

# Night Eating Syndrome, circadian rhythms and seasonality: a study in a population of Italian university students

## *Sindrome da alimentazione notturna, ritmi circadiani e stagionalità: studio in una popolazione di studenti universitari italiani*

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**SUMMARY. Purpose.** The aim of this research was to assess the prevalence of Night Eating Syndrome (NES) in a university student population and to clear up the relationship between NES, depression and chronotype. The relation between NES and seasonality was also investigated. **Methods.** The data were collected from a sample of 1136 students of the L'Aquila University, Italy. All subjects were invited to answer to the Sociodemographic Information Form and to take a self-report battery composed by four questionnaires: the Night Eating Questionnaire (NEQ), the Morningness Eveningness Questionnaire (MEQ), the Seasonal Pattern Assessment Questionnaire (SPAQ) and the Beck Depression Inventory (BDI). **Results.** The 5.3% of our population (60 subjects) reached the criteria for NES. The distribution of chronotypes in the sample was: Morning Type 15.3%, Intermediate 64.3% and Evening Type 20.4%. The 36.7% of the participants reaching the criteria for NES, obtained low scores on the MEQ. The data indicated that NEQ and MEQ scores are significantly inversely correlated ( $r = -.22$ ;  $p < .01$ , two-tailed test). The 3.6% of our population (41 subjects) reached the criteria for Seasonal Affective Disorder (SAD) and 10.7% for subclinical SAD (121 subjects). Furthermore, the 11.7% of subjects with NES presented SAD and the 5% presented Sub-clinical SAD. The data demonstrated that NES and Global Seasonality Score (GSS) are significantly associated ( $r = .22$ ;  $p < 0.01$ , two-tailed test). **Conclusions.** The main finding of this study is the strong relation between NES and eveningness dimension. Our results help to clear up the literature debate about the role of eveningness dimension in the night eating, suggesting that subjects with NES present a circadian delay, not only in the food intake, but in the entire functioning. At the best of one knowledge this study is the first one to examine the relationship between NES and seasonality. This research found preliminary evidence that, similarly to the findings of previous studies in subjects with Bulimia Nervosa (BN) and Binge Eating Disorder (BED), night eating symptoms may vary significantly across the seasons; subjects with NES experience seasonal variation in their mood and in their eating patterns.

**KEY WORDS:** Night Eating Syndrome, seasonality, Seasonal Affective Disorder, evening chronotype, chronotype.

**RIASSUNTO. Introduzione.** Lo scopo del presente studio è quello di valutare la prevalenza della sindrome da alimentazione notturna (Night Eating Syndrome - NES) in una popolazione di studenti universitari e di far luce sulla dibattuta relazione tra NES e cronotipo serotino. Abbiamo, inoltre, indagato il rapporto tra NES e stagionalità. **Metodi.** I dati sono stati raccolti da un campione di 1136 soggetti, composto da 774 femmine e 360 maschi. Tutti i partecipanti hanno fornito informazioni demografiche e hanno compilato una batteria di questionari autosomministrati composta da: il Night Eating Questionnaire (NEQ), il Morningness Eveningness Questionnaire (MEQ), il Seasonal Pattern Assessment Questionnaire (SPAQ) e il Beck Depression Inventory (BDI). **Risultati.** La prevalenza della NES nella popolazione era del 5,28% (60 soggetti). I cronotipi erano così distribuiti: Mattutino: 15,3%, Intermedio 64,3%, Serotino 20,4%. Il 36,7% dei partecipanti che rispondevano ai criteri per la NES riportava bassi punteggi al MEQ, che indicano un cronotipo serotino. I dati mostrano che i punteggi ottenuti al NEQ e quelli ottenuti al MEQ sono inversamente correlati in modo significativo ( $r = -.22$ ;  $p < .01$ ). Il 3,6% del campione, 41 soggetti, ha soddisfatto i criteri per il disturbo affettivo stagionale (Seasonal Affective Disorder - SAD) e il 10,7%, pari a 121 soggetti, per una forma subclinica di SAD. Inoltre, l'11,7% dei soggetti con NES presentava SAD e il 5% manifestava una forma subclinica di SAD. Si osserva una significativa correlazione ( $r = .22$ ;  $p < .01$ ) tra la NES e la stagionalità, misurata tramite il Global Seasonality Score (GSS). **Conclusioni.** Il principale risultato dello studio è quello di sottolineare la forte relazione che intercorre tra NES e cronotipo serotino. I nostri dati aiutano a chiarire il dibattito presente in letteratura circa il ruolo del cronotipo serotino nell'alimentazione notturna, suggerendo che i soggetti con NES presentino un ritardo circadiano non solo nell'assunzione di cibo, ma nell'intero funzionamento. Questo studio, da quanto sappiamo, è stato il primo a esaminare la relazione tra NES e stagionalità, trovando evidenze preliminari che suggeriscono che, in accordo con

