Journal of Cognitive Psychotherapy: An International Quarterly
Volume 28, Number 2 • 2014

Obsessions and Time of Day: A Self-Monitoring Study in Individuals With Obsessive-Compulsive Disorder

Jacob A. Nota, MS
Brandon E. Gibb, PhD
Meredith E. Coles, PhD
Binghamton University

Deepening our understanding of the basic mechanisms underlying obsessive-compulsive disorder (OCD) often leads to advances in clinical practice. And, as noted by Kazdin (2008), clinical experiences are an important resource for identifying novel targets for empirical study. One potential target for furthering our understanding of OCD is to investigate clinical reports of within-day symptom fluctuations. Self-monitoring data from 17 adults with OCD were used to test for a diurnal pattern in obsessions. Results from generalized estimating equations revealed that obsessions were most common during midday and that the midday exacerbation was briefer in males. In combination with prior findings of similar diurnal patterns for other anxious symptoms (e.g., panic), these findings suggest that daily social rhythms and/or circadian influences may influence levels of obsessions. Furthermore, treatment may be improved by attending to these heightened symptom periods and integrating this information into therapy (e.g., when developing the exposure hierarchy).

Keywords: obsessive-compulsive; anxiety; circadian; self-monitoring; generalized estimating equations

Deepening our understanding of the basic mechanisms underlying obsessive-compulsive disorder (OCD) often leads to advances in clinical practice. And, as noted by Kazdin (2008), clinical experiences are an important resource for identifying novel targets for empirical study. Individuals with OCD frequently report experiencing symptoms throughout the day. Some individuals report experiencing their symptoms as occurring randomly or when triggered by the environment, whereas others report feeling as though their symptoms are a constant burden throughout their waking hours. Indeed, the perceived uncontrollable or inescapable nature of OCD symptoms can be a contributor to the distress and impairment associated with the disorder. Clinicians working with individuals with OCD often begin by helping their clients identify antecedents to their symptoms and better understand the maintenance of their OCD symptoms. In their efforts to do this, several clinicians have noted that there may be patterns to the fluctuations related to the time of day. Indeed, Rachman (2002) described a patient whose symptoms were most disruptive at night, spending hours engaging in compulsive rituals

http://dx.doi.org/10.1891/0889-8391.28.2.134

after his family members went to bed. Similarly, in our clinic, patients have reported increased symptom-related distress late at night (e.g., Coles & Sharkey, 2011). According to these reports, increases in compulsions at night were related to greater difficulty dismissing intrusive thoughts and obsessions that the actions must be performed "perfectly." However, case studies and anecdotal evidence cannot adequately specify whether these patterns are unique to certain individuals or whether they reflect a more universal pattern across individuals with OCD.

Diurnal patterns across individuals have been identified for other psychopathological constructs including depressive rumination and panic symptoms. Interestingly, different patterns were identified for each construct: Depressive rumination was found to have the *lowest* levels in the afternoon and *increases* in the morning and evening (Moberly & Watkins, 2008; Takano & Tanno, 2011), whereas panic symptoms were found to have their *highest* levels in the afternoon with *decreases* in the morning and evening (Cameron, Lee, Kotun, & McPhee, 1986; Kenardy, Fried, Kraemer, & Taylor, 1992). Information from these studies could be applied to clinical practice to further patient's understanding of symptoms, inform more targeted and effective treatment (e.g., timing of medication doses or therapy sessions; Portaluppi & Smolensky, 2001), and generate hypotheses regarding the mechanisms of patients' experiences (Myin-Germeys et al., 2009). For example, symptom fluctuations within a day may be related to social rhythms such as work schedules, time spent with others, timing of meals, or exercise. Indeed, patients with mood and anxiety disorders have demonstrated increased variability in social rhythms (Meyer & Maier, 2006; Monk, Flaherty, Frank, & Hoskinson, 1990). Further, patients with mood and anxiety disorders exhibit disruptions in their cortisol, melatonin, and core body temperature rhythms as well as shifts in the timing of sleep–wake behavior (for review, see Harvey, Murray, Chandler, & Soehner, 2011; Wulff, Gatti, Wettstein, & Foster, 2010). Thus, some researchers hypothesize that physiological circadian rhythms (e.g., sleep, hormones, blood pressure, core body temperature; Portaluppi & Smolensky, 2001) may influence psychopathology symptoms directly or interact with the mechanisms underlying symptoms (Uhde, Cortese, & Vedeniapin, 2009). Researchers have also identified fluctuations in cognitive functioning across the hours of the day (Valdez, Reilly, & Waterhouse, 2008). This could suggest that changes in capacity to inhibit or direct attention to internal and external cues play a role in the experience of symptoms.

