

## Seasonal Variations in Obsessive-Compulsive Disorder: Analysis of Prospective-Clinical Data

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### ABSTRACT

**Introduction:** Few studies have investigated potential seasonal changes in anxiety disorders. This study aimed to evaluate whether seasonal changes influence the severity of obsessive and compulsive symptoms in obsessive-compulsive disorder (OCD). The relationship between comorbid anxiety and depression symptoms and the seasons was also investigated. Furthermore, we compared the differences between retrospective data reliant on patients' recall and data obtained by prospective observation.

**Methods:** The Yale-Brown Obsessive Compulsive Scale (Y-BOCS), Y-BOCS Symptom Checklist, Beck Anxiety Scale, and Beck Depression Scale were administered to 148 patients with OCD in each of the four seasons over a year. The relationships between the seasons and the scales based on retrospective observations of the patients, and between the seasons and scales based on prospective data collected over the

year were analyzed. Scores from clinical assessments were compared between the different seasons.

**Results:** The severity of obsessive and compulsive symptoms, did not show seasonal changes. Multi-level growth models suggested that the change in Y-BOCS Total scores across seasons could be explained by subjective symptoms of depression and anxiety and their interactions. Importantly, results obtained using prospective observations from structured clinical assessment differed from those obtained using retrospective observations of patients.

**Conclusions:** Our study does not support the existence of seasonal variations in symptoms of OCD. Future studies are needed to delineate seasonal variations in OCD symptoms.

**Keywords:** Obsessive-compulsive disorder, seasonality, anxiety, depression

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### INTRODUCTION

The effects of the seasons on human emotions, behaviors, and physiology have been recognized for many centuries. In particular, the seasons are known to influence sleep, appetite, mood, and energy. The changes induced by the seasons may not only influence the normal population but also that of individuals with psychiatric disorders (1).

Within the context of psychopathology, the most significant disorder associated with the seasons is Seasonal Affective Disorder (SAD). Also, depression, suicidality, appetite and sleep are known to be affected by the seasons (2). Several studies in various cultural contexts have found that symptoms of anxiety and depression may be influenced by the seasons (3, 4). In contrast, multi-center studies investigating large case series of patients presenting to psychiatry outpatient clinics have not found seasonal effects on clinical presentation (5).

Fewer studies have investigated the relationship between anxiety disorders and the seasons. Nonetheless, a study using data from the Netherlands Study of Depression and Anxiety (NESDA) reported that depressive symptoms experienced by patients with anxiety disorders increased in winter (6). De Graaf et al. investigated seasonal changes in the prevalence of mental disorders, and potential associations with gender

and age. They reported no statistically significant seasonal variations in the main category of anxiety disorders. However, they did report that panic disorder and generalized anxiety disorder were more prevalent in winter, and obsessive compulsive disorder (OCD) was more prevalent in autumn (7).

Obsessive-compulsive disorder is a multidimensional and etiologically heterogeneous disorder, ranked as the fourth most common mental disorder after depressive disorder, specific phobia, and substance abuse (8). Epidemiologic studies report lifetime prevalence rates of OCD ranging between 1.6% and 3.0% (8). Despite its importance from a public health perspective and clues about seasonality of symptoms; temporal trends in symptoms of patients with OCD have been rarely studied (7, 8). There are limited case reports of patients with OCD displaying seasonal variations in symptoms (9). Also a cross-sectional study from Turkey reported that among a clinical sample of patients with OCD more than half reported seasonal mood changes while those seasonal affective changes did not affect severity of OCD (10). The seasons and sunlight may also affect serotonergic function in the central nervous system, although this effect may not be observed among patients with OCD (11). Cheng et al. reported that patients with OCD were significantly more likely to be born