studi precedenti condotti su pazienti con bulimia nervosa (BN) e BED, i sintomi dell'alimentazione notturna possono variare in modo significativo durante le stagioni. I soggetti con NES sperimentano, quindi, variazioni stagionali nell'umore e negli schemi alimentari.

**PAROLE CHIAVE:** sindrome da alimentazione notturna, stagionalità, disturbo affettivo stagionale, cronotipo serotino, cronotipo.

## INTRODUCTION

Chronotypes are defined as the individual preference for activity and sleep during the day<sup>1</sup>. Morning type and Evening type subjects differ in sleep-wake cycle timing<sup>2-4</sup>, in the peak performance times and in the feeling after the awakening.

Several researches<sup>5-8</sup> demonstrated an association between mood and chronotypes, especially eveningness dimension appearing to be correlated with depressive symptoms and Major Depressive Disorder (MDD)<sup>2,9</sup>. The findings of these researches are consistent with the hypothesis that evening chronotype could be considered a vulnerability factor to MDD.

Different studies investigated the relationship between personality traits and chronotypes<sup>10</sup>; evening type subjects resulted more anxious, hostile, impulsive, vulnerable and depressed. On the other hand morning chronotype was associated with traits such as conscientiousness, methodicalness and with the tendency to be compliant<sup>11-14</sup>.

Some researches highlighted the relationship between the eveningness dimension and unhealthy dietary patterns and obesity<sup>15,16</sup>. Evening type subjects have the tendency to skip breakfast more often, compared to the morning types<sup>17</sup>; and morning chronotype was more often associated with both a more flexible dietary control and a greater ability to regulate the amount of food intake, compared to the evening chronotype<sup>18</sup>. These findings suggest a correlation between the tendency to stay up late at night and the night eating behavior.

The Night Eating Syndrome (NES), first described by Stunkard<sup>19</sup> and included in the DSM-5 category "Other Specified Feeding or Eating Disorder", is characterized by recurrent episodes of night eating<sup>20,21</sup> or excessive food intake after the evening meal<sup>22</sup>, morning anorexia and difficulties in sleep maintenance<sup>23</sup>. NES frequently co-occur with depressed mood that worsens in the evening<sup>20,24,25</sup>, high levels of State and Trait Anxiety<sup>26</sup>, elevated perceived stress<sup>27-29</sup> and low self-esteem<sup>30</sup>.

The literature is not concordant about the relationship between eveningness dimension and NES. Some studies suggested that subjects with NES have a circadian delay only in their eating without affecting their global functioning<sup>22,23,31</sup>. On the other hand, Harb's findings<sup>32</sup> showed an association between evening chronotype and both NES and Binge Eating Disorder (BED), in a clinical population. Previous studies had already affirmed that subjects with NES had the tendency to have low scores on the MEQ, indicating an evening chronotype<sup>27,33</sup>. A recent study has also demonstrated the correlation between evening chronotype, depressive symptoms and NES in a non-clinical sample of adolescents<sup>34</sup>.