There have been three published studies examining diurnal variations in OCD symptoms; all were published at the close of the last century (Herman & Koran, 1998; Millet et al., 1999; Millet et al., 1998). Two of these studies (Millet et al., 1999; Millet et al., 1998) measured fluctuations in participants' OCD symptoms over the course of a 1-day hospital stay. The third study (Herman & Koran, 1998) used an ecological momentary assessment methodology (for review, see Myin-Germeys et al., 2009) to measure fluctuations in reported severity of symptoms over the course of 3 days. However, these studies did not find patterns in obsessions or compulsions across the day. Despite this, advances in short-term symptom measurement and statistical analysis since the publication of these studies suggest that a study utilizing current methods may be better suited to determine the presence or absence of diurnal patterns than was previously possible.

This study was designed to examine whether the obsessions experienced by individuals with OCD follow a diurnal pattern. Self-monitoring data collected in the individuals' own environments were used, thus increasing the ecological validity of the data in comparison to some previous studies (e.g., Millet et al., 1999; Millet et al., 1998). Furthermore, analytic techniques were employed that are uniquely suited to examining patterns in nested, repeated measures (Zeger & Liang, 1986) and offered increased power in comparison to previous approaches (e.g., Herman & Koran, 1998). Based on clinical observations and previously published case studies of variations in OCD symptom distress (e.g., Coles & Sharkey, 2011; Rachman, 2002), we hypothesized that there would be diurnal variation in obsession occurrence. However, we tested competing hypotheses regarding the form of this variation. Based on similarity between obsessive intrusions

and rumination (e.g., Nota & Coles, ; Wahl, Ertle, Bohne, Zurowski, & Kordon, 2011), we would predict heightened levels of obsessions in the morning and evening. However, given overlap with other symptoms of anxiety including panic (e.g., Deacon & Abramowitz, 2006), one would predict peaks in obsessions midday.

We also examined models including variables that are related to differences in social and physiological rhythms and that might reasonably moderate the diurnal pattern of obsession occurrence. We chose to examine gender based on findings from previous studies of individuals' experiences in daily life that suggest men and women may be differentially exposed to and may react in unique ways to stressors (e.g., James & Bovbjerg, 2012). We also examined the potential influence of comorbid depression given that previous research suggests that individuals with depression have disruptions in their physiological circadian rhythms (for review, see Wulff et al., 2010) and that symptoms of depression (i.e., rumination) have a diurnal rhythm (Moberly & Watkins, 2008; Takano & Tanno, 2011). Given that there is little research on patterns of obsessions in particular across the day, we did not have hypotheses regarding the direction of these effects and treated these analyses as exploratory.

Method

Participants

Participants were 17 individuals with a primary *Diagnostic and Statistical Manual of Mental Disorders* (4th ed.; *DSM-IV*) diagnosis of OCD who received cognitive behavioral therapy between July 2005 and April 2012 and logged their symptoms via self-monitoring forms prior to beginning exposure and ritual prevention. All participants provided informed consent for their de-identified data to be used for research purposes. Participants' age ranged from 20 to 66 years old ($M = 34.9$, $SD = 15.2$), were roughly half males (52.9%), and all identified as White. At intake, 6 were married or living with a significant other (35.3%), 8 were living with family or roommates (58.8%), and only 6 (35.3%) were employed full-time. OCD symptom severity ($M = 23.2$, $SD = 6.2$) as measured by the Yale-Brown Obsessive-Compulsive Scale (YBOCS; Goodman et al., 1989) was consistent with that observed in other clinical samples (Foa et al., 2005) and depressive symptoms were bordering on the clinical range on average ($M = 19.2$, $SD = 12.8$) as measured by the Beck Depression Inventory-II (BDI-II; Beck, Steer, & Brown, 1996). There were 7 patients who had minimal depressive symptoms (BDI-II less than 13) and 5 had severe depressive symptoms (BDI-II higher than 29). There were 11 patients who reported current selective serotonin reuptake inhibitor or anxiolytic medication use (64.7%) and 8 (47.1%) had comorbid diagnoses of major depressive disorder. The symptom presentation was varied, but the most common obsessions were doubting ($n = 10$), contamination ($n = 9$), aggressive/violent ($n = 2$), sexual ($n = 2$), and religious ($n = 1$).[1] Demographic characteristics of the male and female participants are presented in Table 1.