during August to November and that this effect was more pronounced in males (12). In a recent, pilot study, Vitale et al. found that patients with OCD and tics displayed seasonal changes in obsessions and compulsions but not tics (13). According to their results, OCD symptoms were most severe in autumn and winter and that chronotype may have limited effects on seasonality. In a recent review, Cox and Olatunji, reported that results of studies on circadian and circannual rhythms and OCD are inconsistent but decreased light exposure may increase OCD symptoms and the symptoms may display diurnal variability (14). According to the results of previous studies, consideration of potential seasonal changes (by asking patients about perceived seasonal influences, as well as monitoring symptoms across seasons) may improve quality of life, and inform approaches to disease management in OCD, especially among colder climates and those with depressive symptoms. Furthermore, investigation of seasonal changes may inform etiological mechanisms of the pathophysiology of OCD (9, 10, 12).

### Aims

Except Vitale et al., none of the previous studies of seasonality in patients with OCD was conducted prospectively and seasonality was mostly evaluated with changes in prevalence (6, 7, 10, 13). Therefore, the aim of this prospective observational study was to determine whether there are seasonal changes in the severity of obsessive and compulsive symptoms in OCD. Additionally, we aim to investigate seasonal changes in comorbid symptoms of anxiety and depression. Finally, we compare the differences between data obtained retrospectively from patients' recall and data obtained by prospective observation.

## METHODS

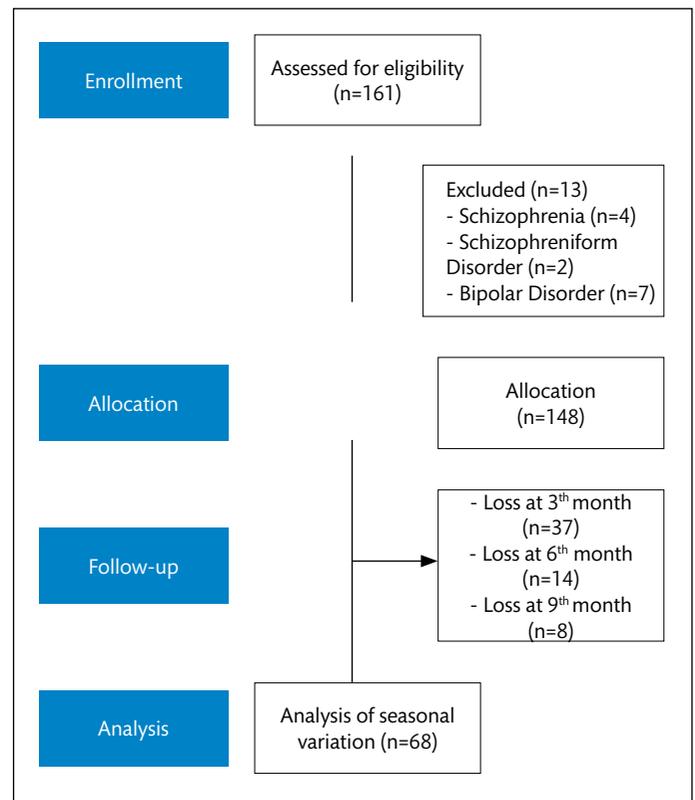
### Study Center, Sampling and Time Frame

The study was conducted at the Department of Psychiatry of Başkent University School of Medicine between June 2013 and January 2019. Written informed consent was obtained from all patients or from parents of patients if they were younger than 18 years old.

Within the time frame patients with a primary diagnosis of Obsessive Compulsive Disorder as per DSM-IV-TR criteria (F 42.2 in ICD) were approached for potential participation. Hoarding Disorder, Skin Picking Disorder, Other and Unspecified Obsessive Compulsive Disorder (F 42.3, 42.4, 42.8 and 42.9 in ICD; respectively), obsessive compulsive disorder symptoms in psychotic disorders, comorbid bipolar spectrum disorders (cyclothymia, BP-I and II), intellectual disability, neurological disorder requiring treatment (i. e. seizures, migraine etc.) were criteria for exclusion. Patients aged less than 15 years old or with a history of any serious and progressive organic physical disease were also excluded, as were women who were pregnant or breast-feeding.