Some researches proved the effectiveness of Bright Light Therapy (BLT) in the treatment of NES, as previously reported in two case reports<sup>35,36</sup>. In a recent pilot trial<sup>37</sup> McCune observed that BLT was effective to improve night eating behavior, mood and sleep. These findings were concordant with those achieved with Cognitive-Behavioral Therapy<sup>38</sup> and SSRI<sup>39</sup>. The efficacy of BLT in the treatment of NES suggest the need of further systematic investigations to clear

up the relationship between NES, mood and circadian rhythms.

Seasonality can be conceptualized along a continuum<sup>40,41</sup>. Kasper<sup>42,43</sup> defined seasonality as the general tendency to experience seasonal variations in mood and behaviour, including changes in sleep length, energy level, social activity, choice of foods and appetite. Rosenthal and Wehr defined two different types of Seasonal Affective Disorder (SAD). The most recognized pattern is the winter-type, with the onset of the symptoms in fall and winter alternating with non-depressed periods in spring and summer<sup>44</sup>; whereas the summer-type is characterized by recurrent depressive episodes in the summer months followed by periods of remission in fall and winter<sup>45</sup>.

A study<sup>46</sup> pointed out the similarities and the differences between NES and winter type SAD. These disorders have some shared features, such as consumption of high-carbohydrate and high-fat food and consequent weight gain<sup>20</sup>, circadian rhythm dysregulations<sup>20</sup>, depressive symptoms<sup>47</sup>, responsiveness to SSRI<sup>48,49</sup> and to BLT<sup>35,36</sup>. However, NES and SAD have different patterns that indicate they are not overlapping disorders. Subjects with NES or SAD also differ in the improvement and in the worsening of mood<sup>20</sup>; the night eaters show evening mood worsening, while SAD patients often present morning worsening and evening mood improvement. Furthermore, as previously mentioned, the literature is not concordant about the relationship between NES and eveningness dimension<sup>22,23,31,32,34</sup>; on the contrary, SAD is characterized by a delayed sleep-wake cycle that affects the global functioning.

The aim of this research was to assess the prevalence of NES in a university student population and to clear up the relationship between NES, depression and chronotype. We hypothesized that evening type subjects would reach higher scores on the NEQ and on a scale to assess the severity of depressive symptoms, as other studies observed in the clinical population<sup>23</sup>, in the non-clinical population<sup>50</sup> and in the adolescent population<sup>34</sup>. We also investigated the relation between seasonality and NES.

## METHODS

### Participants

The data were collected from a sample of 1136 (M=360; F=774) university students of the L'Aquila University, Italy. No exclusions criteria were applied.

### Procedure

All subjects were invited to answer to Sociodemographic Information Form and to fill a self-report battery composed by four questionnaires: the Night Eating Questionnaire, the Morningness Eveningness Questionnaire, the Seasonal Pattern Assessment Questionnaire and the Beck Depression Inventory.

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- The *Night Eating Questionnaire* (NEQ)<sup>51</sup>. The Italian version of the NEQ was used to assess the night eating behavior. The NEQ is composed by 15 items assessing mood, sleep difficulties, morning anorexia, food cravings, food intake after evening meal, nocturnal awakenings with ingestion of food, awareness and feelings of control during the eating episodes. The cutoff is set at 25 points.
- The *Morningness Eveningness Questionnaire* (MEQ)<sup>52</sup>. The Italian version of the MEQ was used to assess the chronotype; it's composed by 19 items assessing individual differences in the timing of the sleep-wake cycle, activities and in the performance peak. The subjects, according to their total score, are divided in three different categories: Morning Type (scores 59-86), Intermediate Type (score 42-58) and Evening Type (score 16-41).
- The *Seasonal Pattern Assessment Questionnaire* (SPAQ), introduced by Rosenthal et al.<sup>44</sup> is a retrospective, self-administered tool that screens for SAD and S-SAD. It is composed by four sections that investigate seasonal changes. The first section assess seasonal variations in mood, energy, sleep, social activity, weight gain and eating habits rating each item on a likert rating scale, item scales range from 0 (no change) to 4 (extremely marked change). The total scale ranges from 0 to 24, the cut-off of the self-report version of the SPAQ is set at 11 point. This score is used to calculate the Global Seasonality Score (GSS), that indicates the presence of SAD and the severity degree. A second criterion is based on the item whether seasonal changes are considered a problem, ranged from 0 (no problem) to 5 (disabling problem), a score of at least 2 indicates presence of SAD. The last session, aimed to identify the presence of SAD or S-SAD, is the one asking the subjects to indicate the months in which the symptoms occur. Kasper et al.<sup>41</sup> suggested that SAD subjects would indicate that symptoms get worse in December, January or February, on the other hand S-SAD subjects should feel worst in June, July or August.
- The *Beck Depression Inventory* (BDI)<sup>53</sup>. The scale, used to assess the severity of depressive symptoms, it is composed by 21 items, each characterized by four possible answers, scored from 0 to 3. The total score of 16 and above indicates the presence of moderate or severe depression.
- *Sociodemographic Information Form*. This form was developed to obtain information about participants such as age, gender, height and weight, university type, academic year. Participants were asked to provide responses to the questions appearing on the form. Body Mass Index of the participants were obtained from the answers that they provided about their height and weight. BMI was calculated using the formula  $BMI = \text{weight (kg)} / \text{height}^2 (\text{m})$ . A BMI below 18.5 was considered as underweight, 18.5-25 normal weight, 25-30 overweight, 30 and over obese, respectively.