Measures

The Anxiety Disorder Interview Schedule for DSM-IV—Lifetime Version (ADIS-IV-L; Brown, Di Nardo, & Barlow, 1994) semistructured interview was used to assess Axis I psychopathology (American Psychiatric Association, 2000). ADIS-IV-L interviewers were trained to reliability by matching the diagnoses assigned by a senior clinician while observing and then administering three interviews (cf. Brown, Di Nardo, Lehman, & Campbell, 2001; Di Nardo, Moras, Barlow, Rapee, & Brown, 1993). The YBOCS (Goodman et al., 1989) was used to assess current obsessive-compulsive (OC) symptom severity. This interviewer-administered tool is considered the "gold

TABLE 1. Demographic Information by Gender

	Male ($n = 9$) M (SD) or %	Female ($n = 8$) M (SD) or %
Age	34.7 (17.4)	35.1 (13.7)
Married or living with significant other	33.3%	37.5%
Living with roommates or family	55.6%	62.5%
Full-time employment	22.2%	50.0%
Current psychotropic medication	77.8%	50.0%
Comorbid depression	33.3%	62.5%
YBOCS	22.7 (7.3)	23.6 (5.5)
BDI-II	19.4 (13.6)	18.9 (12.7)

Note. YBOCS = Yale-Brown Obsessive-Compulsive Scale; BDI-II = Beck Depression Inventory-II.

standard" for assessment of OC symptom severity. The BDI-II (Beck et al., 1996) was used to assess depressive symptom severity. This self-report measure has been demonstrated to be specifically sensitive to depressive symptoms (Beck et al., 1996) and is widely used.

Paper-and-pencil self-monitoring forms were used for patients to record their OCD symptoms throughout the day. Patients were instructed to carry these forms with them and log the occurrence of obsessions (e.g., aggressive, sexual, contamination, symmetry) and any subsequent compulsions (e.g., washing, checking, repeating, reassurance seeking) completed in response to obsessions as soon as possible after their occurrence. These forms collected data on the time of the obsession, the situation or thought that triggered the obsession, the use of compulsions, and a rating of subjective distress. Given the original clinical, rather than research, purpose of these forms, there was variability in the rate of completion of all of these fields between and within patients. Further, because our patients had just begun treatment, their ability to distinguish obsession and compulsions and record them as such was not yet adequate. Therefore, this study used binary data regarding the presence or absence of obsessions in a given hour only. The average number of hour periods (hits) per day where obsessions were recorded on the self-monitoring forms was moderately correlated ($r = .44$, $p = .10$) with the obsessions scale of the YBOCS—supporting the validity of the self-monitoring data, despite the lack of significance because of our small sample size. Further, this relation was stronger than the correlation with the compulsions scale of the YBOCS ($r = .29$, $p = .30$); however, this difference in strength of relations was not statistically significant ($z = 1.15$, $p = .13$).

Procedure

This study used archival data collected as part of cognitive behavioral treatment for OCD. ADIS-IV-L interviews, YBOCS, and BDI-II were administered before treatment began, typically preceding treatment by approximately 2 weeks. In the first treatment session, clinicians provided psychoeducation about OCD, provided the treatment rationale, and explained the procedures for self-monitoring to the participants. Participants subsequently completed self-monitoring records daily. To avoid changes in symptoms because of treatment, we examined self-monitoring completed during the first 3 weeks of treatment, prior to the onset of exposure and ritual prevention. Participants monitored from 1 to 13 days ($M = 6.9$, $SD = 3.1$). The number of days of monitoring was not found to explain variance in the intercept, linear slope, or quadratic slope of the probability of having obsessions during that hour (all ps $> .05$), and therefore, no participants were excluded.

Statistical Analysis

We restricted our examination of the self-monitoring data to avoid confounding the absence of obsessions with sleep. Because we are examining the presence or absence of obsessions in a given hour, we are making the assumption that periods where there are no reports are periods where there are no obsessions. If we were to include all 24 hours in our analysis, the period during the night when patients are asleep would unduly influence and confound the analysis looking for diurnal patterns in obsessions. Because we did not have data regarding the patients' sleep schedules, we consulted national sleep norms (National Sleep Foundation, 2011) and limited our models to the hours between 6 a.m. and 11 p.m. Thus, our analyses examined diurnal patterns of obsessions during typical hours of wakefulness. This resulted in a 3.6% reduction in data. The final data set contained 490 recorded instances of obsessions over 117 days of monitoring.

Generalized estimating equations (GEEs; Zeger & Liang, 1986) in the GENLIN module of SPSS 20 were used to model patterns of obsessions throughout the day. This analytic approach was chosen for several reasons. First, GEEs account for the nonindependence of observations in the data (e.g., the technique accounts for the fact that one patient's symptoms at different times of the day may be associated with each other in contrast to models that treat the data as if every observation is independent of all others). This technique more accurately represents the data and increases power to detect significant changes over hours within a day. In addition, GEE models are appropriate for use with unbalanced designs where there are a different number of observations for each individual (Diggle, Liang, & Zeger, 1994). Given that we were modeling dichotomous outcomes (i.e., whether or not obsessions occurred during that hour), a logit link function was employed to transform the outcome distribution to the appropriate binomial distribution. In all models, the robust covariance estimator was used to correct for underestimation of standard errors, reducing the risk of type 1 error. An autoregressive working correlation matrix was specified. QIC model fit indices (Pan, 2001) were used to evaluate model fit. Adjusted incidence rate ratios (IRRs) along with 95% confidence intervals were calculated. Similar to odds ratios, IRRs describe the relative increase in risk of obsession occurrence for every one unit of change in a given predictor variable.