A total of 148 patients with OCD were recruited between June 2013 and January 2019 from the. Thirteen patients were excluded for a variety of reasons. These included patients with alternative diagnoses (schizophrenia, schizophreniform disorder or bipolar affective disorder) and those with intellectual disability or severe neurologic disorder (Figure 1).

Study participants were recruited from the Adana County of the Republic of Turkey. Participants experience a sunny coastal climate (average sunny days 300/year), with an average temperature of 19°C. Average hours of sunlight between 1985–2016 for the study region was reported to be 7.3–8.1 hours/day (Daily sunlight magnitude for Turkey. Meteorology General Directorate of the Ministry of Forestry and Waterworks of the RoT. Turkish, <https://www.mgm.gov.tr/FILES/resmi-istatistikler/Turkiye-Gunluk-Guneslenme-Siddeti.pdf>, Accessed on 07.07.2017).



**Figure 1.** CONSORT Diagram of study to evaluate seasonal variations in patients with Obsessive-Compulsive Disorder.

The patients were not aware of the study hypothesis and Y-BOCS evaluations were conducted by research assistants blinded to the study hypothesis. All of the patients received naturalistic treatment in accordance with the choices of their primary clinicians. Only selective serotonin reuptake inhibitors (SSRI) were used within the effective dose range for the Obsessive Compulsive Disorder. 127 patients were treated with SSRI monotherapy (n=29 fluoxetine 60–80 mg/day; n=18 fluvoxamine 200–300 mg/day; n=23 escitalopram 60–90 mg/day; n=25 sertraline 200–300 mg/day; n=32, paroxetine 40–60 mg/day) and twenty one of patients were used at least 2 SSRI's.

### Data Collection

Patients were followed prospectively for one year. During the initial assessment, diagnoses of OCD and any comorbid psychiatric disorders were established by a clinician using the Structured Clinical Interview for the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV) (APA, 1994). Other clinical assessments were administered including the Beck Depression Inventory (BDI), Beck Anxiety Inventory (BAI), Yale-Brown Obsessive Compulsive Scale (Y-BOCS) and Y-BOCS Symptoms Checklist. More details regarding the assessments used are provided below.

The primary research question of this study concerned whether or not OCD presentation changed seasonally, and if it did, in which season (s) this was. Initially, patients were asked to recall whether or not the severity of their OCD symptoms changed in particular seasons. According to their answers, patients were divided into two groups: seasonal and non-seasonal. All patients were evaluated on four occasions at which the BDI, BAI, and Y-BOCS were administered: spring (21st March – 22nd June); summer (22nd June – 23rd September); autumn (23rd September – 22nd December); and winter (22nd December – 21st March). The data collected from patients on all of the four seasons were evaluated for seasonal changes.

### Ethics Statement

This study adhered to the tenets of the Declaration of Helsinki and was approved by the Başkent University Institutional Review Board and Ethics Committee (Project no: KA 13/115). It was supported by the Başkent University Research Fund.

### Study Instruments

**Structured Clinical Interview for DSM-IV - Axis I Disorders:** Diagnosis was ascertained using the SCID-I. The SCID-I is a structured clinical interview to diagnose the presence of Axis I psychiatric disorders (15). It consists of six modules examining diagnostic criteria for a total of 38 Axis I disorders. Acceptable levels of validity and reliability for the Turkish version used in this study have been established (16).

**Yale-Brown Obsessive Compulsive Scale:** The presence and severity of OCD symptoms were measured by the Yale-Brown Obsessive Compulsive Scale (Y-BOCS), assessed using a structured interview. The scale includes 19 items, only 10 of which we used to calculate the total score: 5 for obsessions and 5 for compulsions. Each item rates from 0 (no symptoms) to 4 (extreme symptoms), with a total range of 0 to 40 (17). Acceptable levels of validity and reliability for the Turkish version used in this study have been established (18).

