Night eating patterns and chronotypes: A correlation with binge eating behaviors

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Abstract

This cross-sectional study examined the association between the morningness/eveningness dimension and eating patterns. The sample consists of 100 subjects who were screened at a nutrition clinic and was composed of 77% women; mean age was 39.5 (± 11.7) years; and 66% were overweight. Significant bivariate correlations were found between the Morningness–Eveningness Questionnaire (MEQ) total score and the Binge Eating Scale (BES) and the Night Eating Questionnaire (NEQ). The NEQ and BES were also significantly correlated. Body mass index (BMI) was correlated with the MEQ, NEQ and BES, but it was not a confounding variable as no associations were found between the MEQ and BMI. To control for potential multicollinearity effects among variables, we also used multivariate regression analysis in which the values of the correlation coefficients were adjusted. Only the BES remained statistically associated with the MEQ. In conclusion, these results suggest that the study of chronotype may be an important issue to be considered when characterizing disordered eating. This study serves as an impetus for examining circadian intake patterns in more detail between those with binge eating disorder (BED) and night eating syndrome (NES) to help discern these important nosological questions.

1. Introduction

Humans show inter-individual differences in organizing their behaviors around the 24 h day. Some individuals prefer to go to bed early and wake up early (morning-types) and others prefer to go to bed late and wake up late (evening-types) (Horne and Ostberg, 1976; Roenneberg et al., 2007). These circadian typologies defined as chronotypes, may explain the variations in the rhythmic expression of biological or behavioral patterns (Adan and Natale, 2002; Horne and Ostberg, 1976). The relationship between the circadian system and different chronotypes is genetically well established in experimental studies in organisms ranging from unicells to mammals (Barclay et al., 2011; Layana and Diambra, 2011). Additional factors, such as social, cultural and environmental zeitgeber could modulate chronotype (Levandovski et al., 2011).

Some studies have showed that evening-types tend to skip breakfast more often when compared to morning-types (Sato-Mito et al., 2011). Other research has demonstrated that people who prefer to wake up earlier have more flexible diet control in addition to having greater control over their amount of food intake (Fleig and Randler, 2009; Schmidt and Randler, 2010). These data also suggest that staying up late at night can lead to overeating (Fleig and Randler, 2009). Chronotype can be related to lifestyle, as well as to genetic factors. Studies have demonstrated that chronotype is linked to CLOCK, PER2 and PER3 polymorphisms (Klei et al., 2005; Barclay et al., 2011). Clock genes may synchronize the metabolism and feeding (van der Veen et al., 2006). Moreover PER2 has been implicated in feeding anticipatory behavior (Froy, 2007).

Although eating behavior has been well correlated with circadian rhythm (Garaulet and Madrid, 2010), how specific eating disorders may be linked to chronicity remains unclear. One problem in differentiating the relationship between specific eating disorders and chronotype is diagnostic overlap, most often occurring between binge eating disorder (BED) and night eating syndrome (NES). For example, individuals with either BED or NES may share a feeling of loss of...
control over their eating, but the time when this happens is different (Aronoff et al., 1994); in the NES group loss of control occurs in the evening and nighttime, but it the BED group, binge episodes may occur at any time of day (Allison et al., 2007).

As reported earlier, the individual differences in circadian typology may influence eating behavior as a zeitgeber (Natale et al., 2008). Studies demonstrated that persons with NES had significantly lower scores on the Morningness/Eveningness Questionnaire (MEQ), indicating that they had a higher probability of endorsing the eveningness type (Natale et al., 2008; Lundgren et al., 2008). To our knowledge, no studies have examined chronotype in relation to both binge eating and night eating symptoms, which could help clarify the question of overlap between the two disorders. Thus, in this study our aim was to investigate the correlation between chronotypes and disordered eating behavior, including binge eating and night eating, and body mass index (BMI). We hypothesized that night eating would show the strongest relationship with the eveningness type among these factors.

2. Methods

2.1. Participants

Cross-sectional data were collected from 100 participants consecutively admitted to an outpatient nutrition clinic. The inclusion criteria targeted adult patients between 18 and 65 yr. Demographic information is presented and summarized in Table 1.

