FULL-LENGTH REPORT
Journal of Behavioral Addictions
DOI: 10.1556/2006.7.2018.07

Eveningness is associated with poor sleep quality and negative affect in obsessive–compulsive disorder

PÉTER SIMOR[1,2]*, ANDRÁS HARSÁNYI[2], KATA CSIGÓ[2], GERGELY MIKLÓS[3], ALPÁR SÁNDOR LÁZÁR[4] and GYULA DEMETER[5,6,7]

[1]Institute of Psychology, Eötvös Loránd University, Budapest, Hungary
[2]Nyírő Gyula Hospital, National Institute of Psychiatry and Addictions, Budapest, Hungary
[3]Semmelweis University, Budapest, Hungary
[4]Faculty of Medicine and Health Sciences, University of East Anglia, Norwich, United Kingdom
[5]Department of Cognitive Sciences, Budapest University of Technology and Economics, Budapest, Hungary
[6]Rehabilitation Department of Brain Injuries, National Institute of Medical Rehabilitation, Budapest, Hungary
[7]Learning and Memory Disorders Research Group, Research Centre for Natural Sciences, Hungarian Academy of Sciences, Budapest, Hungary

(Received: November 16, 2017; revised manuscript received: January 18, 2018; accepted: January 21, 2018)

Background: Obsessive–compulsive disorder (OCD) is characterized by intrusive thoughts and repetitive behaviors that severely encumber daily functioning. OCD patients seem to exhibit sleep disturbances, especially delayed bedtimes that reflect disrupted circadian rhythmicity. Morningness–eveningness is a fundamental factor reflecting individual variations in diurnal preferences related to sleep and waking activities. Eveningness reflecting a delayed sleep–wake timing has repeatedly been associated with sleep problems and negative affect (NA). Therefore, the aim of this study was to examine the associations between morningness–eveningness, sleep complaints, and symptom severity in OCD patients and compared with a mixed psychiatric control group. *Materials and methods:* The data of 49 OCD and 49 mixed psychiatric inpatients (with unipolar depression and anxiety disorders) were analyzed. Patients completed questionnaires regarding morningness–eveningness, sleep quality, nightmare frequency, depression, anxiety, and affective states. Obsessive and compulsive symptom severity was also assessed within the OCD group by clinician-rated scales. *Results:* Eveningness preference was associated with impaired sleep quality and higher NA in OCD patients. In addition, impaired sleep quality showed a moderate correlation with anxiety and strong correlations with depressive symptoms and NA. Interestingly, in the mixed psychiatric group, eveningness was not linked to NA, and sleep quality also showed weaker associations with depressive symptoms and NA. Within the OCD group, eveningness preference was predictive of poorer sleep quality regardless the influence of depressive symptoms. *Conclusion:* Our findings suggest that eveningness and sleep complaints are predictive of affective dysfunctions, and should be carefully considered in the evaluation and treatment of OCD patients.

Keywords: obsessive–compulsive disorder, chronotype, affect, morningness–eveningness, sleep

INTRODUCTION

Obsessive–compulsive disorder (OCD) is a neuropsychiatric condition characterized by highly distressing and intrusive thoughts, images or ideas (obsessions), as well as coercive, repetitive, and often ritualistic behaviors (compulsions) that temporarily attenuate the anxiety provoked by the obsessions (American Psychiatric Association [APA], 2013). OCD is a chronic and severe illness affecting approximately 2% of the adult population (Kessler et al., 2005); however, the prevalence, the onset, and the progression of the disease show marked variations in males and females (Ruscio, Stein, Chiu, & Kessler, 2010). Symptoms of OCD fluctuate in severity and often show comorbidity with other mental complaints, such as depression, general anxiety disorder, panic disorder, or substance abuse (LaSalle et al., 2004; Ruscio et al., 2010; Torres et al., 2006).

Although sleep disturbances are not among the core features of the disorder, studies suggest that sleep complaints are prevalent in OCD patients (Paterson, Reynolds, Ferguson, & Dawson, 2013; Reynolds, Gradisar, & Alfano, 2015). Altered sleep, such as increased sleep latency (the time required to fall asleep after going to bed), shortened sleep duration, nocturnal awakenings, reduced sleep efficiency, and increased rapid eye movement (REM) sleep pressure were also reported (Paterson et al., 2013). Sleep disturbances in OCD are relevant from a clinical point of view as disrupted sleep architecture (especially altered REM sleep) was attributed to comorbid depression and associated with increased symptom severity in

* Corresponding author: Péter Simor, PhD; Department of Affective Psychology, Eötvös Loránd University, Izabella utca 46, Budapest 1064, Hungary; Phone: +36 1 461 2691; Fax: +36 1 461 4500/5675; E-mail: simor.peter@ppk.elte.hu

OCD patients (Cox & Olatunji, 2016; Paterson et al., 2013). Furthermore, subjective sleep complaints were associated with obsessive symptoms in non-clinical samples; however, the causal nature of this relationship is unclear (Timpano, Carbonella, Bernert, & Schmidt, 2014).

Recent studies suggest that certain sleep difficulties in OCD might not simply stem from depressive symptomatology. For instance, longer sleep latency and shortened sleep duration seem to be independent of comorbid depressive symptoms (Díaz-Román, Perestelo-Pérez, & Buela-Casal, 2015; Nota, Sharkey, & Coles, 2015). This is in line with other studies indicating that OCD patients are prone to exhibit delayed sleep phase disorder (DSPD) indexed by late bedtimes (Coles, Schubert, & Sharkey, 2012; Cox & Olatunji, 2016; Mukhopadhyay et al., 2008; Nota et al., 2015), regardless of comorbid depression (Díaz-Román et al., 2015). Delayed sleep timing might reflect disrupted circadian rhythmicity that, in turn, can exacerbate sleep complaints and psychological dysfunctions (Karatsoreos, 2014; Wulff, Gatti, Wettstein, & Foster, 2010). Disrupted sleep–wake cycles are prevalent in a wide variety of psychiatric conditions (Wulff et al., 2010), and delayed sleep times were shown to be related to increased symptom severity in depressed patients (Emens, Lewy, Kinzie, Arntz, & Rough, 2009; Murray et al., 2017).

Circadian rhythms show considerable individual variations corresponding to preferred sleep and wake times, daily fluctuations of alertness and mental performance (Carrier & Monk, 2000; Kyriacou & Hastings, 2010), and the expression of physiological markers of endogenous rhythms (Baehr, Revelle, & Eastman, 2000; Randler & Schaal, 2010). Age, sex, and various genetic polymorphisms (Archer, Viola, Kyriakopoulou, von Schantz, & Dijk, 2008; Schmidt, Collette, Cajochen, & Peigneux, 2007; Schmidt, Peigneux, & Cajochen, 2012) have been shown to associate with the features of the endogenous circadian rhythm, but the basis of individual differences is still not well understood. These individual differences can be determined by questionnaires assessing morningness–eveningness quantified along a continuum or by discrete circadian types called chronotypes. A growing body of data indicates that evening types are more susceptible to mental health complaints including depression (Antypa et al., 2017; Fabbian et al., 2016), addictive behaviors (Randler et al., 2016; Urbán, Magyaródi, & Rigó, 2011), anxiety (Díaz-Morales, 2016), and insomnia symptoms (Simor, Zavecz, Pálosi, Török, & Köteles, 2015). Some studies suggest that sex might moderate these links (Díaz-Morales & Pilar Sánchez-López, 2008), and the association between eveningness and mental complaints is stronger among females (Fabbian et al., 2016).