### Data analysis

The data analysis included descriptive statistics, chi-square test, independent samples t-test and Pearson correlation test. Descriptive statistics were used to examine the frequencies and percentages. Data are presented as mean  $\pm$  SD (standard deviation) for continuous variables and percent frequency for categorical variables. The study participants were divided into two groups in according to NEQ cut-off. Independent Student's t-test was conducted to compare NEQ total score, MEQ total score, GSS, BDI total score and BMI in two groups. Chi-square test was conducted to assess the differences in cronotype distribution (MEQ), seasonality (GSS) and the BMI categories.

Pearson correlation test ( $r$ ) was computed to investigate the relationship between MEQ total score, GSS, BDI and BMI. Two-tailed  $p$  values  $<.05$ , were required for statistical significance.

All the statistical analyses were performed with IBM SPSS Statistics for Windows, Version 20.0. (IBM Corp, Armonk, NY, USA).

### Ethics

This research was conducted in accordance with the Declaration of Helsinki and was approved by the Ethical Committee of the University of L'Aquila. All the procedures were carried out with the adequate understanding of the subjects, who read and signed an informed consent form before participating in this research project.

### RESULTS

The sample was composed by 1136 subjects, 360 males and 774 females; the mean age was 25.97 (SD=10.78) and mean BMI of 22.38 (SD=3.6), kg/m<sup>2</sup> (Table 1).

The 5.3% of our population (60 subjects) reached the criteria for NES.

The distribution of chronotypes in the sample was: Morning Type 15.3%, Intermediate 64.3% and Evening Type 20.4%. The 36.7% of the participants who reached the criteria for NES, obtained low scores on the MEQ ( $\chi^2=10.41$   $p<.005$ ). Furthermore, the data indicated that NEQ and MEQ scores are significantly inversely correlated ( $r=-.22$ ;  $p<.01$ ).

The 3.6% of our population (41 subjects) reached the criteria for SAD and the 10.7% for subclinical SAD (121 subjects). Furthermore, the 11.7% of subjects with NES presented SAD and the 5% presented Subclinical SAD ( $\chi^2=13.21$   $p<.001$ ). NES and Global Seasonality Score (GSS) are significantly correlated ( $r=.22$ ;  $p<.01$ ).

Depressive symptoms correlate with NES ( $r=.43$ ;  $p<.01$ ); the 14.87% of subjects with NES had higher scores on the BDI.

No significant association between NES and BMI was seen ( $r=-.026$ , NS).

### DISCUSSION

The aim of the current study was to assess the prevalence of NES in a university student population and to investigate the relationship between NES, circadian rhythms and seasonality.

The prevalence of NES in our sample was 5.28%. This estimate is similar to the one assessed by Runfola<sup>50</sup> in university students (4%) and Nolan<sup>54</sup> in college students (5.7%).