2.2. Procedures

The study protocol (reference number: 226/06) was approved by the Human Research Committee at Fundação Faculdade Federal de Ciências Médicas de Porto Alegre (FFCMFA) and was performed in compliance with the Helsinki Declaration. All study participants signed an informed consent form.

The participants were invited to participate in the research study when they came to the nutrition clinic for weight loss treatment or improvement of their eating habits. Their weight and height were measured on an anthropometric scale at the end of the evaluation; participants completed a battery of questionnaires.

2.3. Measures

2.3.1. Independent variable

The independent variable was chronotype as assessed by the Morningness–Eveningness Questionnaire (MEQ). This questionnaire provided an indication of circadian preference which is a construct developed to estimate phase tendencies in circadian rhythm. Scores range from 16 to 86, with higher scores indicating a circadian preference which is a construct developed to estimate phase tendencies in circadian rhythm. Scores range from 16 to 86, with higher scores indicating eveningness.

2.3.2. Dependent variables

The dependent variables were: (1) BMI and weight related demographic information, (2) Binge Eating Scale (BES), (3) Eating Attitudes Test, and (4) Night Eating Questionnaire (NEQ).

2.4. Assessment of eating behavior and eating disorders

BMI was calculated according to the Quetelet index (weight in kilograms divided by height in meters squared). Information was also collected related to time since last weight reduction program and use of antidepressants and hypnotic drugs.

The Binge Eating Scale (BES) (Gormally et al., 1982) is a 16-item self-reported questionnaire, designed specifically to identify the behavioral and cognitive characteristics of binge eating in obese individuals. It is used as a screening tool to identify persons with binge eating, evaluate binge eating severity, and serve as a predictor of treatment outcome. A cut-off score of 18 or more is used to identify cases of BED.

The Eating Attitudes Test (EAT) (Garnder and Garfinkel, 1979) assesses abnormal eating attitudes and behaviors, in particular those of a restrictive type that characterize anorexia nervosa. We used the 26-item Brazilian version which discriminates between clinically diagnosed cases of eating disorders and healthy controls at the original cut-off score of 20.

The Night Eating Questionnaire (NEQ) (Allison et al., 2008), a 14-item screening instrument for NES, was used to assess the presence of night eating behavior. The questions assess hunger and craving patterns throughout the day, percentage of calories ingested after suppertime, feelings of depression, insomnia, awakenings, and nocturnal food cravings and ingestions. A score of 30 is strongly suggestive of NES. We used the version of the NEQ that was translated and adapted to Portuguese for the Brazilian population.

2.5. Statistical analyses

Descriptive statistics were performed to describe the demographic characteristics of participants. The asymmetric variables were described with medians and inter-quartile ranges. The means or medians of the BES, EAT, NEQ and MEQ are presented in Table 1. Age was categorized in two groups ≥ 40 yr and < 40 yr. Comparisons of means were performed using Students t test for independent variables. We performed logarithmic transformations due to wide standard deviations for the following variables: NEQ, BES and time since last weight reduction program.

Pearson’s correlations were used to evaluate the relationships among BMI, BES, EAT, NEQ and MEQ total score (Table 2). Multilinear regression models were used to evaluate the associations among the variables with potential confounding variable (BES and NEQ) and the MEQ total score.

For all analyses, statistical significance was set at p < 0.05, two-tailed. Data were analyzed using SPSS version 13.0 (SPSS, Chicago, IL).

3. Results

The sample (n = 100) had a mean age of 39.5 ± 11.7 yr. Among these, 77% were women, 66%, overweight (BMI > 25 kg/m²), 43% presented with binge eating behaviors (≥ 18 on the BES), 27% with abnormal eating attitudes and behaviors (≥ 20 on the EAT).