**Yale-Brown Obsessive Compulsive Symptom Checklist:** The Y-BOCS Symptom Checklist includes over 60 symptoms organized according to 15 categories of different types of obsessions and compulsions. This scale comprehensively identifies all possible types of obsessions and compulsions (18).

**Beck Depression Inventory:** We used the Turkish version of the Beck Depression Inventory (BDI) to assess depressive symptoms. The BDI is a self-report inventory with 21 items, each consisting of four statements scored 0 to 3, with total scores ranging from 0 to 63 (19). Reliability and validity for the Turkish version have been established, and scores of 17 or above were found to indicate major depression in the Turkish population. (20).

**Beck Anxiety Inventory:** The Beck Anxiety Inventory (BAI) is a 21-item scale widely used to measure the severity of anxiety (21). Acceptable validity and reliability has been reported in various populations, including in Turkish samples (22). Each item is scored from 0 to 3, in increasing order of severity. The scores for each of these 21 items were totaled at the end of the psychological evaluation.

### Statistical Analysis

All statistical analyses were carried out using SPSS 17.0 (SPSS Inc., Chicago, IL). Continuous measurements were summarized as mean and standard deviation (for normal data). Categorical variables were summarized as counts and percentages.

Little's Missing Completely at Random (MCAR) test was used to analyze whether data were lost at random. (23). This test is used to evaluate whether "missing" observations in multi-variate, quantitative data are completely independent of observed and unobserved data by using a chi-square distribution. Rejection of the null hypothesis ( $P < 0.05$ ) suggests that the data is not completely missing at random and likelihood-based inferences may not be valid.

Sociodemographic and clinical variables of patients and their relationships with season of visit (including obsessions and compulsions) were evaluated with multinomial log-linear tests. Log-linear analyses are used to evaluate probabilities of observations in cells of large contingency tables according to multi-nomial or Poisson distribution assumptions and they may be followed with post-hoc chi-square tests (24).

"Reliable change" is defined as the extent to which the change in scores of an individual on an instrument falls outside the measurement variability of the aforementioned instrument (25). The measurement variability is termed as the "Reliable Change Index" (RCI) and is assessed by using the standard errors of consecutive measurements ( $SE_{diff}$ ) and the reliability ( $r$ ) of the instrument (25) as  $SE_{diff} = SD \sqrt{2(1-r)}$ . Change exceeding 1.96 times this SE is unlikely to occur more than 5% of the time by unreliability of the measure alone. "Clinically significant" deterioration was accepted as pre to post-measurement change of  $\geq 2$  standard deviations from the original mean. Those indices were used to determine rate of reliable/clinically significant change/deterioration in scores across seasons among patients with OCD.

Multivariate analysis of variance (MANOVA) with repeated measures was used to evaluate seasonal change of depressive, anxiety and obsessive-compulsive symptoms. Because seasonal measurements were nested within individuals (i. e. one patient having multiple measures) multi-level growth models were used to determine individual predictors of change in obsessive-compulsive symptoms (26). In those models, explanatory power is expressed as pseudo- $R^2$  while model fit criteria ( $-2 \log$  Likelihood etc.) are used to compare fit of differing models. For all tests, the level of statistical significance was considered to be  $p=0.05$ . All comparisons were two-tailed.

## RESULTS

### Sample Characteristics

The baseline sample had a mean age of 31.8 years (S. D. =10.2) with a mean education of 11.9 (S. D. =3.5) years. Symptoms of OCD according to subjective reports started at a mean age of 23.2 (S. D. =9.6) years. Mean duration of untreated symptoms was 61.7 (S. D. =60.7) months. Mean age at first psychiatric evaluation for OCD symptoms was found to be 30.9 (S. D. =10.0) years. Among the baseline sample, twenty-six patients (17.6%) had a diagnosis of OCD without any comorbidities. Of the remaining patients with comorbid psychiatric disorders, 56 (37.8%) had depressive disorder, 5 (3.4%) had somatization disorder, 27 (18.2%) had social anxiety disorder, 30 (20.3%) had generalized anxiety disorder, and 4 (2.5%) had panic disorder. One-fourth of the sample were lost at the spring visit, with lost follow-up gradually increasing through the year (34.5%, 39.9% and 54.1% for the summer, autumn and winter visits; respectively). Data were missing at random (Little's MCAR,  $p=1.0$ ). Multi-nomial log linear analysis demonstrated that socio-demographic and clinical features were similar for visit samples (Table 1 and 2). Therefore, no imputations for missing values were attempted. Socio-demographic characteristics are summarized in Table 1 while content of OCD symptoms are summarized in Table 2.