Results

Diurnal Trajectories in Probabilities of Obsession Occurrence

The probability of at least one obsession occurring in a given hour was predicted as a function of hour within day. Given that the zero point is meaningful for interpretation, we chose to center time around noon. Hour within day was modeled with both linear and quadratic trends based on examination of individual plots and evidence of quadratic patterns in other psychopathological constructs. This model provides average estimates of the probability of obsessions at noon (intercept) and the linear and quadratic rate of change across time collapsing across all days of monitoring and participants.

These analyses revealed significant intercept ($\beta = -.86$, $SE = .16$, Wald = 30.0, $p < .001$, IRR = .42, 95% CI = .31–.58), linear ($\beta = .07$, $SE = .02$, Wald = 11.38, $p = .001$, IRR= 1.07, 95% CI = 1.03–1.12), and quadratic effects ($\beta = -.02$, $SE = .01$, Wald = 13.36, $p < .001$, IRR = .98, 95% CI = .97–.99) of hour of day. Visual examination of the data showed that, on average, the likelihood of reporting an obsession at noon was greater than zero (the intercept effect) and showed a slight overall increase across the day (the linear effect). Further, the likelihood increased more rapidly from the morning until the middle of the day and then decreased for the remainder of the afternoon and evening but never reduced lower than in the earliest hours of the analysis (the quadratic effect).[2] Thus, these findings provide support for diurnal variation in the likelihood of experiencing obsessions (see Figure 1).

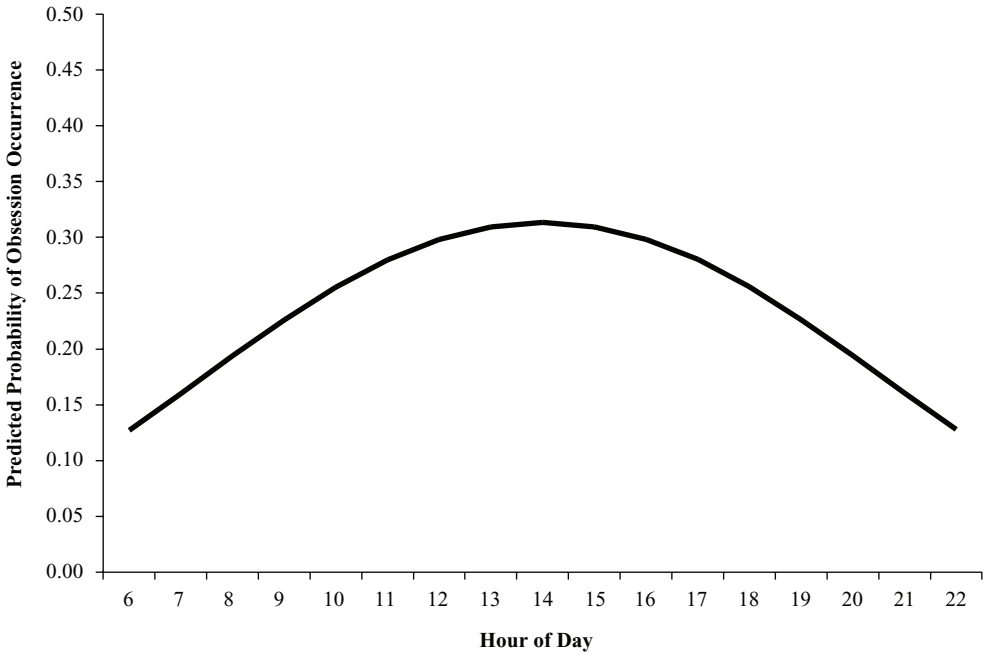

Figure 1. Predicted probability of obsession occurrence across waking hours of the day. *Note.* Log odds (η) were transformed into predicted probabilities (φ) for ease of interpretation. The pattern depicted was determined by combining both the linear and quadratic effects.

Moderation Models

Next, we sought to explain variability in these within-day fluctuations.[3] We first tested a model that included the main effects of the linear and quadratic time variables, gender, and presence of a comorbid depression diagnosis as well as all possible two- and three-way interactions between these variables (excluding interactions containing both linear and quadratic time). However, this model was rejected as the QIC model fit indices did not indicate an improvement in model fit (QIC = 2251.3, QICC = 2174.9) compared to the model containing only the linear and quadratic effects of time (QIC = 2206.8, QICC = 2172.7; smaller numbers indicate better fit). Furthermore, no significant interactions were identified.