Evening chronotype is a risk factor for sleep disturbances and the misalignment of circadian and social time that likely play key roles in the development of emotional dysfunctions (Hasler, Soehner, & Clark, 2014; Levandovski et al., 2011; Simor, Zavecz, et al., 2015). Accordingly, evening chronotype is predictive of more severe psychopathological symptoms (Bahk, Han, & Lee, 2014) and non-remission (Chan et al., 2014) in depressed patients.

Although eveningness preference is a risk factor for insomnia complaints and emotional dysfunctions, no previous studies examined the relevance of chronotype in OCD. Given that individuals with evening preference might also be more susceptible to delayed sleep phase syndrome (Archer et al., 2003), the consideration of chronotype might be important in the evaluation and treatment of OCD. Therefore, the aim of this study was to investigate the associations between morningness–eveningness, sleep complaints, and symptom severity in OCD patients and the extent to which these clinical features and their interrelationships were different compared with a mixed psychiatric control group without OCD. More specifically, we hypothesized that eveningness preference in OCD patients would be associated with increased negative emotionality and more severe obsessive–compulsive (OC) symptomatology.

MATERIALS AND METHODS

Participants and procedure

A total of 52 OCD inpatients (males = 36; age $M = 32.25$, $SD = 9.30$) admitted to the National Institute of Psychiatry and Addictions, Department of Psychiatry, Budapest, Hungary were recruited to participate in the study. The psychiatric unit of the hospital is a multiprofile psychiatric clinic (treating all kinds of psychiatric patients) but has a special focus on the treatment of OCD patients. By this way, the unit offers specialized, pharmacological, and psychotherapeutic treatment for their patients diagnosed with OCD. Patients were diagnosed using the Structured Clinical Interview for DSM-V Personality Disorders and DSM-V (APA, 2013; First, Williams, Benjamin, & Spitzer, 2016) by certified psychiatrists. Comorbidity was present in 31% of the patients having unipolar depression ($n = 14$) and other anxiety disorders ($n = 2$). Individuals with prior history of psychiatric disease were already taking one or a combination of more psychotropic medications (mean consumption of medication = 4.21 years, $SD = 6.6$), including selective serotonin reuptake inhibitors (SSRIs, $n = 26$), benzodiazepines (BZDs) ($n = 24$), and non-SSRI antidepressants ($n = 19$). Only 17 out of the 52 patients were free of medications. The mean duration of OCD based on the first clinical diagnosis of OCD symptoms was 14.6 years, $SD = 10.4$.

The psychiatric control group consisted of 52 inpatients (males = 11; age $M = 44.73$, $SD = 13.20$) admitted to the same unit and diagnosed with unipolar depression ($n = 37$), or anxiety disorders (e.g., phobias, panic disorder, and generalized anxiety disorder; $n = 15$). Thirty-four percent of the patients showed comorbid syndromes, such as unipolar depression ($n = 4$), personality disorder ($n = 8$), or other anxiety disorders ($n = 5$). Psychotropic medication in the psychiatric control group included SSRIs ($n = 29$), BZDs ($n = 40$), and non-SSRI antidepressants ($n = 20$). Only nine patients were free of psychotropic medications. The mean duration of mental disorders based on the first psychiatric diagnoses of these patients was 17.20 years, $SD = 11.70$.

Within 5 days of admission, prior to commencing the treatment, patients completed on a voluntary basis, a questionnaire-battery consisting of scales that measure sleep quality, chronotype, and mental health indices (see below). The data of three OCD patients were excluded due to the

report of higher amounts (more than 1 L of beer/3 dl of wine/0.5 cl of liquor or short drinks) of weekly alcohol consumption. Three patients from the psychiatric control group were excluded due to missing and unreliable data in the questionnaires. Hence, the final sample consisted of 49 OCD patients (34 males, age $M = 32.23$, $SD = 9.34$) and 49 psychiatric patients (9 males, age $M = 46.73$, $SD = 14.31$) with other anxiety and mood disorders. Demographic and clinical variables of the final sample are summarized in Table 1.

Instruments

Morningness–Eveningness Questionnaire (MEQ-H). To measure chronotype along a continuum, we applied the shortened (13 itemed), Hungarian version of the Horne–Östberg MEQ (MEQ-H; Horne & Ostberg, 1976; Zavecz, Török, Köteles, Pálosi, & Simor, 2015). The original scale is a widely used and reliable measure focusing on individual differences in diurnal preference. The items concern subjective preferences of sleep–wake schedules and optimal time periods for intellectually or physically demanding activities. Higher scores indicate increased morningness. The 13-item long Hungarian version of the questionnaire showed excellent internal consistency (Cronbach's $\alpha = .86$), test–retest reliability over a period of 8 months ($r = .89$, $p < .001$) and adequate validity indices in previous studies (Simor, Zavecz, et al., 2015; Zavecz et al., 2015). Although the MEQ-H was previously used only in healthy populations, the scale showed good internal consistency in the present sample as well (Cronbach's $\alpha = .79$).

Pittsburgh Sleep Quality Index (PSQI). We used the Hungarian version of the PSQI, a widely used instrument to evaluate subjective sleep quality (Buysse, Reynolds, Monk, Berman, & Kupfer, 1989; Takács et al., 2016). The scale assesses subjective sleep complaints, such as having difficulties falling asleep, nocturnal awakenings, pain and discomfort during bedtime, as well as daytime sleepiness, and fatigue. Items are grouped into seven component scores that are summed to yield a global PSQI score, where higher scores indicate poorer sleep quality. The internal consistency of the scale in the present sample was excellent (Cronbach's $\alpha = .84$).

Nightmare frequency (NM). NM is a relevant aspect of sleep quality especially among psychiatric patients (Swart, Van Schagen, Lancee, & Van Den Bout, 2013). We measured the NMs (unpleasant dreams provoking awakenings) by an 8-point Likert scale. (How often do you experience frightening and/or unpleasant dreams that case abrupt awakenings? 0 – never, 1 – less than once a year, 2 – once or twice a year, 3 – two or three times a year, 4 – monthly, 5 – two or three time a month, 6 – once a week, and 7 – more than once a week).

Beck Depression Inventory (BDI). We used the Hungarian version of the nine-item BDI (Rózsa, Szádóczky, & Furedi, 2001), a one-dimensional scale assessing different symptoms of depression, including social withdrawal, indecision, sleep disturbance, fatigue, intense worry about bodily symptoms, work inhibition, pessimism, lack of satisfaction, and self-accusation. The items are scored on a 4-point Likert scale. The instrument showed good internal consistency, and high specificity and sensitivity for screening depression (Rózsa et al., 2001). The Cronbach's α internal consistency measure of the scale in this study was .83.

Spielberger Trait Anxiety Inventory (STAI). The STAI (Spielberger, Gorsuch, & Lushene, 1970) is a widely used self-report instrument that differentiates between the temporary condition of state anxiety and the long-standing quality of trait anxiety. We used the 20-item Hungarian version of the STAI trait anxiety questionnaire (STAI-T) to assess the severity of general anxiety symptoms (Sipos, Sipos, & Spielberger, 1994). The scale has proven to be valid and reliable tool for the measurement of trait anxiety, showing excellent internal consistency in different studies (Köteles, Szemerszky, Freyler, & Bárdos, 2011). The Cronbach's α of the scale was .86 in the present sample.