### Associations Between Scores Obtained at Follow-Up and Seasonal Changes Identified by Retrospective Observations of Patients

At initial presentation, patients were asked whether the severity of their symptoms showed any changes with changing seasons. Sixty-four patients (43.2%) stated that their disease is associated with seasonal changes. Subjective seasonality was not associated with loss at follow-up (Table 1). Multivariate analysis of variance for repeated measures showed that patients who reported the experience of seasonal changes did not differ significantly from those who reported no seasonal changes on scores for the Y-BOCS, BAI or BDI, in any of the seasons ( $p=0.22$ , Greenhouse-Geisser correction, Box's  $M=270.4$ ,  $p=0.00$ , Pillai's Trace used).

### Seasonal Influences on Symptoms Based on Prospective Measurements Across one Year

When MANOVA with repeated measures was used to evaluate effects of seasons on psychometric scales; no statistically significant effects were found (Table 3).

**Table 1.** Sociodemographic and clinical features of patients with OCD according to season of visit

% (n)	Baseline	Spring	Summer	Autumn	Winter	P*
Comorbidity	81.1 (120)	77.5 (86)	78.4 (76)	78.7 (70)	77.9 (53)	1.0
Comorbid MDD	41.2 (61)	40.5 (45)	41.2 (40)	40.4 (36)	39.7 (27)	0.99
FH OCD (+)	37.2 (55)	39.6 (44)	40.2 (39)	42.7 (38)	42.6 (29)	0.99
Consanguinity	18.2 (27)	17.1 (19)	15.5 (15)	18.0 (16)	14.7 (10)	0.85
Stressor at onset	69.6 (103)	73.9 (82)	72.2 (70)	68.5 (61)	70.6 (48)	1.0
Stressor in last 6 months	54.7 (81)	55.9 (62)	54.6 (53)	49.4 (44)	54.4 (37)	0.97
Subjective seasonality	41.9 (62)	44.1 (49)	43.3 (42)	44.9 (40)	42.6 (29)	1.0
Limited insight	58.8 (87)	57.7 (64)	56.7 (55)	61.8 (55)	57.4 (39)	1.0
Suicidality	15.5 (23)	15.3 (17)	16.5 (16)	13.5 (12)	13.2 (9)	1.0
Hospitalization	8.1 (12)	9.0 (10)	10.3 (10)	7.9 (7)	7.4 (5)	1.0
Limited social supports	27.0 (40)	27.0 (30)	27.8 (27)	28.1 (25)	27.9 (19)	1.0

\*Multinomial Log-linear test.

MDD: major depressive disorder; FH, family history.