The main finding of this study is the strong relation between NES and eveningness dimension. According to our initial hypothesis, subjects with NES gained lower scores on the MEQ, as other researchers observed in the clinical population<sup>23</sup>, in the non-clinical population<sup>50</sup> and in the adolescent population<sup>34</sup>. These results help to clear up the literature debate about the role of eveningness dimension in the night eating, suggesting that subjects with NES present a circadian delay, not only in the food intake, but in the entire functioning<sup>27,32-34</sup>.

Table 1. Characteristic of the sample.

Variable	Total sample	with NES	no NES	p
N	1136	60 (5.3%)	1076 (94.7%)	
Age	25.97 (ds 10.78)	23.25 (10.88)	26.13 (10.76)	
M/F (%)	360/774 (31.7/68.1)	23/37 (38.3/61.7)	339/737 (31.5/68.5)	t=-1.98 p ns
BMI	22.38 (ds 3.6)	22.24 (SD 3.71)	22.39 (SD 3.59)	t=.937 p ns
Underweight	117 (11.1%)	6 (11.8%)	111 (11.0%)	$\chi^2(5, N 1136)=1.57$ p.903
Normal	743 (70.4%)	34 (66.7%)	709 (70.5%)	
Overweight	196 (18.6%)	11 (21.6%)	185 (18.4%)	
NEQ total score	11.36 (5.06)	38 (SD 24.72)	20 (SD 10.61)	t=-26.99 p<.001
MEQ total score	82 (49.06)	45.77 (SD 8.97)	49.26 (SD 9.19)	t=-2.85 p.004
Evening type	231 (20.4%)	22 (36.7%)	209 (19.5%)	$\chi^2(2, N 1136)=10.41$ p.005
Intermediate type	729 (64.3%)	30 (50.0%)	699 (65.1%)	
Morning type	173 (15.3%)	8 (13.3%)	165 (15.4%)	
SAD	41 (3.6%)	7 (11.7%)	34 (3.2%)	$\chi^2(2, N 1136)=13.21$ p.001
S-SAD	121 (10.7%)	3 (5.0%)	118 (11.1%)	
GSS	23 (SD 8.1)	10.03 (SD 5.012)	7.99 (SD 4.260)	t=-3.52 p<.001
BDI total score	7.54 (SD 6.63)	14.87 (SD 8.81)	7.13 (SD 6.25)	t=-8.8 p<.001

We found preliminary evidence that, similarly to the findings of previous studies in subjects with BN and BED, night eating symptoms may vary significantly across the seasons; subjects with NES experience seasonal variation in their mood and in their eating patterns. Other researches have already demonstrated the association between SAD and compulsive eating behavior, especially Bulimia Nervosa (BN) and Binge Eating Disorder (BED), and suggested that sensitivity to seasonal changes in light availability was associated with risk for BED and BN<sup>55,56</sup>. Recent findings indicated that greater seasonality scores significantly predicts binge eating symptomatology in healthy subjects<sup>57</sup>. Further investigations are needed to clarify the impact of seasonality on night eating behavior and to investigate whether the night eating symptoms get worse at northern latitudes, such as researchers observed in BN and BED<sup>55,58</sup>.

Our results did not show any correlation between NES and BMI, suggesting, in accordance to literature, that this association may be clearer in the clinical samples than in epidemiological studies<sup>50,51,54</sup>. Furthermore, other researchers<sup>59</sup> suggested that age may be considered a mediator in the relationship between NES and BMI. Strong association between NES and BMI in subjects aged 55-60 has been found but, on the other hand, no correlation in young subjects. Our results are consistent with this hypothesis.

The findings of the current study also indicate a strong relation between NES and depressive symptoms. Further studies should investigate the role of depression in the night eating behavior.

This research has some limitations to be considered: first,

the study relies on self-reported data and not clinical interview-based assessments of NES and SAD.

Furthermore, the sample is composed by students of L'Aquila University, the most originating from central Italy. This design helped to increase the homogeneity of the population, but lack to identify the differences of SAD and NES symptoms at different latitudes. It would be interesting to replicate this research at northern latitudes to investigate any variation.