Given the failure of the original all-inclusive moderation model to explain further variability in the occurrence of OC obsessions, we considered the overlap between our moderators. Because more of our female patients had comorbid depression, the overlap in variance between these two moderators may have limited the unique variance accounted for by each of the moderators in the all-inclusive model. Therefore, we decided to modify our moderation model to examine each of our potential moderators separately. We tested two models including the main effects and all two-way interactions (excluding interactions containing both linear and quadratic time) of the linear and quadratic time variables: (a) gender or (b) comorbid depression, respectively. QIC model fit indices were mixed for the model including gender (QIC = 2209.4, QICC = 2169.4), indicating a possible improvement in fit compared to the model containing only the linear and quadratic effects of time. However, the model including comorbid depression diagnosis (QIC = 2227.3, QICC = 2180.2) did not indicate any improvement in model fit. Furthermore, the model including gender showed that there was a significant interaction

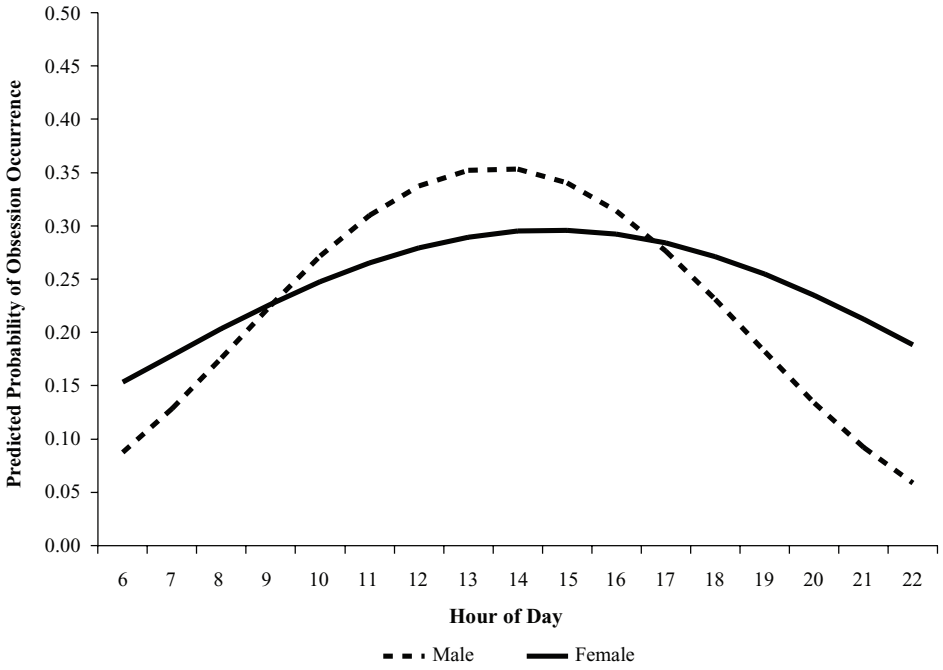

Figure 2. Predicted probability of obsession occurrence across waking hours of the day by gender. *Note.* Log-odds (η) were transformed into predicted probabilities (φ) for ease of interpretation. The pattern depicted was determined by combining both the linear and quadratic effects.

between gender and the quadratic effect of time (β = .02, *SE* = .001, Wald = 5.3, *p* = .02, IRR = 1.02, 95% CI = 1.00–1.03) but no interaction between gender and the linear effect of time (β = −.02, *SE* = .040, Wald = 0.2, *p* = .64, IRR = 0.98, 95% CI = 0.91–1.06) or main effect of gender (β = −.30, *SE* = .339, Wald = 0.8, *p* = .38, IRR = 0.74, 95% CI = 0.38–1.45). These results show that males demonstrate a sharper peak in their predicted probability of obsession occurrence in the middle of the day compared to females. Furthermore, males appear to have a slightly earlier peak in their probability of obsession occurrence compared to females (see Figure 2).

Discussion

Examination of within-day fluctuations in obsessions in individuals with OCD showed that, on average, the highest probability of obsession occurrence was in the afternoon. To our knowledge, this is the first study documenting a relation between the occurrence of obsessions and time of day. The pattern found in the current sample (see Figure 1) was similar to previous studies examining occurrences of other anxious symptoms (e.g., panic; Kenardy et al., 1992) and was the inverse of the diurnal pattern observed in studies of depressive rumination (Moberly & Watkins, 2008; Takano & Tanno, 2011). Taken together, this could suggest that mechanisms impacting anxious symptoms across the day are shared in both patients with panic and OCD and that different mechanisms drive the patterns of depressive symptoms; however, it could also be that similar processes (e.g., social, physiological, and cognitive rhythms) have different effects on the constructs being examined.