Positive and Negative Affect Schedule (PANAS). We used the Hungarian version of the PANAS to examine emotional states that characterized patients during the last month (Gyollai, Simor, Köteles, & Demetrovics, 2011; Watson, Clark, & Tellegen, 1988). The PANAS consists of two independent scales assessing positive and NA on a 5-point Likert scale. The 10-item NA scale measures the general dimension of subjective distress subsuming a variety of aversive mood states (e.g., guilt, fear, and hostility), whereas the 10-item positive affect scale assesses the extent to which a person feels enthusiastic, active, and alert. The Hungarian version of both scales shows good internal consistency in previous studies (Köteles & Simor, 2013;

Table 1. Demographic and clinical data of OCD and non-OCD psychiatric inpatientss

	OCD group ($N = 49$)	Non-OCD group ($N = 49$)	Test statistics	p value (adjusted)
Sex	34 males and 15 females	9 males and 40 females	$\chi^2 = 25.9$	<.001
Age	32.23 (9.34)	46.73 (14.31)	$t = 5.89$	<.001
Education (years)	13.67 (2.7)	13.29 (3.2)	$t = -0.62$	.60
SSRI	$N = 26$	$N = 29$	$\chi^2 = 0.37$	.60
Atypical antidepressant	$N = 19$	$N = 20$	$\chi^2 = 0.43$	.80
Benzodiazepine	$N = 24$	$N = 40$	$\chi^2 = 11.53$	.004
Mental illness (duration in years)	14.48 (10.35)	17.55 (11.67)	$t = 1.35$	.29
Psychotropic medication (duration in years)	4.21 (6.55)	8.04 (10.21)	$t = 2.11$	.07
Smoking	$N = 10$	$N = 18$	$\chi^2 = 2.99$	.21

Note. Means and standard deviation are shown in case of continuous variable. OCD: obsessive–compulsive disorder; SSRI: selective serotonin reuptake inhibitors.

Simor, Krietsch, Köteles, & McCrae, 2015). The internal consistencies of the positive and negative subscales were excellent with Cronbach's α .89 and .9, respectively.

Yale–Brown Obsessive–compulsive Scale (Y-BOCS). The obsessive–compulsive symptomatology was assessed with the Y-BOCS (Goodman, Price, Rasmussen, Mazure, Delgado, et al., 1989; Goodman, Price, Rasmussen, Mazure, Fleischmann, et al., 1989). The Y-BOCS is a clinician-rated semi-structured interview-based scale that assesses OC symptoms and their severity. The severity of obsessions and compulsions are rated using a 5-point Likert scale ranging from 0 to 4, with higher scores indicating greater severity. The 10 severity items, which assess frequency, interference, distress, resistance, and symptom control, yield three scores: an Obsessions Severity Score (range = 0–20), a Compulsions Severity Score (range = 0–20), and a Total Score (range = 0–40). Mild cases score 10–20 points, moderate cases score 21–30 points, and severe cases score 31–40 points.

Statistics

Statistical analyses were performed in R (Team, 2014). In the first step, we compared the groups along the studied measures (morningness–eveningness, sleep complaints, and mental health indices). Normality was assessed by inspecting the skewness and kurtosis of data distribution. Due to significant group differences in age, sex, and BZD consumption, we included these variables as covariates when comparing morningness–eveningness, sleep complaints, and mental health indices across the studied groups. This way, group (OCD vs. non-OCD group), sex, and BZD consumption were set as fixed factors, and age as a continuous covariate in the univariate ANCOVA models. In our second analysis, we aimed to examine the associations between morningness–eveningness, sleep quality, and mental complaints within the groups; therefore, we examined these associations by Pearson's *r* correlation in the OCD and non-OCD group separately. To evaluate whether the studied associations were different across the groups, we applied Fisher *r*-to-*z* transformations. Our third analysis explored whether morningness–eveningness was associated with sleep quality, regardless the effects of depressive symptoms. To measure the independent association of morningness–eveningness with sleep quality irrespective of depression severity, we ran hierarchical, linear regression models in each group, including sleep quality as the response variable, and age, sex, and BZD consumption, MEQ, and BDI scores as predictor variables. Finally, associations between morningness–eveningness and sleep quality with OCD symptom severity within the OCD group were evaluated by Pearson's *r* correlation coefficients. Multiplicity was addressed by the Benjamini–Hochberg procedure to estimate false discovery rate (FDR; Benjamini & Hochberg, 1995). Both the original *p* values and the corrected significant findings are indicated throughout the text.

Ethics

The study procedures were carried out in accordance with the Declaration of Helsinki. Patients were given a detailed description regarding the aims of the study and were assured that the participation in the study would not interfere with their clinical treatment. Informed consents were obtained prior to participation, and the project was approved by the institutional ethical review board of the hospital.

RESULTS

Demographic and clinical data

Demographic variables are summarized in Table 1. OCD and non-OCD groups were balanced with respect to the ratio of patients taking SSRIs or atypical antidepressants, the duration of their mental illness, and the duration of psychotropic medication use. Nevertheless, age, sex ratio, and the consumption of BZDs were significantly different between our groups: the OCD group was in average younger with a lower female to male ratio compared with the non-OCD group. BZDs were prescribed to a fewer amount of patients in the OCD group. The number of patients taking SSRIs, non-SSRI (atypical) antidepressants, and BZDs, as well as other demographic and clinical variables are shown in Table 1.

Group comparisons

As shown in Table 2, after controlling for the effect of age, sex, and BZD consumption, the OCD group showed

Table 2. Means, standard deviations (*SD*s), and main effects of group regarding morningness–eveningness, sleep quality, and mental health indices

	OCD group ($N = 49$)	Non-OCD group ($N = 49$)	ANCOVA (controlled for age, sex, and BZD consumption)
	Mean and *SD*	Mean and *SD*	*F* and adjusted *p* values
MEQ	34.76 (6.42)	37.84 (7.15)	0.15 (ns)
PSQI	6.88 (4.15)	11.02 (3.09)	26.13 (<.001)
NM	3.85 (2.12)	3.71 (2.31)	0.04 (ns)
PANAS−	19.28 (9.84)	21.59 (10.7)	3.55 (.06)
PANAS+	15.53 (8.95)	13.22 (8.24)	0.15 (ns)
BDI	7.92 (5.13)	10.86 (5.34)	3.02 (.08)
STAI-T	52.96 (10.5)	52.3 (11.28)	0.01 (ns)

Note. MEQ: Morningness–Eveningness Questionnaire; PSQI: Pittsburgh Sleep Quality Index; NM: Nightmare frequency; PANAS: Positive and Negative Affect Schedule; BDI: Beck Depression Inventory; STAI-T: Spielberger Trait Anxiety Inventory; BZD: benzodiazepine; OCD: obsessive–compulsive disorder; ANCOVA: analysis of covariance.

significantly better sleep quality ($F = 26.13$, $p < .001$), and a non-significant trend toward lower depressive symptoms ($F = 3.02$, $p = .08$) and reduced NA ($F = 3.55$, $p = .06$) compared with the non-OCD group. No significant group effects were present for diurnal preference (MEQ score), NM, positive affective states, and anxiety symptoms (indexed by STAI-T scores). Age was associated with MEQ scores ($F = 10.49$, $p = .002$), NA ($F = 8.01$, $p = .006$), and sleep quality ($F = 7.57$, $p = .007$) with older age being predictive for morning preference, better sleep quality, and educed NA. Sex as an independent predictor was not significantly associated with any of the measured variables (all $p > .15$). Patients taking BZDs showed worse sleep quality than those without BZDs (mean: 10.19 ± 4.27 vs. 6.76 ± 4.01) ($F = 6.41$, $p = .01$); however, the difference was not significant after FDR correction. None of the other studied variables was associated with BZD consumption (all $p > .20$). Interactions between the fixed variables (group, sex, and BZD consumption) were not significantly associated with the examined outcome variables (all $p > .18$) (see Table 2 for a detailed summary of descriptive data and statistical parameters).