Our study, as far as we are aware, is the first one to examine the relationship between NES and seasonality and to investigate the relation between NES and eveningness dimension in the Italian young adult population. The findings may have some major clinical implications and may explain the effectiveness of Bright Light Therapy in the treatment of NES.

*Conflict of interests:* the authors have no conflict of interests to declare.

## REFERENCES

1. Natale V, Cicogna P. Morningness-eveningness dimension: is it really a continuum? *Personality and Individual Differences* 2002; 32: 809-16.
2. Bersani G, Liberati D, Rasa A, et al. Premorbid sleep, appetite, energy, and cognitive circadian profile in patients with depressive disorders. *Eur Psychiatry* 2010; 25: 461-4.
3. Liberati D, Rasa A, Polli E, Ciufea M, Pacitti F, Bersani G. [Premorbid sleep and general activity circadian profile in patients with depressive disorder]. *Riv Psichiatr* 2008; 43: 370-5.



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4. Bersani FS, Iannitelli A, Pacitti F, Bersani G. Sleep and biorythm disturbances in schizophrenia, mood and anxiety disorders: a review. *Riv Psichiatr* 2012; 47: 365-75.
5. Drennan MD, Klauber MR, Kripke DF, Goyette LM. The effects of depression and age on the Horne-Ostberg morningness-eveningness score. *J Affect Disord* 1991; 23: 93-8.
6. Danilenko KV, Putilov AA. Melatonin treatment of winter depression following total sleep deprivation: waking EEG and mood correlates. *Neuropsychopharmacology* 2005; 30: 1345-52.
7. Natale V, Adan A, Scapellato P. Are seasonality of mood and eveningness closely associated? *Psychiatry Res* 2005; 136: 51-60.
8. Hirata FC, Lima MC, de Bruin VM, Nóbrega PR, Wenceslau GP, de Bruin PF. Depression in medical school: the influence of morningness-eveningness. *Chronobiol Int* 2007; 24: 939-46.
9. Bersani G, Bersani FS, Prinzivalli E, et al. Premorbid circadian profile of patients with major depression and panic disorder. *Riv Psichiatr* 2012; 47: 407-12.
10. Tirassa P, Iannitelli A, Sornelli F, et al. Daily serum and salivary BDNF levels correlate with morning-evening personality type in women and are affected by light therapy. *Riv Psichiatr* 2012; 47: 527-34.
11. Tonetti L, Fabbri M, Natale V. Relationship between circadian typology and big five personality domains. *Chronobiol Int* 2009; 26: 337-47.
12. Tonetti L, Adan A, Caci H, De Pascalis V, Fabbri M, Natale V. Morningness-eveningness preference and sensation seeking. *Eur Psychiatry* 2010; 25: 111-5.
13. Lee S, Park JE, Cho SJ, Cho IH, Lee YJ, Kim SJ. Association between morningness-eveningness and temperament and character in community-dwelling Korean adults. *Asia Pac Psychiatry* 2014; 6: 77-82.
14. Lee K, Lee HK, Jung K, Park JY. Relationship between chronotype and temperament/character among university students. *Psychiatry Res* 2017; 251: 63-8.
15. Ruiz-Lozano T, Vidal J, de Hollanda A, Canteras M, Garaulet M, Izquierdo-Pulido M. Evening chronotype associates with obesity in severely obese subjects: interaction with CLOCK 3111T/C. *Int J Obes* 2016; 40: 1550-7.
16. Ceccanti M, Iannitelli A, Fiore M. Italian guidelines for the treatment of alcohol dependence. *Riv Psichiatr* 2018; 53: 105-6.
17. Sato-Mito N, Shibata S, Sasaki S, Sato K. Dietary intake is associated with human chronotype as assessed by both morningness-eveningness score and preferred midpoint of sleep in young Japanese women. *Int J Food Sci Nutr* 2011; 62: 525-32.
18. Fleig D, Randler C. Association between chronotype and diet in adolescents based on food logs. *Eat Behav* 2009; 10: 115-8.
19. Stunkard AJ, Grace WJ, Wolff HG. The night-eating syndrome; a pattern of food intake among certain obese patients. *Am J Med* 1955; 19: 78-86.
20. Birketvedt GS, Florholmen J, Sundsfjord J, et al. Behavioral and neuroendocrine characteristics of the night-eating syndrome. *JAMA* 1999; 282: 657-63.
21. Allison KC, Grilo CM, Masheb RM, Stunkard AJ. Binge eating disorder and night eating syndrome: a comparative study of disordered eating. *J Consult Clin Psychol* 2005; 73: 1107-15.
