Light upon seasonality
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Abstract

Background: Seasonal changes in mood and behavior are considered to be common in the general population and in patients with psychiatric disorders. However, in several studies this seasonality could not be demonstrated. The present study examined self-attributed seasonality of depressive symptoms among patients with a lifetime diagnosis of a depressive disorder (D), an anxiety disorder (A), a co-morbid depressive and anxiety disorder (DA) and healthy controls (HC).

Methods: The CIDI was used to establish diagnoses according to DSM-IV criteria in 2,168 participants of the Netherlands Study of Depression and Anxiety (NESDA). The Seasonal Pattern Assessment Questionnaire (SP AQ) was administered to assess variation in mood and behavior.

Results: Of the 2,168 participants 53.5% reported seasonality of mood. Highest percentages of low mood were seen in the winter months. Although all groups showed this pattern of lowered mood during the winter months, D, A and DA were significantly (p <0.001) more likely to experience seasonality in this respect. This was also shown for seasonal changes in energy, social activities, sleeping, eating, weight and for the Global Seasonality Score. A limitation of this study was the cross-sectional design.

Conclusions: Seasonal variation in mood and behavior was demonstrated for both participants with a lifetime diagnosis of depression and / or anxiety disorder and for healthy controls, but patients with anxiety and/or depression were more likely to experience this seasonal variation. Clinicians should take into account that the time of the year could influence the feelings of well- and ill-being of their patients.

Introduction

Seasonal changes in mood and behavior are considered to be common in the general population and in patients with psychiatric disorders, and therefore highly relevant to public health [1-4]. On the other hand in several studies seasonal variation in the prevalence of mood disorders in the general population could not be demonstrated [5-7].

Most studies on seasonality of mood and behavior concern seasonal affective disorder (SAD). SAD is a syndrome originally defined as recurrent depressive episodes during autumn and winter and remitting the following spring or summer, for at least two successive years [8]. In the current version of the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) [9] seasonality is added as one of the specifiers to bipolar or recurrent major depressive disorders. Because seasonality of mood and behavior is commonly associated with atypical depressive symptoms, the majority of the studies on this topic focus on atypical depressive symptoms: mood reactivity accompanied by significant weight gain or increase in appetite, hypersomnia, leaden paralysis (i.e. heavy feelings in arms or legs) and interpersonal rejection sensitivity (DSM-IV). The onset of winter SAD typically occurs between 20 and 30 years of age but individuals suffering from it usually have had many episodes before the condition is recognized and treatment sought [10]. Individuals suffering from SAD may look for help in a primary care setting for their unrecognized complaints like decreased activity and fatigue and a wide variety of
other complaints. These patients have a higher consultation rate in winter as compared to individuals without this condition. They receive more prescriptions, undergo more investigations, have more referrals, and suffer from more impairment in functioning as compared to non-seasonal controls in primary care.

Despite the vast body of literature on seasonality and SAD, seasonal variation in the prevalence of mood disorders in the general population could not be demonstrated in a study of de Graaf et al. in the Netherlands using the Composite International Diagnostic Interview (CIDI) nor by Michalak et al. in the United Kingdom, Spain, Finland and Norway, using the Beck Depression Inventory. Posternak and Zimmerman found no seasonal fluctuation in mood disorders in an outpatient psychiatric practice using the Structured Clinical Interview for DSM IV. Magnusson et al. reported on the lack of seasonality in symptoms of anxiety and depression, measured with the Hospital Anxiety and Depression Scale, in the Icelandic population and Blacker et al. found no significant seasonal variation in General Health Questionnaire scores in a primary care population.

In a previous cross-sectional study among patients with depressive and anxiety disorders, we found that seasonal differences in the severity of depressive and anxiety symptoms were absent or relatively small in size of effect. That study measured current symptoms of participants who were recruited in different seasons of the year. An explanation for that finding may be the cross-sectional method of sampling which resulted in the inclusion of different groups of patients in different seasons and thus introduced a source of selection bias. Other explanations may be that the proportion of the respondents with a specific seasonal pattern of their complaints was too small to have an effect on the mean scores of depression or anxiety symptoms in that population. Finally, seasonal mood changes may have been masked by use of medication or other types of treatment.

However, a potentially better way to detect seasonality would be to use a questionnaire that asks for seasonal changes in mood and behavior in the course of a year. The Seasonal Pattern Assessment Questionnaire (SP AQ) is a well-established instrument for this purpose. In this report, we present data concerning self-reported seasonal changes in mood and behavior measured with the SPAQ in participants of the Netherlands Study of Depression and Anxiety (NESDA). We examined potential differences in the seasonality of symptoms between patients with a lifetime diagnosis of a depressive and/or anxiety disorder and healthy controls.