Associations between variables

The correlations between morningness–eveningness, sleep quality, and mental health indices within the OCD and the non-OCD group are summarized in Figure 1. Within the OCD group (Figure 1a), eveningness preference was associated with lower sleep quality ($r = -.42$ $p = .003$), increased NM ($r = -.30$, $p = .039$), and higher NA ($r = -.35$, $p = .014$). In the non-OCD group, however, morningness–eveningness was not significantly associated with any of the examined variables (see Figures 1b and 2b). Impaired sleep quality showed positive correlations with NM, depressive, and anxiety symptoms, and with NA in both groups (Figure 1). Nevertheless, NM was associated with depressive symptoms ($r = .49$, $p < .001$) and NA ($r = .37$, $p = .009$) within the OCD, but not within the non-OCD group.

As a further step, we compared the correlation coefficients of the two groups by Fisher *r*-to-*z* transformation. We specifically focused on the associations between chronotype, sleep parameters, and mental health indices. The links between morningness–eveningness and sleep quality and between morningness–eveningness and NM were significantly different across the two groups ($z = -1.62$, $p = .05$; $z = -1.87$, $p = .03$, respectively). The associations between morningness–eveningness and NA were not significantly different according to the *r*-to-*z* transformation ($z = -0.53$, $p = .29$).

In addition, the positive association between impaired sleep quality and depressive symptoms was significantly stronger among OCD patients than among non-OCD individuals ($r = .61$ vs. $r = .33$, $z = 1.76$, $p = .03$). Similarly, impaired sleep quality showed a stronger correlation with NA in the OCD compared with the non-OCD group ($r = .64$ vs. $r = .37$, $z = 1.77$, $p = .03$). Finally, the correlation between NM and depressive symptoms was stronger within the OCD than in the non-OCD group ($r = .49$ vs. $r = .14$, $z = 1.89$, $p = .03$). Other correlation coefficients did not significantly differ across the groups (all $p > .20$).

Almost all associations remained significant after FDR correction, except the correlation between morningness–eveningness and NM in the OCD group, and the correlation between sleep quality and depressive symptoms in the non-OCD group that remained as non-significant trends ($p = .07$ and $p = .06$, respectively). The pattern of results remained the same after correcting for age, sex, and BZD consumption (partial correlation coefficients with age, sex, and BZD consumption as covariates are summarized in Table S1 of Supplementary Material).

Morningness–eveningness, sleep quality, and depression severity

We examined the main effects of age, sex, BZD consumption, chronotype (MEQ), and depressive symptoms (BDI) on sleep quality (PSQI) in both groups, separately using

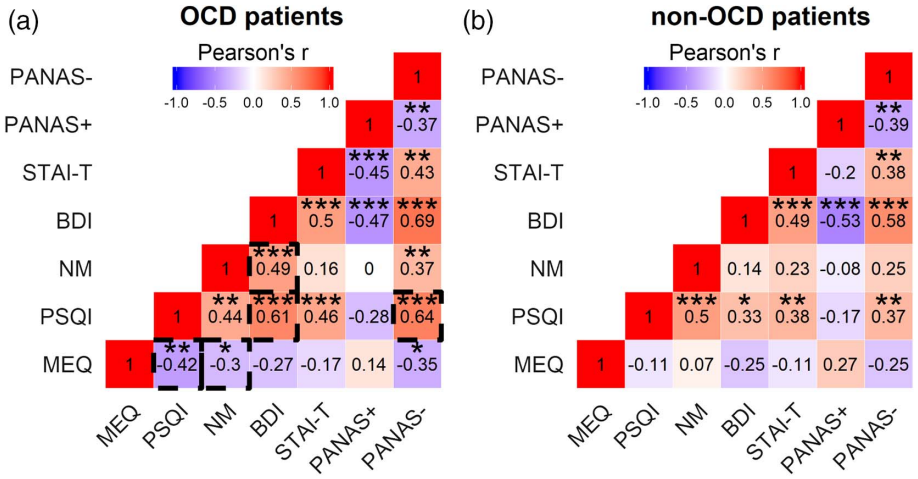

Figure 1. Pearson's correlation coefficients between the examined variables in the OCD and non-OCD group. Dashed squares indicate significantly different correlation values between the two groups. *$p < .05$. **$p < .01$. ***$p < .001$. Correlation coefficients above .33 remained significant after FDR correction