Table 1

<table>
<thead>
<tr>
<th>Participants’ characteristics</th>
<th>Total sample (n = 100)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)—mean ± S.D.</td>
<td>39.5 ± 11.7</td>
</tr>
<tr>
<td>Sex—n (%)</td>
<td>23 (23.0)</td>
</tr>
<tr>
<td>Men</td>
<td>77 (77.0)</td>
</tr>
<tr>
<td>Weight (kg)—mean ± S.D.</td>
<td>73.3 ± 13.9</td>
</tr>
<tr>
<td>Height (m)—mean ± S.D.</td>
<td>1.65 ± 0.08</td>
</tr>
<tr>
<td>Body mass index (kg/m²)—mean ± S.D.</td>
<td>26.8 ± 4.02</td>
</tr>
<tr>
<td>Body mass index classifications—n (%)</td>
<td>48 (48.0)</td>
</tr>
<tr>
<td>Overweight</td>
<td>18 (18.0)</td>
</tr>
<tr>
<td>Obese</td>
<td>26 (26.0)</td>
</tr>
<tr>
<td>Antidepressant medication—n (%)</td>
<td>8 (8.0)</td>
</tr>
<tr>
<td>Hypnotic medication and Benzodiazepines—n (%)</td>
<td>24.5 (16–46)</td>
</tr>
<tr>
<td>Time of the last weight reduction program (months)—median (P25–P75)</td>
<td>14.5 (9–21.8)</td>
</tr>
<tr>
<td>Binge Eating Scale (BES)—median (P25–P75)</td>
<td>13 (9–18)</td>
</tr>
<tr>
<td>Eating Attitudes Test (EAT)—mean ± S.D.</td>
<td>7.81 ± 4.02</td>
</tr>
<tr>
<td>Night Eating Questionnaire (NEQ)—median (P25–P75)</td>
<td>52.4 ± 14.0</td>
</tr>
<tr>
<td>Morningness/Eveningness Questionnaire (MEQ)—mean ± S.D.</td>
<td>16.7 ± 7.81</td>
</tr>
</tbody>
</table>
and 18% with night eating behaviors (≥30 on the NES). The sample characteristics are presented in Table 1.

BMI ($r = -0.101; p = 0.319$), time of the last weight reduction program ($r = -0.019; p = 0.855$) and the EAT ($r = -0.168; p = 0.095$) were not correlated to the MEQ (Table 2). Therefore, these variables do not confound the relationship between the MEQ and eating behaviors. However, BMI was correlated with the NEQ ($r = 0.25; p = 0.001$) and BES ($r = 0.32; p = 0.012$).

MEQ means compared by age, categorized in two groups (<40 and ≥40 yr), showed no significant difference ($r = -1.77; p = 0.08$). As this result represented a tendency we analyzed the influence of age on the correlations between the MEQ, the BES, and the NEQ (Fig. 1a and b). Evenness was correlated with higher BES scores in older subjects (≥40 yr). Examining the entire sample, significant bivariate correlations were found between the MEQ total score and the BES ($r = -0.33; p = 0.001$) and NEQ ($r = -0.24; p = 0.015$). The NEQ and BES were also significantly correlated ($r = 0.47, p < 0.001$) (Fig. 2).

To control for potential multicollinearity effects among variables, we used multivariate regression analysis in which the variables BES, eating attitudes, and BMI were entered into the model. The main finding of this study suggested that persons with binge eating and night eating behaviors were more likely to endorse an evenness chronotype than a morningness chronotype. However, the correlation between the MEQ and NEQ was not maintained when multivariate analysis was applied, possibly because the BES and NEQ scores were significantly correlated.

As previous studies have shown a relationship between the NEQ and circadian disruption (Lundgren et al., 2008; Goel et al., 2009), it was expected that the NEQ would be correlated with the BES, i.e., participants who reported higher scores on the NEQ would show eveningness characteristics. The previous research findings indicated that participants with NES considered themselves to function better in the latter part of the day than control participants (Lundgren et al., 2008). However, the findings in this current study only suggested a weak correlation between the morningness/eveningness dimension and night eating, which may be due to the small sample endorsing these behaviors or due to a confounding effect with binge eating behaviors as the correlation was attenuated after controlling for BES scores.