**Methods**

**Sample**

NESDA is an ongoing longitudinal study of a cohort of 2,981 adults aimed at describing the long-term course of depressive and anxiety disorders. The NESDA protocol was approved by the ethical committees of participating universities, and informed consent was obtained from all participants.
Measurements

Sociodemographic and clinical variables

Sociodemographic variables included age, sex, North European ancestry, marital status, years of education, employment status and income.

The CIDI (WHO version 2.1) was used to establish psychiatric diagnoses at baseline according to DSM-IV criteria\(^9\). This was repeated two years later. We used diagnostic data from this second assessment and defined four groups: participants with a lifetime diagnosis of co-morbid depressive and anxiety disorder (DA); participants with a lifetime diagnosis of a depressive disorder (D); participants with a lifetime diagnosis of an anxiety disorder (A); and healthy controls who had no psychiatric diagnosis (HC). Besides the lifetime diagnoses we established the last-month and last-year diagnosis of depressive and anxiety disorder. Actual use of antipsychotic, anxiolytic and antidepressant medication was recorded.

Assessment of seasonality

One year after the baseline measurement, the SPAQ was administered. The SPAQ is a self-rating screening instrument for SAD Seasonal Affective Disorder (SAD) that retrospectively measures variation in mood and behavior by month\(^{[17]}\). The SPAQ was originally designed as a screening instrument for SAD needing a subsequent clinical interview for confirmation of the diagnosis. Kasper et al.\(^{[22]}\) developed criteria to identify respondents who are likely to have SAD, later applied by others\(^{[1,23-26]}\): respondents with a high seasonality score should consider the seasonal changes to be problematic and the changes should occur within a specified timeframe of the year (in general: winter).

The SPAQ provides 12 questions to assess whether, and if so in which month, the participant generally feels worst and best, is most and least socially active, has most and least energy, sleeps most and least, eats most and least, and weighs most and least. The respondents could indicate more than one month. Feeling worst was the primary outcome variable in this study.

This study used the question whether or not the participant generally feels worst during any month of the year as the primary outcome variable. Next, we analyzed in which months of the year participants reported to feel worst.

The Global Seasonality Score (GSS) is a composite measure of the SPAQ that can range from 0 to 24. The GSS is calculated by addition of six-items that measure the degree of seasonal change in mood, sleep, energy, social activity, weight, and appetite. Each item is scored on a Likert scale ranging from (0) “no change”, to (4) “extremely marked change”. The GSS has a good internal consistency and has become a frequently used dimensional measure of seasonality\(^{[18,20,27]}\).

The dates of assessment of the SPAQ were recorded and were categorized into four seasonal categories (spring: March 21 - June 20, summer: June 21 – September 20, autumn: September 21- December 20, winter: December 21 - March 20). We calculated the GSS and determined the season of administration to test whether the season of administration influenced the GSS.
**Statistical analysis**

Discrete and continuous demographic and clinical variables were compared across groups with chi-square tests and analyses of variance (ANOVA). A chi-square test was used to determine whether the groups (D, A, DA vs. HC) responded differently to the question whether they generally feel worst in a particular month of the year.

Analysis started with a comparison of symptom reports between DA versus HC followed by D versus HC and A versus HC. A $\chi^2$-test was used to determine whether DA and HC (D and HC, A and HC respectively) responded differently to the question whether they generally feel worst in a particular month of the year. A two-sided p-value below 0.05 was considered to be significant. Odds ratios (OR) and their 95% confidence intervals (95% CI) were calculated.

Based on the descriptive statistics and the graphic representation of the data, a Generalized Estimating Equations (GEE) logistic regression analysis was chosen to analyze the data. This GEE was used to model the seasonal pattern as a quadratic function of time, and it was used to test whether the quadratic effect was different for the different groups. The GEE model had a two-level hierarchical structure, with the participants assigned to the highest level. The months of the year, considered to be repeated measures, were assigned to the lowest level (12 categories starting with January and ending with December). The dependent variable was the dichotomous variable “usually feeling worst this month of the year”.