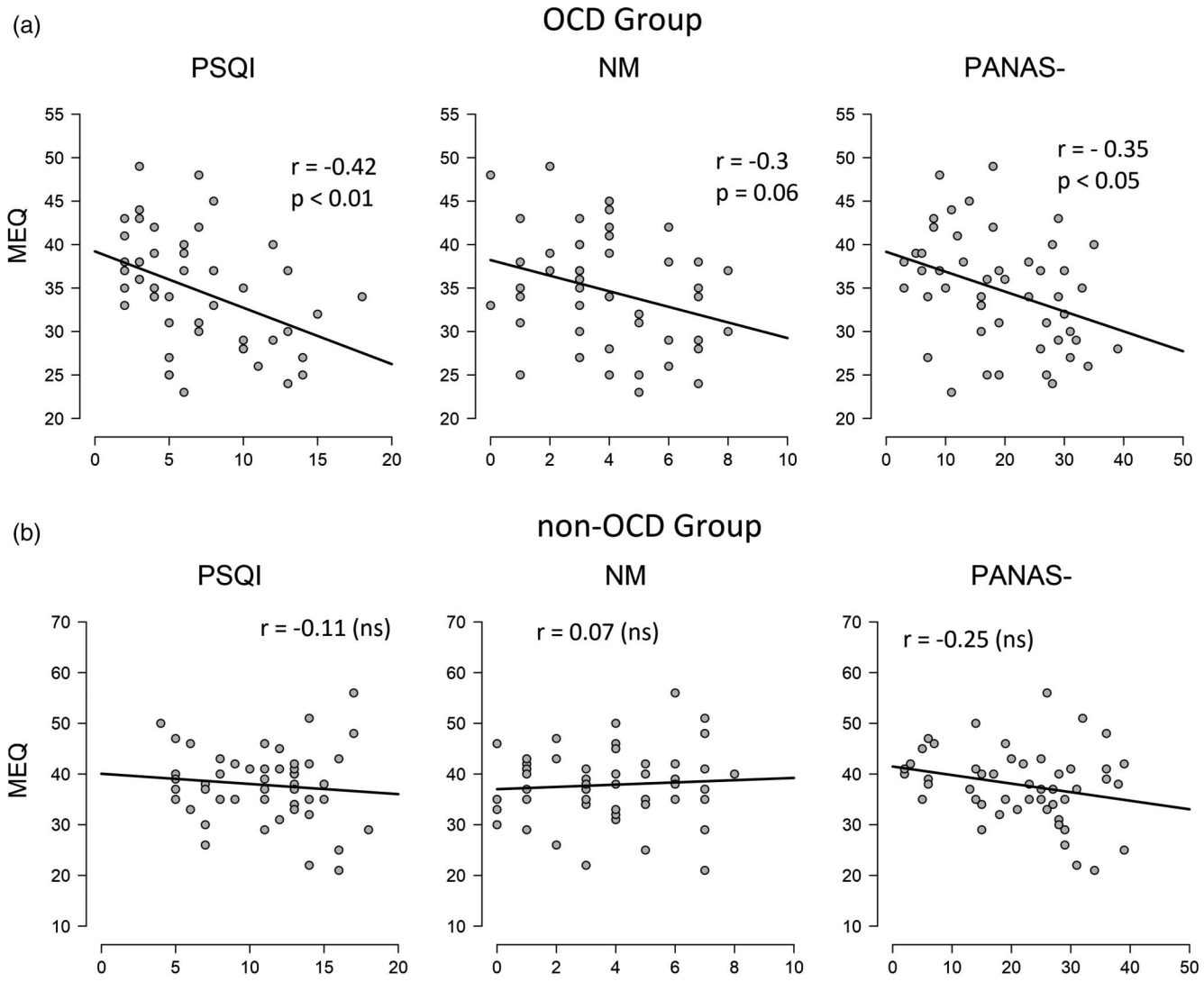

Figure 2. Scatterplots showing the associations of morningness-eveningness (MEQ) with sleep quality (PSQI), nightmare frequency (NM), and negative affect (PANAS−) within the OCD and non-OCD groups. Values correspond to Pearson's *r* coefficients and FDR-corrected levels of significance

hierarchical linear regression. In case of the OCD group, the control variables, age and sex (Step 1), were not significant predictors of sleep quality, but BZD consumption predicted worse sleep quality. In Step 2, MEQ scores were added to the model. Eveningness preference was associated with lower sleep quality, explaining and additional 17% of the variance in PSQI scores. In the final step (Step 3), the inclusion of BDI explained an additional 20% of the total variance. Both morningness–eveningness and depressive symptoms were significant predictors of sleep quality (Table 3).

Regarding the non-OCD group, in Step 1, sex and BZD consumption were not significant predictors, but age was significantly and negatively associated with PSQI scores explaining 7% of the variance (older age predicting better sleep). In the second step, the inclusion of MEQ scores did not improve the model, as morningness–eveningness was not associated with sleep quality. In the final model, age and depressive symptoms emerged as significant predictors, and explained ~12% of the total variance. The results and statistical parameters of the regression models are detailed in Table 3. These analyses indicate that morningness–eveningness scores were differently associated with sleep quality within the OCD and the non-OCD groups. To corroborate this pattern of findings, we performed a further regression analyses, including all participants, and entering group as an additional predictor. In the final model that explained 46% of the total variance, age, BZD consumption, group, BDI scores, and the interaction between group and MEQ scores emerged as significant predictors of sleep quality (Table S2 of Supplementary Material).

Morningness–eveningness, sleep quality, and OCD symptom severity

Finally yet importantly, we analyzed the associations between chronotype and sleep parameters (PSQI and NM) with OC symptoms, or the Global score of the Y-BOCS. Chronotype and sleep quality were not associated with the severity of OCD symptoms (all coefficients were between −0.10 and 0.10, all $p > .50$).

Table 3. Hierarchical linear regression analyses in the OCD and non-OCD group

Entered variables	OCD group		Non-OCD group	
	Standard β and *p* value	Adj. R^2 and significance of the model	Standard *B* and *p* value	R^2 and significance of the model
Step 1				
Sex	0.06 (ns)		−0.20 (ns)	
Age	−0.20 (ns)		−0.32 (0.03)	
BZD	0.49 (.001)		0.38 (ns)	
		.18 (0.007)		.07 (0.10)
Step 2				
Sex	0.17 (ns)		−0.20 (ns)	
Age	−0.14 (ns)		−0.32 (0.052)	
BZD	0.47 (<.001)		0.04 (ns)	
MEQ	−0.43 (.001)	.35 (<0.001)	0.01 (ns)	.05 (ns)
Step 3				
Sex	0.13 (ns)		−0.19 (ns)	
Age	−0.16 (ns)		−0.31 (0.05)	
BZD	0.39 (<.001)		0.01 (ns)	
MEQ	−0.30 (.008)		0.08 (ns)	
BDI	0.47 (<.001)		0.31 (0.03)	
		.55 (<0.001)		.12 (0.051)

Note. Age, sex, benzodiazepine (BZD) consumption, morningness–eveningness (MEQ scores), and depressive symptoms (BDI scores) were regressed on sleep quality (PSQI scores). OCD: obsessive–compulsive disorder; MEQ: Morningness–Eveningness Questionnaire; BDI: Beck Depression Inventory.

DISCUSSION

The goal of this study was to examine the relevance of circadian preferences in relation to sleep quality and psychopathological symptoms in a psychiatric group of OCD inpatients. More specifically, we focused on the associations between eveningness and the severity of emotional complaints. We showed that eveningness preference was associated with impaired sleep quality and higher NA in OCD patients. Interestingly, the associations between eveningness, impaired sleep quality and NA were not significant in the mixed psychiatric inpatient group (with anxiety and depressive symptomatology) that served as our controls. In addition, although the non-OCD control group exhibited worse sleep quality than the OCD group, the link between subjective sleep complaints and negative emotionality was stronger within the OCD group, compared with the mixed psychiatric group. Similarly, NM was associated with depressive symptoms and NA among OCD patients, whereas it did not seem to correlate with the severity of depressive symptoms within the non-OCD group. These findings indicate that circadian preferences and subjective sleep complaints are important features in OCD, and should be carefully considered in the diagnosis and treatment of OCD patients.

As eveningness was associated with both sleep quality and depressive symptoms within the OCD group, we aimed to verify whether eveningness is predictive of subjective sleep complaints, irrespective of depressive symptoms. Although morningness–eveningness and depression scores explained a large portion (~37%) of the variance in sleep quality within the OCD group, eveningness remained a significant predictor of impaired sleep quality regardless of depression, explaining 17% of the variance of sleep quality scores. This finding is in line with previous studies indicating that sleep complaints related to delayed bedtimes (and presumably to eveningness preference) are independent of depressive symptoms (Díaz-Román et al., 2015; Nota et al., 2015). In fact, a growing number of studies suggest that DSPD is prevalent in OCD and might be associated with more severe symptomatology (Mukhopadhyay et al., 2008; Turner et al., 2007).

Morningness–eveningness did not significantly differ across our groups, after controlling for the differences in age, sex, and medication. Nevertheless, greater eveningness was associated with sleep complaints (sleep quality and NM) and NA within the OCD group, and the associations between sleep disturbances and eveningness were stronger in the OCD group compared with that of the non-OCD group. This finding corroborates previous studies showing that eveningness in contrast to morningness is predictive of a more adverse psychological profile including signs of emotional and behavioral dysregulation (Fabbian et al., 2016; Randler, 2011).

Individuals with eveningness preference showed alterations in the structure and metabolism of a neural circuitry that was critical for accurate affective responses and emotional regulation (Hasler et al., 2012; Kuperczkó et al., 2015; Rosenberg, Maximov, Reske, Grinberg, & Shah, 2014). As the relationship between eveningness and emotional dysregulation seems to be at least partly mediated by sleep complaints (Levandovski et al., 2011; Rosenberg et al., 2014; Simor, Zavecz, et al., 2015), treatments focusing on circadian rhythms and sleep quality might be beneficial for patients with OCD. In fact, pharmacological and behavioral interventions aiming to

normalize circadian rhythms showed promising outcomes in case studies of OCD patients (Coles & Sharkey, 2011; Fornaro, 2011). Moreover, although chronotype is considered to be a relatively stable trait-like construct (Klei et al., 2005), Hasler, Buysse, and Germain (2016) showed that a shift toward morningness during a behavioral sleep intervention resulted in improved affect, better sleep quality, and reduced depressive symptoms in a group of insomnia patients.