22. O'Reardon JP, Ringel BL, Dinges DF, et al. Circadian eating and sleeping patterns in the night eating syndrome. *Obes Res* 2004; 12: 1789-96.
23. Rogers NL, Dinges DF, Allison KC, et al. Assessment of sleep in women with night eating syndrome. *Sleep* 2006; 29: 814-9.
24. Geliebter A, McQuatt H, Tetreault CB, et al. Is night eating syndrome associated with obstructive sleep apnea, BMI, and depressed mood in patients from a sleep laboratory study? *Eat Behav* 2016; 23: 115-9.
25. Striegel-Moore RH, Franko DL, Thompson D, Affenito S, May A, Kraemer HC. Exploring the typology of night eating syndrome. *Int J Eat Disord* 2008; 41: 411-8.
26. Pawlow LA, O'Neil PM, Malcolm RJ. Night eating syndrome: effects of brief relaxation training on stress, mood, hunger, and eating patterns. *Int J Obes Relat Metab Disord* 2003; 27: 970-8.
27. Lundgren JD, Allison KC, O'Reardon JP, Stunkard AJ. A descriptive study of non-obese persons with night eating syndrome and a weight-matched comparison group. *Eat Behav* 2008; 9: 343-51.
28. Caredda M, Roscioli C, Mistretta M, Pacitti F. [Stress vulnerability and night eating syndrome in the general population]. *Riv Psichiatr* 2009; 44: 45-54.
29. Pacitti F, Maraone A, Zazzara F, Biondi M, Caredda M. [Stress and night eating syndrome: a comparison study between a sample of psychiatric outpatients and healthy subjects]. *Riv Psichiatr* 2011; 46: 195-202.
30. Gluck ME, Venti CA, Salbe AD, Krakoff J. Nighttime eating: commonly observed and related to weight gain in an inpatient food intake study. *Am J Clin Nutr* 2008; 88: 900-5.
31. Stunkard AJ, Allison KC, O'Reardon JP. The night eating syndrome: a progress report. *Appetite* 2005; 45: 182-6.
32. Harb A, Levandovski R, Oliveira C, et al. Night eating patterns and chronotypes: a correlation with binge eating behaviors. *Psychiatry Res* 2012; 200: 489-93.
33. Natale V, Ballardini D, Schumann R, Mencarelli C, Magelli V. Morningness-eveningness preference and eating disorders. *Personality and Individual Differences* 2008; 45: 549-53.
34. Riccobono G, Pompili A, Iannitelli A, Pacitti F. The relationship between Night Eating Syndrome, depression and chronotype in a non-clinical adolescent population. *Riv Psichiatr* 2019; 54: 115-9.
35. Friedman S, Even C, Dardennes R, Guelfi JD. Light therapy, obesity, and night-eating syndrome. *Am J Psychiatry* 2002; 159: 875-6.
36. Friedman S, Even C, Dardennes R, Guelfi JD. Light therapy, nonseasonal depression, and night eating syndrome. *Can J Psychiatry* 2004; 49: 790.
37. McCune AM, Lundgren JD. Bright light therapy for the treatment of night eating syndrome: a pilot study. *Psychiatry Res* 2015; 229: 577-9.
38. Allison KC, Lundgren JD, Moore RH, O'Reardon JP, Stunkard AJ. Cognitive behavior therapy for night eating syndrome: a pilot study. *Am J Psychother* 2010; 64: 91-106.
39. O'Reardon JP, Allison KC, Martino NS, Lundgren JD, Heo M, Stunkard AJ. A randomized, placebo-controlled trial of sertraline in the treatment of night eating syndrome. *Am J Psychiatry* 2006; 163: 893-8.
40. Hardin TA, Wehr TA, Brewerton T, et al. Evaluation of seasonality in six clinical populations and two normal populations. *J Psychiatr Res* 1991; 25: 75-87.
41. Rohan KJ, Sigmon ST. Seasonal mood patterns in a northeastern college sample. *J Affect Disord* 2000; 59: 85-96.
42. Kasper S, Wehr TA, Bartko JJ, Gaist PA, Rosenthal NE. Epidemiological findings of seasonal changes in mood and behavior. A telephone survey of Montgomery County, Maryland. *Arch Gen Psychiatry* 1989; 46: 823-33.
43. Kasper S, Rogers SL, Yancey A, Schulz PM, Skwerer RG, Rosenthal NE. Phototherapy in individuals with and without sub-syndromal seasonal affective disorder. *Arch Gen Psychiatry* 1989; 46: 837-44.
44. Rosenthal NE, Sack DA, Gillin JC, et al. Seasonal affective disorder. A description of the syndrome and preliminary findings with light therapy. *Arch Gen Psychiatry* 1984; 41: 72-80.
45. Wehr TA, Sack DA, Rosenthal NE. Seasonal affective disorder with summer depression and winter hypomania. *Am J Psychiatry* 1987; 144: 1602-3.
46. Friedman S, Even C, Thuile J, Rouillon F, Guelfi JD. Night eating syndrome and winter seasonal affective disorder. *Appetite* 2006; 47: 119-22.