**Table 2.** Obsessions and compulsions of patients with OCD according to season of visit

% (n)	Baseline	Spring	Summer	Autumn	Winter	P*
Obsessions						
Contamination	71.6 (106)	71.2 (79)	70.1 (68)	70.8 (63)	73.5 (50)	<b>0.84</b>
Religious	25.0 (37)	27.9 (31)	28.9 (28)	28.1 (25)	27.9 (19)	<b>0.99</b>
Somatic	15.5 (23)	11.7 (13)	10.3 (10)	13.5 (12)	10.3 (7)	<b>0.95</b>
Sexual	14.9 (22)	12.6 (14)	11.3 (11)	14.6 (13)	11.8 (8)	<b>0.99</b>
Doubt	31.8 (47)	31.5 (35)	33.0 (32)	33.7 (30)	30.9 (21)	<b>1.0</b>
Hoarding	8.8 (13)	7.2 (8)	7.2 (7)	7.9 (7)	5.9 (4)	<b>1.0</b>
Aggression	39.9 (59)	33.3 (37)	34.0 (33)	37.1 (33)	32.4 (22)	<b>0.84</b>
Symmetry	24.3 (36)	19.8 (22)	20.6 (20)	24.7 (22)	16.2 (11)	<b>0.42</b>
Other	0.7 (1)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)	<b>0.99</b>
Compulsions						
Cleaning	69.6 (103)	71.2 (79)	70.1 (68)	71.9 (64)	75.0 (51)	<b>0.70</b>
Control	49.3 (73)	46.8 (52)	48.5 (47)	48.3 (43)	45.6 (31)	<b>0.99</b>
Repeating	37.8 (56)	35.1 (39)	38.1 (37)	37.1 (33)	30.9 (21)	<b>0.67</b>
Hoarding	9.5 (14)	8.1 (9)	7.2 (7)	6.7 (6)	5.9 (4)	<b>1.0</b>
Ordering	23.6 (35)	21.6 (24)	22.7 (22)	22.5 (20)	19.1 (13)	<b>0.99</b>
Listing	5.4 (8)	2.7 (3)	3.1 (3)	4.5 (4)	2.9 (2)	<b>0.96</b>
Reassurance	10.8 (16)	10.8 (12)	10.3 (10)	9.0 (8)	7.4 (5)	<b>0.92</b>
Confession	23.6 (35)	21.6 (24)	20.6 (20)	20.2 (18)	17.6 (12)	<b>0.99</b>

\*Multinomial Log-linear

Based on reliable change criteria (25), reliable change occurred in 24.3%, 27.0% and 30.4% of patients; respectively for the summer– spring, autumn– summer and winter– autumn visits in terms of Y-BOCS Total scores. Rates of reliable deterioration in those visits were 11.5%, 13.5% and 16.9% ; respectively. Clinically significant deterioration in Y-BOCS Total scores occurred in 2.0% of patients (n=3) in spring and 0.7% each (n=1) in summer and winter. None of the patients with OCD displayed clinically significant deterioration in autumn.

As the measurements were nested within individuals, were done at fixed intervals and that list-wise deletion due to attrition may have affected results of MANOVA; we conducted multi-level regression growth models to determine the predictors of variance in Y-BOCS Total scores according to visits. All variables were centered according to their means. Covariance type was specified to allow heteroscedasticity and auto-correlation between measurements. Although the model involving the main effects of BAI, BDI and gender explained more of the variance in residuals; the

**Table 3.** Psychometric evaluations of patients with OCD according to season of visit

Means, S. D.	Baseline (n=111)	Spring (n=111)	Summer (n=97)	Autumn (n=89)	Winter (n=68)	P*
YBOCS- O	9.8±5.1	9.8±5.1	9.7±4.6	9.9±5.5	9.5±4.6	0.71†
YBOCS- C	8.9±5.2	8.9±5.2	8.9±4.8	8.4±5.0	8.9±4.7	0.53
BAI	18.4±13.3	18.4±13.2	17.7±12.8	17.3±12.4	16.4±12.6	0.97†
BDI	16.9±11.5	16.9±11.5	16.7±11.8	15.4±10.9	15.9±10.4	0.70

\*Multi-variate analysis of variance for repeated measures.

†With Greenhouse-Geisser correction.

conditional model including BAI, BDI and their interactions displayed the better fit indices. Addition of subjective seasonality, insight and suicidality deteriorated model fit. Accordingly, the change in Y-BOCS Total z scores for individuals in our sample could be calculated with the equation:

$$Y_{\text{Growth}} = 0.13 + 0.07BAI_z + 0.73BDI_z - 0.15 BDI_{z \times BAI_z}$$

(0.09) (0.06) (0.06) (0.04) (Standard Errors)

## DISCUSSION

As far as we are aware, the present study is the second (13) prospective observational study to investigate seasonal changes in OCD and the first to be conducted on a large sample size. In this single-center, prospective study we found that almost one half of patients with OCD recall seasonal changes in their symptoms while none were found to display seasonal changes in prospective follow-up. Retrospective report of seasonality in symptoms of OCD did not affect the psychometric scores of patients at follow-up. Clinically significant deterioration could be observed in few of the patients and multi-level growth models supported the importance of subjective depressive and anxiety complaints in changes of obsessive-compulsive symptoms.