There is evidence that patients with OCD have impaired social functioning (Koran, 2000; Koran, Thienemann, & Davenport, 1996) making it plausible that OCD symptoms could be impacted by social rhythms. Social pressure to suppress symptoms and exposure to external triggers for obsessions may vary as a function of time of day based on one's environment. Social rhythms have been hypothesized to maintain psychopathology (e.g., Lewy, 2010; Meyer & Maier, 2006; Monk et al., 1990) and could explain similar diurnal patterns observed across disorders. In addition, studies examining physiological circadian rhythms in patients with OCD have documented altered levels and rhythms of melatonin, cortisol, and core body temperature (Catapano, Monteleone, Fuschino, Maj, & Kemali, 1992; Millet et al., 1998; Monteleone, Catapano, Buono, & Maj, 2007; Monteleone, Catapano, Tortorella, Di Martino, & Maj, 1995). Further, correlations between mood and cognitive performance and physiological rhythms suggest that physiological rhythms may impact psychological constructs (Schmidt, Collette, Cajochen, & Peigneux, 2007; Valdez et al., 2008). Examination of variables related to social, physiological, and cognitive rhythms is indicated to better understand the possible mechanisms of diurnal fluctuations in obsessions and other psychopathological constructs.

Notably, the peak predicted probability of obsessions was relatively low (approximately 0.4) in our analyses, suggesting that although there was a greater propensity for obsessions to be reported during the middle of the day, at no point were obsessions occurring for most individuals at the same time. This indicates that although there are general trends in obsession occurrence over the day, the pattern will not be the same for each individual or even the same each day. Other variables need to be examined to determine what causes differences in these patterns.

This study examined two potential moderators of the diurnal pattern in obsessions: gender and comorbid depression diagnoses. Analyses indicated that quadratic change in the probability of obsession occurrence across the day was moderated by an interaction with gender. Males were found to have a peak in obsessions centered around midday, whereas women were shown to have more consistent elevation across the entire day (see Figure 2). However, it is not immediately clear why this is the case. One possibility is that the effect of different social contexts (e.g., home vs. work) may interact with gender. For example, males may see reductions in their obsessions when they are home in the mornings and evenings because of reductions in overall stress, whereas women may maintain similar stress levels at both home and work because of greater duties with family in the mornings and evenings. This type of interaction between gender and context has been demonstrated in measures of blood pressure (James & Bovbjerg, 2012).

Although this study provides evidence to suggest that studying diurnal variations in OCD symptoms may be fruitful, the findings must be considered in the context of several limitations. First, our sample size may limit confidence in the generalizability of our findings and may have obscured moderation effects. However, our large number of observations ($n = 1{,}987$) did provide ample data to build our models on. Furthermore, our dichotomous data can only demonstrate that there are times of day when patients were more likely to report experiencing obsessions but cannot speak to the question of how much distress or interference these obsessions caused the individual. Patients in our study may have experienced obsessions that were extremely upsetting to them or that were quickly dismissed without causing interference for the individual. Future studies that are designed to replicate and extend our findings should examine obsession severity because this is theoretically and clinically important. More generally, the self-monitoring data, although a strength with regard to ecological validity, did impose limits on our analyses. For example, the analysis herein focused only on obsessions and could not speak to the occurrence of compulsions. Further, it was not possible to verify patient compliance with self-monitoring instructions (although correlations with "gold standard" YBOCS scores did support the validity of these data). The paper-and-pencil–based monitoring method used herein relied on patients initiating logging their symptoms, and therefore, periods without any information recorded could

reflect the absence of symptoms or may reflect the patient forgetting to monitor. Therefore, future studies would benefit from incorporating more advanced methods for short-term data collection (e.g., ecological momentary assessment, experience sampling; for review, see Myin-Germeys et al., 2009) that prompt the patients to log their symptoms. Collecting information about other daily experiences (e.g., stressors) would also improve the interpretability of the data.

Another limitation was that we did not have information regarding the participants' sleep times. However, the 3.6% reduction in recorded symptoms after the norm-based removal of the hours between 11 p.m. and 6 a.m. was consistent with the hypothesis that most patients were asleep during this period. This said, information about participants' sleep would allow for a more detailed characterization of diurnal variation in obsessions. A growing literature suggests that delayed bed times may be related to OCD symptom frequency and severity independent of overall sleep quantity or quality (Coles, Schubert, & Sharkey, 2012). Our norm-based time cutoffs may have obscured unique information about the occurrence of obsessions late at night.