As predictors in the model, we included: month (as a continuous variable); the square of month (month$^2$); group (DA/HC, D/HC, A/HC); the interaction between month and group; and the interaction between month$^2$ and group. Both interaction terms were included to test whether seasonal differences in symptoms were consistent across the groups. The Quasi-likelihood under the Independence model
Criterion (QIC) was used to select the best-fitting model. Interaction terms that were not statistically significant at the p< 0.05 level were removed from the model. SPSS version 18.0.3 was used to analyze the data. A two-sided p-value below 0.05 was considered to be significant.

Results

Sociodemographic and clinical variables

The study included 2,430 participants (81.5% of baseline) who completed the SPAQ one year after baseline. Excluded from the analysis were 97 participants who were diagnosed with a bipolar disorder on the two-year follow-up assessment and 165 participants who did not complete the two-year follow-up assessment. This resulted in 2,168 participants with valid data for the present analysis: 1059 DA, 370 D, 247 A, 492 HC.

Sociodemographic and clinical variables of the sample are shown in Table 1. The mean age was 44.9 (SD 13.1) years and was not significantly different across the groups (p = 0.86). Of the respondents, 1477 (68.1%) were women. The mean number of years of education was 13.1 (SD 3.3) years and was not significantly different across the groups (p = 0.86).