Previous studies have reported seasonal changes in various disorders, such as recurrent depressive disorder, bipolar disorder, and panic disorder. However, very few studies have been conducted to assess other anxiety disorders. The most commonly used scale in studies of seasonal changes in mental disorders is the Seasonal Pattern Assessment Questionnaire (SPAQ) (27, 28). This self-assessment questionnaire comprises a total of 16 questions. The first 10 questions regard socio-demographic characteristics. The following six questions evaluate mood, social activities, atypical depressive symptoms (e.g. sleep and increased appetite), and energy levels. SPAQ scores from the Netherlands Survey of Depression and Anxiety (NESDA) suggested that patients with depressive, anxiety, or comorbid depressive and anxiety disorders experienced lower mood during the winter and that this increase in low mood was greater than that seen in healthy controls (28). Furthermore, an earlier study by the same authors reported that depressive symptoms (but not anxiety symptoms) are slightly increased in winter in patients with anxiety disorders (6). However, a major limitation of the SPAQ is its reliance on retrospective information. It also does not adequately assess symptoms of anxiety. Moreover, it does not include questions that directly evaluate obsessive or compulsive symptoms (27).

Studies on epidemiological samples with other measures also suggested temporal trends. The HUNT trial recruited 60,995 participants, all of whom were evaluated monthly (except for July) using the Hospital Anxiety and Depression Scale (HADS) (7). It was reported that anxiety and depression comorbidities were the most prevalent in spring and in the month of October, but that levels of anxiety showed no significant differences in any of the seasons. In contrast, Harmatz et al. evaluated

322 healthy individuals in each seasons using the SPAQ and BDI and found that anxiety scores were lowest in the summer but highest in the winter (27). In the Hordaland health study of 11054 participants from the general population, the Global Seasonality Score (a component of the SPAQ) and the HADS revealed significant differences in levels of anxiety and depression depending on the season (29).

Studies on temporal trends in symptoms of patients with OCD have been rare (9, 10, 13, 14). There are limited case reports of patients with OCD displaying seasonal variations in symptoms (9). Also a cross-sectional study from Turkey reported that among a clinical sample of patients with OCD more than half reported seasonal mood changes while those seasonal affective changes did not affect severity of OCD (10). The seasons and sunlight may also affect serotonergic function in the central nervous system, although this effect may not be observed among patients with OCD (11). De Graaf et al. determined that OCD is more prevalent in autumn than summer, but paired comparisons of the prevalence rates in these seasons were not statistically significant (7). Cheng et al. reported that patients with OCD were significantly more likely to be born during August to November and that this effect was more pronounced in males (12). Vitale et al. found that patients with OCD and tics displayed seasonal changes in obsessions and compulsions but not tics. According to their results, OCD symptoms were most severe in autumn and winter. They also reported that Y-BOCS scores of patients with evening-type chronotype were elevated in summer compared to those with morning-type (13). Cox and Olatunji reported that results of studies on circadian and circannual rhythms and OCD are inconsistent but decreased light exposure may increase OCD symptoms and the symptoms may display diurnal variability (14).

We also found no statistically significant changes in OCD symptoms with seasons of visit in our clinical sample, patients reporting seasonality also did not differ in terms of their clinical and sociodemographic features from patients with no report of seasonality. However, with multi-level growth modeling, there was a signal that individual levels of especially depressive and anxious symptoms and their interactions could affect yearly changes in obsessive-compulsive symptoms. This model could explain 52.0% of the seasonal variability in OCD symptoms and three of the five model fit criteria (Table 4) were adequate.