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47. Gluck ME, Geliebter A, Satov T. Night eating syndrome is associated with depression, low self-esteem, reduced daytime hunger, and less weight loss in obese outpatients. *Obes Res* 2001; 9: 264-7.
48. Miyaoka T, Yasukawa R, Tsubouchi K, et al. Successful treatment of nocturnal eating/drinking syndrome with selective serotonin reuptake inhibitors. *Int Clin Psychopharmacol* 2003; 18: 175-7.
49. O'Reardon JP, Stunkard AJ, Allison KC. Clinical trial of sertraline in the treatment of night eating syndrome. *Int J Eat Disord* 2004; 35: 16-26.
50. Runfola CD, Allison KC, Hardy KK, Lock J, Peebles R. Prevalence and clinical significance of night eating syndrome in university students. *J Adolesc Health* 2014; 55: 41-8.
51. Allison KC, Lundgren JD, O'Reardon JP, et al. The Night Eating Questionnaire (NEQ): psychometric properties of a measure of severity of the Night Eating Syndrome. *Eat Behav* 2008; 9: 62-72.
52. Horne JA, Ostberg O. A self-assessment questionnaire to determine morningness-eveningness in human circadian rhythms. *Int J Chronobiol* 1976; 4: 97-110.
53. Beck AT, Ward CH, Mendelson M, Mock J, Erbaugh J. An inventory for measuring depression. *Arch Gen Psychiatry* 1961; 4: 561-71.
54. Nolan LJ, Geliebter A. Night eating is associated with emotional and external eating in college students. *Eat Behav* 2012; 13: 202-6.
55. Donofry SD, Roeklein KA, Rohan KJ, Wildes JE, Kamarck ML. Prevalence and correlates of binge eating in seasonal affective disorder. *Psychiatry Res* 2014; 217: 47-53.
56. Pacitti F, Russo D, Iannitelli A, Bersani G, Pancheri P. [Seasonal affective disorder and premenstrual syndrome. *Ital J Psychopathol* 2006]; 12: 186-93.
57. Davis C. A narrative review of binge eating and addictive behaviors: shared associations with seasonality and personality factors. *Front Psychiatry* 2013; 4: 183.
58. Lam RW, Goldner EM, Grewal A. Seasonality of symptoms in anorexia and bulimia nervosa. *Int J Eat Disord* 1996; 19: 35-44.
59. Meule A, Allison KC, Brähler E, de Zwaan M. The association between night eating and body mass depends on age. *Eat Behav* 2014; 15: 683-5.