Coles et al. (2012) hypothesized that delayed bedtimes and OC symptoms are bidirectionally related: late bedtimes and fatigue might exacerbate cognitive dysfunctions (e.g., impaired inhibitory functions) facilitating more impulsive and automatic behaviors (intrusive thoughts and automatic rituals), and on the other hand, compulsions performed at night may result in late bedtimes and a shift toward eveningness. Although the above hypothesis seems plausible, findings regarding the association between OC symptoms and delayed bedtimes are somewhat inconclusive and were only based on data of healthy individuals (Coles et al., 2012; Timpano et al., 2014). In this study, neither eveningness nor sleep quality were significantly associated with OC symptoms. Therefore, the association between sleep schedules, sleep quality, and OCD symptomatology requires further investigations, preferentially involving objective measurements of sleep and cognitive processes beyond the data provided by self-report and clinician-administered questionnaires.

Whereas eveningness was associated with sleep complaints and NA within the OCD group, these associations were not evidenced within the non-OCD group. Furthermore, the associations between sleep complaints and measures of negative emotionality were relatively weaker within the non-OCD group. Weaker associations within the non-OCD group might stem from the heterogeneity of the sample that included patients with different diagnoses (anxiety and affective disorders) and of a broader age range in contrast to the more homogeneous group of OCD patients. Alternatively, stronger associations among the variables within the OCD group might be the result of common-method variance. However, it is not clear why this confound might specifically affect the associations between eveningness, sleep quality, and NA, as the associations between other measures (e.g., BDI–STAI–PANAS) were not different across groups and resembled the correlation coefficients of previous studies (Gyollai et al., 2011; Simor, Zavecz, et al., 2015; Zavecz et al., 2015). Nevertheless, future studies applying objective measures of sleep quality and emotional regulation (e.g., cognitive tasks) are necessary to corroborate and extend the present findings. Furthermore, medication was not balanced across groups, as BZD consumption was higher in the non-OCD group. According to the statistical analyses, however, age and medication did not seem to influence our main findings. Regarding the heterogeneity in terms of diagnoses, the low number of subsamples within the non-OCD group does not allow us to examine whether the relationship between eveningness, sleep, and mental health is specific for a given psychiatric disorder (e.g., major depression vs. general anxiety disorder) or not. Nevertheless, we should note that the associations between eveningness and symptom severity were mainly evidenced among depressed individuals (Antypa, Vogelzangs, Meesters, Schoevers, & Penninx, 2016; Bahk et al., 2014) with relatively modest effects. Therefore, further studies with larger sample sizes should corroborate our present findings that suggest relatively strong associations between eveningness, sleep quality, and NA in OCD.

In spite of these limitations, this study points to the relevance of morningness–eveningness and sleep quality in the diagnosis and treatment of OCD patients. As eveningness preference and poorer sleep quality are associated with more severe affective dysfunctions, the proper assessment of these factors, as well as a stronger emphasis on sleep-hygiene and chronotherapy might enhance treatment response.

Funding sources: PS was supported by the Hungarian Scientific Research Fund (NKFI PD 115432) of the National Research, Development and Innovation Office and by the János Bolyai Fellowship of the Hungarian Academy of Sciences.

Authors' contribution: PS designed the study, analyzed the data, and wrote the manuscript. ALS and GD designed the study and reviewed the manuscript. GM collected the data, contributed to data analyses, and reviewed the manuscript. KC and AH recruited the patients, performed the clinical interviews, monitored data collection, and reviewed the manuscript. All authors had full access to all data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.

Conflict of interest: The authors declare no conflict of interest.

Acknowledgements: The authors would like to thank Zsófia Dobó for her assistance in data collection.

REFERENCES

American Psychiatric Association [APA]. (2013). *Diagnostic and statistical manual of mental disorders (DSM-5®)*. American Psychiatric Association. Retrieved from https://www.google.com/books?hl=en&lr=&id=-JivBAAAQBAJ&oi=fnd&pg=PT18&dq=diagnostic+manual+of+mental+disorders+&ots=ce-NO65JMx9&sig=FuNIkY7XgaBS2Pq6O9RJ3-RPKbo

Antypa, N., Verkuil, B., Molendijk, M., Schoevers, R., Penninx, B. W. J. H., & Van Der Does, W. (2017). Associations between chronotypes and psychological vulnerability factors of depression. *Chronobiology International, 34*(8), 1125–1135. doi:10.1080/07420528.2017.1345932

Antypa, N., Vogelzangs, N., Meesters, Y., Schoevers, R., & Penninx, B. W. J. H. (2016). Chronotype: Associations with depression and anxiety disorders in a large cohort study. *Depression and Anxiety, 33*(1), 75–83. doi:10.1002/da.22422

Archer, S. N., Robilliard, D. L., Skene, D. J., Smits, M., Williams, A., Arendt, J., & von Schantz, M. (2003). A length polymorphism in the circadian clock gene Per3 is linked to delayed sleep phase syndrome and extreme diurnal preference. *Sleep, 26*(4), 413–415. doi:10.1093/sleep/26.4.413

Archer, S. N., Viola, A. U., Kyriakopoulou, V., von Schantz, M., & Dijk, D.-J. (2008). Inter-individual differences in habitual sleep timing and entrained phase of endogenous circadian rhythms of BMAL1, PER2 and PER3 mRNA in human leukocytes. *Sleep, 31*(5), 608–617. doi:10.1093/sleep/31.5.608

Baehr, E. K., Revelle, W., & Eastman, C. I. (2000). Individual differences in the phase and amplitude of the human circadian temperature rhythm: With an emphasis on morningness-eveningness. *Journal of Sleep Research, 9*(2), 117–127. doi:10.1046/j.1365-2869.2000.00196.x

Bahk, Y.-C., Han, E., & Lee, S.-H. (2014). Biological rhythm differences and suicidal ideation in patients with major depressive disorder. *Journal of Affective Disorders, 168,* 294–297. doi:10.1016/j.jad.2014.07.001

Benjamini, Y., & Hochberg, Y. (1995). Controlling the false discovery rate: A practical and powerful approach to multiple testing. *Journal of the Royal Statistical Society. Series B (Methodological), 57*(1), 289–300. doi:10.2307/2346101

Buysse, D. J., Reynolds, C. F., Monk, T. H., Berman, S. R., & Kupfer, D. J. (1989). The Pittsburgh Sleep Quality Index: A new instrument for psychiatric practice and research. *Psychiatry Research, 28*(2), 193–213. doi:10.1016/0165-1781(89)90047-4

Carrier, J., & Monk, T. H. (2000). Circadian rhythms of performance: New trends. *Chronobiology International, 17*(6), 719–732. doi:10.1081/CBI-100102108

Chan, J. W. Y., Lam, S. P., Li, S. X., Yu, M. W. M., Chan, N. Y., Zhang, J., & Wing, Y.-K. (2014). Eveningness and insomnia: Independent risk factors of nonremission in major depressive disorder. *Sleep, 37*(5), 911–917. doi:10.5665/sleep.3658

Coles, M. E., Schubert, J. R., & Sharkey, K. M. (2012). Delayed bedtimes and obsessive–compulsive symptoms. *Behavioral Sleep Medicine, 10*(4), 258–265. doi:10.1080/15402002.2011.634939