Studies investigating seasonal changes in anxiety disorders have mostly concerned panic disorder and have used cross-sectional retrospective designs. The reliance of previous studies on the recall of participants is a major limitation. Our study overcomes this by investigating clinical presentations prospectively across seasons, carefully monitoring disease severity in each patient in each season. We also compared retrospective data from the patients with prospective data, finding that the two methods obtained differing results. These differences should be considered when interpreting results from previous studies, and should inform the design of future studies of seasonal variations in mental disorders. Our study also

**Table 4.** Model fit for multi-level regression growth models of individual Y-BOCS Total scores according to seasons of visit

Model	Pseudo-R2	-2LL	AIC	AICC	CAIC	BIC
Unconditional	-	1053.7	1061.7	1061.8	1081.6	1077.6
Conditional- BAI	32.0%	946.5	956.5	956.7	981.4	976.4
Conditional- BDI	48.0%	820.5	830.5	830.7	<b>855.4</b>	<b>850.4</b>
Conditional- BAI and BDI	52.0%	819.1	831.1	831.3	860.9	854.9
Conditional- BAI, BDI, BAI X BDI	52.0%	<b>810.6</b>	<b>824.6</b>	<b>825.0</b>	859.4	852.4
Conditional- BAI, BDI and gender	56.0%	827.9	839.9	840.1	869.6	863.6
Conditional, BAI, BDI, BAI X BDI X Gender	52.0%	813.6	827.6	827.9	862.3	855.3
Conditional- BAI, BDI, FH of OCD	52.0%	821.1	835.1	835.4	870.8	862.8

\*Pseud-R2, % of reduction in level one residual variance when unconditional model is compared with the conditional model; -2LL, -2 log likelihood; AIC, Akaike information criteria; AICC, Hurvich and Tsai's criterion; CAIC, Bozdogan's criterion; BIC, Bayesian information criterion, all information criteria except pseudo-R2 is expressed as smaller is better.

provides data in a region with a Mediterranean climate, in which there is a lot of sunlight throughout all the seasons. This is a novel setting because the majority of previous studies have investigated seasonal changes in regions with cold climates (5, 6, 30). In those studies, seasonal variations were more pronounced in colder climates.

### Strengths and Limitations

Our results should be evaluated within their context and limitations. First, the sample was obtained from a single center and does not represent the general population, limiting the generalizability of the results. Future studies of seasonal variations in OCD should consider using multiple sites and/or community samples to increase the representativeness of the sample. Second, socio-demographic data was collected retrospectively and so may be subject to memory bias. Third attrition was high. Fourth assumptions of multi-variate analyses were violated for some of the analyses and compensatory adjustments had to be made (i.e. using Pillai's trace for Box's M). Fifth, using multi-method evaluations of seasonality within our study (i.e. with patient report, with CGI-S scores, with SPAQ etc.) would have strengthened our results. Sixth, we did not evaluate obsessive compulsive symptoms with self-reports. Seventh, we did not evaluate for family history of affective disorders and/or seasonal affective disorder which may be confounders. Eighth, we did not evaluate for the effects of chronotype and past history of tics (13). Ninth, rather than multi-level growth models, time series analysis may have been used in analyses. Lastly, the patients were undergoing naturalistic treatment and this may have affected seasonal changes. However, the patients in the study by Vitale et al. were also undergoing naturalistic treatment and they reported seasonal variations in OCD symptoms.

### CONCLUSION

In conclusion, our data provide no evidence for the existence of seasonal changes in the symptoms of OCD and suggest that the temporal variations may be due to depressive and anxious symptoms. Additionally, the way in which seasonal changes are measured (prospectively or retrospectively, self-report clinician evaluated) as well as "the sampling method" (i. e. clinical vs. community) may influence the results.

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**Informed Consent:** Written informed consent was obtained from all patients or from parents of patients if they were younger than 18 years old.

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