Continued investigation of diurnal patterns in OCD symptoms may provide an opportunity to further our understanding of etiological and maintenance factors, improve treatment, and empower individuals living with the disorder. It could be that social and physiological rhythms are impacting symptom presentation, neither of which is considered in current conceptualizations of symptom maintenance. If physiological or social rhythms do impact symptoms, then the modification of these rhythms could be a new avenue for clinical intervention. The timing of existing treatment could also be tailored to match diurnal variations in symptoms. Even prior to those developments, patients could be empowered by anticipating times where symptoms are more likely. Given these initial findings, it appears that future studies using larger samples and hypothesis-driven models are warranted.

Notes

1. Some patients had obsessions in multiple categories; therefore, total *n* is greater than study *n*.

2. Given that there were some reports of obsessions during the later hours of the night and the literature reporting that some patients have more difficulty dismissing obsessions late at night, we replicated these analyses using reports of obsessions from all 24 hours. Significant linear and quadratic effects of time of day were again observed, consistent with the model excluding hours where patients were likely to be asleep.

3. We tested models that included age, employment status, living situation, current psychotropic medication use, levels of depressive symptoms (BDI-II), and levels of OC symptoms (YBOCS) as moderators; however, none of these were significant predictors of obsession occurrence. Therefore, we did not control for these demographic variables in our analyses.

References

American Psychiatric Association. (2000). *Diagnostic and statistical manual of mental disorders* (4th ed., text rev.). Washington, DC: Author.

Beck, A. T., Steer, R. A., & Brown, G. K. (1996). *Beck depression inventory manual* (2nd ed.). San Antonio, TX: Psychological Corporation.

Brown, T. A., Di Nardo, P., & Barlow, D. H. (1994). *Anxiety disorders interview schedule adult version (ADIS-IV): Client interview schedule*. San Antonio, TX: Psychological Corporation.

Brown, T. A., Di Nardo, P. A., Lehman, C. L., & Campbell, L. A. (2001). Reliability of DSM-IV anxiety and mood disorders: Implications for the classification of emotional disorders. *Journal of Abnormal Psychology*, *110*(1), 49–58.

Cameron, O. G., Lee, M. A., Kotun, J., & McPhee, K. M. (1986). Circadian symptom fluctuations in people with anxiety disorders. *Journal of Affective Disorders*, *11*(3), 213–218.

Catapano, F., Monteleone, P., Fuschino, A., Maj, M., & Kemali, D. (1992). Melatonin and cortisol secretion in patients with primary obsessive-compulsive disorder. *Psychiatry Research*, *44*(3), 217–225.

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

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.

Deacon, B., & Abramowitz, J. (2006). Anxiety sensitivity and its dimensions across the anxiety disorders. *Anxiety Disorders*, *20*, 837–857.

Diggle, P. J., Liang, K. Y., & Zeger, S. L. (1994). *Analysis of longitudinal data*. Oxford, England: Clarendon Press.

Di Nardo, P. A., Moras, K., Barlow, D. H., Rapee, R. M., & Brown, T. A. (1993). Reliability of DSM-III-R anxiety disorder categories: Using the anxiety disorders interview schedule—revised (ADIS-R). *Archives of General Psychiatry*, *50*(4), 251–256.

Foa, E. B., Liebowitz, M. R., Kozak, M. J., Davies, S., Campeas, R., Franklin, M. E., . . . Tu, X. (2005). Randomized, placebo-controlled trial of exposure and ritual prevention, clomipramine, and their combination in the treatment of obsessive-compulsive disorder. *American Journal of Psychiatry*, *162*(1), 151–161.

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

Harvey, A. G., Murray, G., Chandler, R. A., & Soehner, A. (2011). Sleep disturbance as transdiagnostic: Consideration of neurobiological mechanisms. *Clinical Psychology Review*, *31*(2), 225–235.

Herman, S., & Koran, L. (1998). In vivo measurement of obsessive-compulsive disorder symptoms using palmtop computers. *Computers in Human Behavior*, *14*(3), 449–462.

James, G. D., & Bovbjerg, D. H. (2012). Heightened endocrine response to daily life stressors in healthy women at familial risk for breast cancer. In A. Esposito & V. Bianchi (Eds.), *Cortisol: Physiology, regulation, & health implications* (1st ed., pp. 49–72). New York, NY: Nova Science.

Kazdin, A. E. (2008). Evidence-based treatment and practice: New opportunities to bridge clinical research and practice, enhance the knowledge base, and improve patient care. *American Psychologist*, *63*(3), 146–159.

Kenardy, J., Fried, L., Kraemer, H. C., & Taylor, C. B. (1992). Psychological precursors of panic attacks. *The British Journal of Psychiatry*, *160*(5), 668–673.