Coles, M. E., & Sharkey, K. M. (2011). Compulsion or chronobiology? A case of severe obsessive-compulsive disorder treated with cognitive-behavioral therapy augmented with chronotherapy. *Journal of Clinical Sleep Medicine, 7*(3), 307–309. doi:10.5664/JCSM.1080

Cox, R. C., & Olatunji, B. O. (2016). Sleep disturbance and obsessive-compulsive symptoms: Results from the National Comorbidity Survey Replication. *Journal of Psychiatric Research, 75,* 41–45. doi:10.1016/j.jpsychires.2016.01.007

Díaz-Morales, J. F. (2016). Anxiety during adolescence: Considering morningness–eveningness as a risk factor. *Sleep and Biological Rhythms, 14*(2), 141–147. doi:10.1007/s41105-015-0032-8

Díaz-Morales, J. F., & Pilar Sánchez-López, M. (2008). Morningness-eveningness and anxiety among adults: A matter of sex/gender? *Personality and Individual Differences, 44*(6), 1391–1401. doi:10.1016/j.paid.2007.12.007

Díaz-Román, A., Perestelo-Pérez, L., & Buela-Casal, G. (2015). Sleep in obsessive–compulsive disorder: A systematic review and meta-analysis. *Sleep Medicine, 16*(9), 1049–1055. doi:10.1016/j.sleep.2015.03.020

Emens, J., Lewy, A., Kinzie, J. M., Arntz, D., & Rough, J. (2009). Circadian misalignment in major depressive disorder. *Psychiatry Research, 168*(3), 259–261. doi:10.1016/j.psychres.2009.04.009

Fabbian, F., Zucchi, B., Giorgi, A. D., Tiseo, R., Boari, B., Salmi, R., Cappadona, R., Gianesini, G., Bassi, E., Signani, F., Raparelli, V., Basili, S., & Manfredini, R. (2016). Chronotype, gender and general health. *Chronobiology International, 33*(7), 863–882. doi:10.1080/07420528.2016.1176927

First, M. B., Williams, J. B., Benjamin, L. S., & Spitzer, R. L. (2016). *SCID-5-PD: Structured clinical interview for DSM-5® personality disorders*. Washington, DC: American Psychiatric Association Publishing.

Fornaro, M. (2011). Switching from serotonin reuptake inhibitors to agomelatine in patients with refractory obsessive-compulsive disorder: A 3 month follow-up case series. *Annals of General Psychiatry, 10*(1), 5. doi:10.1186/1744-859X-10-5

Goodman, W. K., Price, L. H., Rasmussen, S. A., Mazure, C., Delgado, P., Heninger, G. R., & Charney, D. S. (1989). The Yale-Brown Obsessive Compulsive Scale: II. Validity. *Archives of General Psychiatry, 46*(11), 1012–1016. doi:10.1001/archpsyc.1989.01810110054008

Goodman, W. K., Price, L. H., Rasmussen, S. A., Mazure, C., Fleischmann, R. L., Hill, C. L., Heninger, G. R., & Charney, D. S. (1989). The Yale-Brown Obsessive Compulsive Scale: I. Development, use, and reliability. *Archives of General Psychiatry, 46*(11), 1006–1011. doi:10.1001/archpsyc.1989.01810110048007

Gyollai, Á., Simor, P., Köteles, F., & Demetrovics, Z. (2011). Psychometric properties of the Hungarian version of the original and the short form of the Positive and Negative Affect Schedule (PANAS). *Neuropsychopharmacologia Hungarica, 13*(2), 73–79.

Hasler, B. P., Buysse, D. J., & Germain, A. (2016). Shifts toward morningness during behavioral sleep interventions are associated with improvements in depression, positive affect, and sleep quality. *Behavioral Sleep Medicine, 14*(6), 624–635. doi:10.1080/15402002.2015.1048452

Hasler, B. P., Germain, A., Nofzinger, E. A., Kupfer, D. J., Krafty, R. T., Rothenberger, S. D., James, J. A., Bi, W., & Buysse, D. J. (2012). Chronotype and diurnal patterns of positive affect and affective neural circuitry in primary insomnia. *Journal of Sleep Research, 21*(5), 515–526. doi:10.1111/j.1365-2869.2012.01002.x

Hasler, B. P., Soehner, A. M., & Clark, D. B. (2014). Circadian rhythms and risk for substance use disorders in adolescence. *Current Opinion in Psychiatry, 27*(6), 460–466. doi:10.1097/YCO.0000000000000107

Horne, J. A., & Ostberg, O. (1976). A Self-Assessment Questionnaire to determine morningness-eveningness in human circadian rhythms. *International Journal of Chronobiology, 4*(2), 97–110.

Karatsoreos, I. N. (2014). Links between circadian rhythms and psychiatric disease. *Frontiers in Behavioral Neuroscience, 8,* 162. doi:10.3389/fnbeh.2014.00162

Kessler, R. C., Berglund, P., Demler, O., Jin, R., Merikangas, K. R., & Walters, E. E. (2005). Lifetime prevalence and age-of-onset distributions of DSM-IV disorders in the National Comorbidity Survey Replication. *Archives of General Psychiatry, 62*(6), 593–602. doi:10.1001/archpsyc.62.6.593

Klei, L., Reitz, P., Miller, M., Wood, J., Maendel, S., Gross, D., Waldner, T., Eaton, J., Monk, T. H., & Nimgaonkar, V. L. (2005). Heritability of morningness-eveningness and self-report sleep measures in a family-based sample of 521 hutterites. *Chronobiology International, 22*(6), 1041–1054. doi:10.1080/07420520500397959

Köteles, F., & Simor, P. (2013). Modern health worries, somatosensory amplification and subjective symptoms: A longitudinal study. *International Journal of Behavioral Medicine, 20*(1), 38–41. doi:10.1007/s12529-011-9217-y

Köteles, F., Szemerszky, R., Freyler, A., & Bárdos, G. (2011). Somatosensory amplification as a possible source of subjective symptoms behind modern health worries. *Scandinavian Journal of Psychology, 52*(2), 174–178. doi:10.1111/j.1467-9450.2010.00846.x

Kuperczkó, D., Perlaki, G., Faludi, B., Orsi, G., Altbacker, A., Kovács, N., Dóczi, T., Komoly, S., Schwarcz, A., Clemens, Z., & Janszky, J. (2015). Late bedtime is associated with decreased hippocampal volume in young healthy subjects. *Sleep and Biological Rhythms, 13*(1), 68–75. doi:10.1111/sbr.12077

Kyriacou, C. P., & Hastings, M. H. (2010). Circadian clocks: Genes, sleep, and cognition. *Trends in Cognitive Sciences, 14*(6), 259–267. doi:10.1016/j.tics.2010.03.007

LaSalle, V. H., Cromer, K. R., Nelson, K. N., Kazuba, D., Justement, L., & Murphy, D. L. (2004). Diagnostic interview assessed neuropsychiatric disorder comorbidity in 334 individuals with obsessive–compulsive disorder. *Depression and Anxiety, 19*(3), 163–173. doi:10.1002/da.20009

Levandovski, R., Dantas, G., Fernandes, L. C., Caumo, W., Torres, I., Roenneberg, T., Hidalgo, M. P., & Allebrandt, K. V. (2011). Depression scores associate with chronotype and social jetlag in a rural population. *Chronobiology International, 28*(9), 771–778. doi:10.3109/07420528.2011.602445

Mukhopadhyay, S., Fineberg, N. A., Drummond, L. M., Turner, J., White, S., Wulff, K., & Ghodse, H. (2008). Delayed sleep phase in severe obsessive-compulsive disorder: A systematic case-report survey. *CNS Spectrums, 13*(5), 406–413. doi:10.1017/S1092852900016576