Table 1  Sociodemographic and clinical variables

<table>
<thead>
<tr>
<th></th>
<th>HC (n = 492)</th>
<th>D (n = 370)</th>
<th>A (n = 247)</th>
<th>DA (n = 1,059)</th>
<th>Total (n = 2,168)</th>
<th>Testa</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age at baseline (y), mean (SD)</td>
<td>44.5 (14.4)</td>
<td>45.2 (13.1)</td>
<td>44.9 (13.6)</td>
<td>44.9 (12.4)</td>
<td>44.9 (11.1)</td>
<td>F (3, 2,164) = 0.25</td>
<td>.86</td>
</tr>
<tr>
<td>Female, n (%)</td>
<td>307 (62.4%)</td>
<td>242 (65.4%)</td>
<td>164 (66.4%)</td>
<td>764 (72.1%)</td>
<td>1,477 (68.1%)</td>
<td>X² (3) = 16.91</td>
<td>&lt;.01</td>
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<td>North European descent, n (%)</td>
<td>478 (97.2%)</td>
<td>358 (96.8%)</td>
<td>216 (95.5%)</td>
<td>1,004 (94.8%)</td>
<td>2,076 (95.8%)</td>
<td>X² (3) = 5.66</td>
<td>.13</td>
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<tr>
<td>Married (%)</td>
<td>236 (48.0%)</td>
<td>146 (39.5%)</td>
<td>115 (46.6%)</td>
<td>418 (39.5%)</td>
<td>915 (42.2%)</td>
<td>X² (3) = 13.01</td>
<td>&lt;.01</td>
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<tr>
<td>Divorced (%)</td>
<td>39 (7.9%)</td>
<td>66 (17.8%)</td>
<td>28 (11.3%)</td>
<td>185 (17.5%)</td>
<td>318 (14.7%)</td>
<td>X² (3) = 29.66</td>
<td>&lt;.01</td>
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<td>Years of education, mean (SD)</td>
<td>13.3 (3.3)</td>
<td>13.0 (3.3)</td>
<td>12.9 (3.3)</td>
<td>12.2 (3.2)</td>
<td>12.6 (3.3)</td>
<td>F (3, 2,164) = 14.11</td>
<td>&lt;.01</td>
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<tr>
<td>Employment status, n (%)</td>
<td>330 (69.2%)</td>
<td>239 (66.4%)</td>
<td>161 (67.1%)</td>
<td>628 (60.7%)</td>
<td>1,358 (64.3%)</td>
<td>X² (3) = 12.37</td>
<td>&lt;.01</td>
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<tr>
<td>Income &lt; € 800 per month, n (%)c</td>
<td>31 (6.4%)</td>
<td>14 (3.8%)</td>
<td>10 (4.1%)</td>
<td>44 (4.2%)</td>
<td>99 (4.6%)</td>
<td>X² (3) = 4.54</td>
<td>.21</td>
</tr>
<tr>
<td>Income &lt; € 1,400 per month, n (%)c</td>
<td>75 (15.4%)</td>
<td>64 (17.4%)</td>
<td>48 (19.7%)</td>
<td>233 (22.3%)</td>
<td>420 (19.6%)</td>
<td>X² (3) = 11.19</td>
<td>.01</td>
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<td>Psychopathology last year</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Major depressive disorder, n (%)</td>
<td>0 (0.0%)</td>
<td>88 (23.8%)</td>
<td>0 (0.0%)</td>
<td>431 (42.0%)</td>
<td>519 (29.3%)</td>
<td>X² (3) = 395.96</td>
<td>&lt;.01</td>
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<tr>
<td>Dysthymia, n (%)</td>
<td>0 (0.0%)</td>
<td>16 (4.3%)</td>
<td>0 (0.0%)</td>
<td>170 (16.1%)</td>
<td>186 (8.6%)</td>
<td>X² (3) = 153.31</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Social Phobia, n (%)</td>
<td>0 (0.0%)</td>
<td>0 (0.0%)</td>
<td>36 (14.6%)</td>
<td>258 (24.4%)</td>
<td>294 (13.6%)</td>
<td>X² (3) = 240.86</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Panic disorder with agoraphobia, n (%)</td>
<td>0 (0.0%)</td>
<td>0 (0.0%)</td>
<td>16 (6.5%)</td>
<td>94 (8.9%)</td>
<td>110 (5.1%)</td>
<td>X² (3) = 78.88</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Panic disorder without agoraphobia, n (%)</td>
<td>0 (0.0%)</td>
<td>0 (0.0%)</td>
<td>20 (8.1%)</td>
<td>112 (10.6%)</td>
<td>132 (6.1%)</td>
<td>X² (3) = 94.93</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Agoraphobia, n (%)</td>
<td>0 (0.0%)</td>
<td>0 (0.0%)</td>
<td>21 (8.5%)</td>
<td>111 (10.5%)</td>
<td>132 (6.1%)</td>
<td>X² (3) = 94.15</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Generalized anxiety disorder, n (%)</td>
<td>0 (0.0%)</td>
<td>0 (0.0%)</td>
<td>8 (3.2%)</td>
<td>161 (15.2%)</td>
<td>169 (7.8%)</td>
<td>X² (3) = 160.86</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Psychopathology last month</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Major depressive disorder, n (%)</td>
<td>0 (0.0%)</td>
<td>34 (9.2%)</td>
<td>0 (0.0%)</td>
<td>223 (21.1%)</td>
<td>257 (13.9%)</td>
<td>X² (3) = 187.74</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Dysthymia, n (%)</td>
<td>0 (0.0%)</td>
<td>11 (3.0%)</td>
<td>0 (0.0%)</td>
<td>137 (12.9%)</td>
<td>148 (6.8%)</td>
<td>X² (3) = 124.94</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Social Phobia, n (%)</td>
<td>0 (0.0%)</td>
<td>0 (0.0%)</td>
<td>30 (12.1%)</td>
<td>207 (19.5%)</td>
<td>237 (10.9%)</td>
<td>X² (3) = 186.89</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Panic disorder with agoraphobia, n (%)</td>
<td>0 (0.0%)</td>
<td>0 (0.0%)</td>
<td>12 (4.9%)</td>
<td>73 (6.9%)</td>
<td>85 (3.9%)</td>
<td>X² (3) = 60.59</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Panic disorder without agoraphobia, n (%)</td>
<td>0 (0.0%)</td>
<td>0 (0.0%)</td>
<td>11 (4.5%)</td>
<td>69 (6.5%)</td>
<td>80 (3.7%)</td>
<td>X² (3) = 57.22</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Agoraphobia, n (%)</td>
<td>0 (0.0%)</td>
<td>0 (0.0%)</td>
<td>12 (4.9%)</td>
<td>81 (7.6%)</td>
<td>91 (4.3%)</td>
<td>X² (3) = 67.93</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Generalized anxiety disorder, n (%)</td>
<td>0 (0.0%)</td>
<td>0 (0.0%)</td>
<td>7 (2.8%)</td>
<td>117 (11.0%)</td>
<td>124 (5.7%)</td>
<td>X² (3) = 111.87</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Medication use</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use of antipsychotic drug, n (%)</td>
<td>0 (0.0%)</td>
<td>4 (1.1%)</td>
<td>1 (0.4%)</td>
<td>19 (1.8%)</td>
<td>24 (1.1%)</td>
<td>X² (3) = 11.19</td>
<td>.01</td>
</tr>
<tr>
<td>Use of anxiolytics drug, n (%)</td>
<td>0 (0.0%)</td>
<td>10 (2.7%)</td>
<td>24 (9.7%)</td>
<td>120 (11.3%)</td>
<td>159 (7.5%)</td>
<td>X² (3) = 67.54</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Use of antidepressant drug, n (%)</td>
<td>0 (0.0%)</td>
<td>57 (15.4%)</td>
<td>32 (13.0%)</td>
<td>367 (34.7%)</td>
<td>462 (21.3%)</td>
<td>X² (3) = 248.87</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Global seasonality score, mean (SD)</td>
<td>2.8 (2.6)</td>
<td>4.8 (3.7)</td>
<td>3.9 (3.3)</td>
<td>5.9 (4.1)</td>
<td>4.8 (3.9)</td>
<td>F (3, 2,164) = 86.14</td>
<td>&lt;.01</td>
</tr>
</tbody>
</table>