Following from this, we found a significant correlation between the BES and NEQ total scores. Previous studies suggest (Allison et al., 2007) that BED and NES appear to be two different disorders rather than variable expressions of the same underlying psychopathology. Given this, we would have expected the NES group to have a more pronounced eveningness type. However,

![Fig. 1. The graphics show the influence of age (≥40 yr) on the correlation between the Morningness–Eveningness Questionnaire and the Binge Eating Scale (BES score—(a)) and the Night Eating Questionnaire (NEQ score—(b)) (plots of scores). Lower scores on the MEQ were related to higher scores on the BES and NEQ in the older group (≥40). Total sample size was 100 subjects. $n$ = Number of subjects; BES = Binge Eating Scale; NEQ = Night Eating Questionnaire.](image)

### Table 2

<table>
<thead>
<tr>
<th>Variables</th>
<th>Bivariate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Correlation</td>
</tr>
<tr>
<td></td>
<td>coefficient</td>
</tr>
<tr>
<td>Body mass index</td>
<td>-0.101</td>
</tr>
<tr>
<td>Time since the last weight reduction program*</td>
<td>-0.019</td>
</tr>
<tr>
<td>Binge Eating Scale*</td>
<td>-0.328</td>
</tr>
<tr>
<td>Eating Attitudes Test</td>
<td>-0.168</td>
</tr>
<tr>
<td>Night Eating Questionnaire*</td>
<td>-0.243</td>
</tr>
</tbody>
</table>

* The variable was treated with logarithmic transformation.

Level of significance: * p < 0.05.
previous studies have shown that participants with NES have similar sleep onset and offset times to those of controls (O’Reardon et al., 2004; Rogers et al., 2006), suggesting that their circadian delay may be confined to their eating as opposed to more globally affecting other aspects of their functioning.

Also, the correlation between the NEQ and MEQ may be modified according to age. Unfortunately, the sample size for those scoring above the clinical cut-score for NES was small in this study. But we observed that, comparing subjects over and under 40 yr, the curve shape (Fig. 1a and b) indicated a negative correlation with the both extreme chronotype. Therefore, we may raise the hypothesis that, age may influenced this correlation, probably mediated by sexual hormone, since high testosterone levels lead to eveningness (Randler et al., in press) and menstrual symptoms were more significant in eveningness girls (Negriff and Dorn, 2009).

No significant relationship was found between the EAT and MEQ total scores. No evidence of an association between restrictive behaviors and chronotype has been found in the literature so far. Also, there was no association between the MEQ and BMI, in spite of previous evidence suggesting that morningness is correlated with lower BMI (Schubert and Randler, 2008).

Limitations of this study include the use of surveys to assess eating behaviors and the low incidence of night eating behaviors. Additionally, this was a treatment-seeking population with a narrow age range. Demand characteristics may have influenced responses to questionnaires as they were completed before participants returned for treatment. In spite of the limitations, this is the first study that examining the relation between chronotype and eating behaviors on a clinical sample.

In conclusion, these findings of the current study suggest that evening-type patients endorsed more binge eating behaviors than those reporting morning-type chronicity, and they reported a weaker number of night eating behaviors. These results suggest that the study of chronotype may be an important issue to consider when characterizing disordered eating behavior. This link between chronotype and eating behavior may be regulated by leptin and ghrelin circadian rhythms. Patients with NES showed a phase delay in two food-regulatory rhythms—leptin and insulin—and, as expected, the levels of ghrelin were phase advanced (Goel et al., 2009; Jakubowicz et al., 2012).

Our results were surprising, and indicate that more work is needed to examine when binge episodes may be occurring, and what the average proportion of energy intake after dinner may be for those with BED to differentiate it and NES. Consuming 25% of intake after the evening meal (Allison et al., 2010) is adequate for diagnosing NES, or if it is not specific enough. If the latter were the case, then perhaps both evening hyperphagia and nocturnal ingestions would be required for a diagnosis of NES. In sum, this study serves as an impetus for examining circadian intake patterns in more detail between those with BED and NES to help discern these important nosological questions.

Acknowledgments

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References


