, P.E. |(1982) The eating attitudes test: psychometric features and clinical correlates. Psychol Med, 12 (4):871-878.

54. Ianuca, I. (1990) Validation of the EAT in Israel. Unpublished doctoral dissertation School of Medicine. Tel Aviv University, Israel.

55. Fairburn CG, Beglin SJ: Assessment of eating disorders: interview or self-report questionnaire?. Int J Eat Disord 1994, 16:363–370.

56. Mond JM, Hay PJ, Rodgers B, Owen C, Beumont PJV: Validity of the Eating Disorder Examination Questionnaire (EDE-Q) in screening for eating disorders in community samples. Behav Res Ther 2004, 42:551–567.

57. Beck, A.T., Ward, C.H., Mendelson, M., Mock, J.E.,

and Erbaugh, J.K. (1961) An inventory for measuring depression. Arch Gen Psychiatry, 4:561-571.

58. Beck, A.T., and Steer, R.A. (1984) Internal consistencies of the original and revised Beck Depression Inventory. J Clin Psychol, 40(6):1365-1367.

59. Reynolds, W.M., and Gould, J.W. (1981) A psychometric investigation of the standard and short form Beck Depression Inventory. J Consult Clin Psychol, 49(2):306.

60. Allison, K.C., Lundgren JD, O'Reardon JP, Martino NS, Sarwer DB, Wadden TA, et al. The Night Eating Questionnaire (NEQ): psychometric properties of a measure of severity of the Night Eating Syndrome. Eat Behav 2008 Jan;9(1):62-72.

61. Latzer, Y., Tzischinsky, O., Hason-Rozenstein, M., and Allison, K. (2014) Reliability and cross-validation of the Night Eating Questionnaire (NEQ): Hebrew version. Isr J Psychiatry Relat Sci, 51(1):68-73.

62. Allison, K.C., Grilo, C.M., Masheb, R.M., and Stunkard, A.J. (2007) High self-reported rates of neglect and emotional abuse, by persons with binge eating disorder and night eating syndrome. Behav Res Ther, 45(12):2874-2883.

63. Sassaroli, S., Ruggiero, G.M., Vinai, P., Cardetti, S., Carpegna, G., et al. (2009) Daily and nightly anxiety among patients affected by night eating syndrome and binge eating disorder. Eat Disord, 17(2):140-145.

64. Colles, S.L., Dixon, J.B., and O'Brien, P.E. (2007) Night eating syndrome and nocturnal snacking: association with obesity, binge eating and psychological distress. Int J Obes (Lond), 31 (11):1722-1730.

65. Manni, R., and Ratti, M.T. (1997) Tartara A. Nocturnal eating: prevalence and features in 120 insomniac referrals. Sleep 1997 Sep;20(9):734-738.

66. Latzer, Y. & Tzischinsky, O. (2012). Night Eating Syndrome and Other Eating Disorders, In Jennifer D. Lundgren., Kelly C. Allison., Albert J. Stunkard (Eds), Night Eating Syndrome: Research, Assessment, and Treatment. Chapter 7 (Pp. 108-126), NY, USA : Guilford Press.

67. Tzischinsky O., Vinai P., Howell M & Latzer, Y. (2013). Sleep related eating disoreders: a separate entity or part of NES clinical spectrum?. In Sanjeev Kothare & Anna Ivanenko (Eds.) Parasomnias: Clinical Characteristics and Treatment .chapter 21, (Pp. 303-326) . USA: Springer Publishers.