Koran, L. M. (2000). Quality of life in obsessive-compulsive disorder. *Psychiatric Clinics of North America*, *23*(3), 509–517.

Koran, L. M., Thienemann, M. L., & Davenport, R. (1996). Quality of life for patients with obsessive-compulsive disorder. *The American Journal of Psychiatry*, *153*(6), 783–788.

Lewy, A. J. (2010). Depressive disorders may more commonly be related to circadian phase delays rather than advances: Time will tell. *Sleep Medicine*, *11*(2), 117–118.

Meyer, T. D., & Maier, S. (2006). Is there evidence for social rhythm instability in people at risk for affective disorders? *Psychiatry Research*, *141*(1), 103–114.

Millet, B., Touitou, Y., Poirier, M. F., Bourdel, M. C., Amado, I., Hantouche, E. G., . . . Olié, J. P. (1999). Obsessive-compulsive disorder: Evaluation of clinical and biological circadian parameters during fluoxetine treatment. *Psychopharmacology*, *146*(3), 268–274.

Millet, B., Touitou, Y., Poirier, M. F., Bourdel, M. C., Hantouche, E., Bogdan, A., & Olié, J. P. (1998). Plasma melatonin and cortisol in patients with obsessive-compulsive disorder: Relationship with axillary temperature, physical activity, and clinical symptoms. *Biological Psychiatry*, *44*(9), 874–881.

Moberly, N. J., & Watkins, E. R. (2008). Ruminative self-focus and negative affect: An experience sampling study. *Journal of Abnormal Psychology*, *117*(2), 314–323.

Monk, T. K., Flaherty, J. F., Frank, E., & Hoskinson, K. (1990). The social rhythm metric: An instrument to quantify the daily rhythms of life. *Journal of Nervous and Mental Disease*, *178*(2), 120–126.

Monteleone, P., Catapano, F., Buono, G., & Maj, M. (2007). Circadian rhythms of melatonin, cortisol and prolactin in patients with obsessive-compulsive disorder. *Acta Psychiatrica Scandinavica*, *89*(6), 411–415.

Monteleone, P., Catapano, F., Tortorella, A., Di Martino, S., & Maj, M. (1995). Plasma melatonin and cortisol circadian patterns in patients with obsessive-compulsive disorder before and after fluoxetine treatment. *Psychoneuroendocrinology*, *20*(7), 763–770.

Myin-Germeys, I., Oorschot, M., Collip, D., Lataster, J., Delespaul, P., & van Os, J. (2009). Experience sampling research in psychopathology: Opening the black box of daily life. *Psychological Medicine*, *39*(9), 1533–1547.

National Sleep Foundation. (2011). *Sleep in America poll: Communications technology in the bedroom*. Crofton, MD: Author.

Nota, J. A. & Coles, M. E. (2014). *Transdiagnostic repetitive negative thoughts and sleep disruption*. Manuscript in preparation.

Pan, W. (2001). Akaike's information criterion in generalized estimating equations. *Biometrics*, *57*(1), 120–125.

Portaluppi, F., & Smolensky, M. H. (2001). Circadian rhythm and environmental determinants of blood pressure regulation in normal and hypertensive conditions. In W. B. White (Ed.), *Contemporary cardiology: Blood pressure monitoring in cardiovascular medicine and therapeutics* (pp. 79–138). Totowa, NJ: Humana Press.

Rachman, S. (2002). A cognitive theory of compulsive checking. *Behaviour Research and Therapy*, *40*(6), 624–639.

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

Takano, K., & Tanno, Y. (2011). Diurnal variation in rumination. *Emotion*, *11*(5), 1046–1058.

Uhde, T. W., Cortese, B. M., & Vedeniapin, A. (2009). Anxiety and sleep problems: Emerging concepts and theoretical treatment implications. *Current Psychiatry Reports*, *11*, 269–276.

Valdez, P., Reilly, T., & Waterhouse, J. (2008). Rhythms of mental performance. *Mind, Brain, and Education*, *2*(1), 7–16.

Wahl, K., Ertle, A., Bohne, A., Zurowski, B., & Kordon, A. (2011). Relations between a ruminative thinking style and obsessive-compulsive symptoms in non-clinical samples. *Anxiety, Stress, & Coping*, *24*(2), 217–225.

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), 589–599.

Zeger, S. L., & Liang, K. Y. (1986). Longitudinal data analysis for discrete and continuous outcomes. *Biometrics*, *42*(1), 121–130.

Correspondence regarding this article should be directed to Jacob A. Nota, MS, Department of Psychology, Binghamton University, Binghamton, NY 13902-6000. E-mail: Jnota1@binghamton.edu