Murray, J. M., Sletten, T. L., Magee, M., Gordon, C., Lovato, N., Bartlett, D. J., Kennaway, D. J., Lack, L. C., Grunstein, R. R., Lockley, S. W., Rajaratnam, S. M., & Delayed Sleep on Melatonin (DelSoM) Study Group. (2017). Prevalence of circadian misalignment and its association with depressive symptoms in delayed sleep phase disorder. *Sleep, 40*(1). doi:10.1093/sleep/zsw002

Nota, J. A., Sharkey, K. M., & Coles, M. E. (2015). Sleep, arousal, and circadian rhythms in adults with obsessive–compulsive disorder: A meta-analysis. *Neuroscience and Biobehavioral Reviews, 51,* 100–107. doi:10.1016/j.neubiorev.2015.01.002

Paterson, J. L., Reynolds, A. C., Ferguson, S. A., & Dawson, D. (2013). Sleep and obsessive-compulsive disorder (OCD). *Sleep Medicine Reviews, 17*(6), 465–474. doi:10.1016/j.smrv.2012.12.002

Randler, C. (2011). Association between morningness-eveningness and mental and physical health in adolescents. *Psychology, Health & Medicine, 16*(1), 29–38. doi:10.1080/13548506.2010.521564

Randler, C., & Schaal, S. (2010). Morningness-eveningness, habitual sleep-wake variables and cortisol level. *Biological Psychology, 85*(1), 14–18. doi:10.1016/j.biopsycho.2010.04.006

Randler, C., Wolfgang, L., Matt, K., Demirhan, E., Horzum, M. B., & Beşoluk, Ş. (2016). Smartphone addiction proneness in relation to sleep and morningness-eveningness in German adolescents. *Journal of Behavioral Addictions, 5*(3), 465–473. doi:10.1556/2006.5.2016.056

Reynolds, K. C., Gradisar, M., & Alfano, C. A. (2015). Sleep in children and adolescents with obsessive-compulsive disorder. *Sleep Medicine Clinics, 10*(2), 133–141. doi:10.1016/j.jsmc.2015.02.006

Rosenberg, J., Maximov, I. I., Reske, M., Grinberg, F., & Shah, N. J. (2014). "Early to bed, early to rise": Diffusion tensor imaging identifies chronotype-specificity. *NeuroImage, 84,* 428–434. doi:10.1016/j.neuroimage.2013.07.086

Rózsa, S., Szádóczky, E., & Furedi, J. (2001). Psychometric properties of the Hungarian version of the shortened Beck Depression Inventory. *Psychiatr Hung, 16*(4), 384–402.

Ruscio, A. M., Stein, D. J., Chiu, W. T., & Kessler, R. C. (2010). The epidemiology of obsessive-compulsive disorder in the National Comorbidity Survey Replication. *Molecular Psychiatry, 15*(1), 53–63. doi:10.1038/mp.2008.94

Schmidt, C., Collette, F., Cajochen, C., & Peigneux, P. (2007). A time to think: Circadian rhythms in human cognition. *Cognitive Neuropsychology, 24*(7), 755–789. doi:10.1080/02643290701754158

Schmidt, C., Peigneux, P., & Cajochen, C. (2012). Age-related changes in sleep and circadian rhythms: Impact on cognitive performance and underlying neuroanatomical networks. *Frontiers in Neurology, 3,* 118. doi:10.3389/fneur.2012.00118

Simor, P., Krietsch, K. N., Köteles, F., & McCrae, C. S. (2015). Day-to-day variation of subjective sleep quality and emotional states among healthy university students—A 1-week prospective study. *International Journal of Behavioral Medicine, 22*(5), 625–634. doi:10.1007/s12529-015-9464-4

Simor, P., Zavecz, Z., Pálosi, V., Török, C., & Köteles, F. (2015). The influence of sleep complaints on the association between chronotype and negative emotionality in young adults. *Chronobiology International, 32*(1), 1–10. doi:10.3109/07420528.2014.935786

Sipos, K., Sipos, M., & Spielberger, C. D. (1994). A State-Trait Anxiety Inventory (STAI) magyar változata. In F. Mérei & F. Szakács (Eds.): *Pszichodiagnosztikai vademecum* (Vol. 2, pp. 123–148). Budapest, Hungary: Nemzeti Tankönyvkiadó.

Spielberger, C. D., Gorsuch, R. L., & Lushene, R. E. (1970). *Manual for the State-Trait Anxiety Inventory*. Retrieved from https://ubir.buffalo.edu/xmlui/handle/10477/2895

Swart, M. L., Van Schagen, A. M., Lancee, J., & Van Den Bout, J. (2013). Prevalence of nightmare disorder in psychiatric outpatients. *Psychotherapy and Psychosomatics, 82*(4), 267–268. doi:10.1159/000343590

Takács, J., Bódizs, R., Ujma, P. P., Horváth, K., Rajna, P., & Harmat, L. (2016). Reliability and validity of the Hungarian version of the Pittsburgh Sleep Quality Index (PSQI-HUN): Comparing psychiatric patients with control subjects. *Sleep & Breathing = Schlaf & Atmung, 20*(3), 1045–1051. doi:10.1007/s11325-016-1347-7

Team, R. C. (2014). *R: A language and environment for statistical computing*. Vienna, Austria: R Foundation for Statistical Computing.

Timpano, K. R., Carbonella, J. Y., Bernert, R. A., & Schmidt, N. B. (2014). Obsessive compulsive symptoms and sleep difficulties: Exploring the unique relationship between insomnia and obsessions. *Journal of Psychiatric Research, 57,* 101–107. doi:10.1016/j.jpsychires.2014.06.021

Torres, A. R., Prince, M. J., Bebbington, P. E., Bhugra, D., Brugha, T. S., Farrell, M., Jenkins, R., Lewis, G., Meltzer, H., & Singleton, N. (2006). Obsessive-compulsive disorder:

Prevalence, comorbidity, impact, and help-seeking in the British National Psychiatric Morbidity Survey of 2000. *American Journal of Psychiatry, 163*(11), 1978–1985. doi:10.1176/ajp.2006.163.11.1978

Turner, J., Drummond, L. M., Mukhopadhyay, S., Ghodse, H., White, S., Pillay, A., & Fineberg, N. A. (2007). A prospective study of delayed sleep phase syndrome in patients with severe resistant obsessive-compulsive disorder. *World Psychiatry, 6*(2), 108–111.

Urbán, R., Magyaródi, T., & Rigó, A. (2011). Morningness-eveningness, chronotypes and health-impairing behaviors in adolescents. *Chronobiology International, 28*(3), 238–247. doi:10.3109/07420528.2010.549599

Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS Scales. *Journal of Personality and Social Psychology, 54*(6), 1063–1070. doi:10.1037/0022-3514.54.6.1063

Wulff, K., Gatti, S., Wettstein, J. G., & Foster, R. G. (2010). Sleep and circadian rhythm disruption in psychiatric and neurodegenerative disease. Nature reviews. *Neuroscience, 11*(8), 589. doi:10.1038/nrn2868

Zavecz, Z., Török, C., Köteles, F., Pálosi, V., & Simor, P. (2015). The psychometric properties of the Hungarian version of the Morningness-Eveningness Questionnaire (MEQ-H): The separate factors of morning freshness and circadian rhythmicity. *Psychiatria Hungarica: A Magyar Pszichiátriai Társaság Tudományos Folyóirata, 30*(3), 318–331.