aBased on Chi-square test for categorical variables and ANOVA for continuous variables.

bN = 2,112.

cN = 2,145.

dN = 2,150.
(68.1%) were female with the highest percentage in the DA group (72.1%) (p<0.01). Other significant group differences were found concerning marital status (p<0.01), years of education (p<0.01), employment status (p<0.01), and income of less than €1400 per month (p<0.01).

A Major Depressive Disorder during the last year was diagnosed in 40.7% of DA and 23.8% of D. Dysthymia during the last year was diagnosed in 16.1% of DA and in 4.3% of D. Social phobia during the last year was diagnosed in 24.4% of DA and in 14.6% of A. Panic disorder with agoraphobia, panic disorder without agoraphobia and agoraphobia without panic were present during the last year in 8.9%, 10.6% and 10.5% of DA and in 6.5%, 8.1% and 8.5% of A. Generalized anxiety disorder during the last year was diagnosed in 15.2% of DA and in 3.2% of A.

**Seasonality of symptoms**

Of the 2,168 participants, 53.5% reported that they generally felt worst in a particular month of the year: for HC and DA this was 29.9% and 65.0% respectively. DA were more likely to feel worst in a particular month of the year than HC with an odds ratio (OR) of 4.35 (95% confidence interval (CI) 3.45 – 5.48; X2(1) = 166.4, p < 0.001). The odds ratio for D versus HC was 2.85 (95% CI 2.15 – 3.78) and for A versus HC 2.29 (95% CI 1.67 – 3.14).

**Figure 1** shows the percentages of participants who reported to feel worst per in a specific month. This percentage was high from November through February, intermediate in October and March and low from April through September. The same picture was found for the items: having least energy, being least socially active, sleeping most, eating most and weighing most. An inverse picture was found for the items that asked for the months in which participants usually felt best, ate least, weighed least, slept least, were most social active and had most energy.

A first-order autoregressive correlation structure fitted the data best in the GEE analysis including the predictor variables DA and HC. The interaction between month and group, and the interaction between month2 and group were not significant. Removing these variables did not worsen model fit according to the QIC. The three predictor variables were highly significant (p < 0.001) in the final model: Bmonth = -1.09 (95% CI -1.16 – -1.03); Bmonth2 = 0.08 (95% CI 0.08 – 0.09); BDA = 1.26 (95% CI 1.05 – 1.47) (HC = reference). Thus, the GEE analyses confirmed that the seasonal pattern can be described as a quadratic curve. This quadratic curve was also confirmed for D and A (data not shown).

According to the non-significance of the interaction terms, the strength of the curvature was not different for the different groups. This means that in all groups the number of respondents that felt worst during a certain month showed a curvilinear relationship with time, with the minimum of the parabola in the midst of the months June – July, the highest numbers during the winter months and no group difference in the form of the parabola. Transformation of the B for group to an OR (exp B) showed that the DA were more likely to feel worst in a particular month than HC (OR: 3.52; 95% CI 2.86 – 4.33). The OR was 2.41 (95% CI 1.89 – 3.07) for D versus HC and 2.07 (95% CI 1.58 – 2.73) for A versus HC.
Global Seasonality Score

The Global Seasonality Score could be calculated for 2150 participants in the four groups (table 1). The grand mean GSS was 4.8 (SD 3.9) with significant differences between the groups: F(3, 2164) = 86.1, p < 0.01. DA scored highest with a mean GSS of 5.9 (SD 4.1), followed by D (4.8, SD 3.7), A (3.9, SD 3.3) and with a lowest mean score for HC (2.8, SD 2.6).

The date of administration was recorded for 1699 participants. The mean GSS in spring was 5.1 (SD 3.9), in summer 4.4 (SD 3.5), in autumn 4.5 (SD 3.7) and in winter 5.5 (SD 4.1). There was a significant difference in GSS between the seasons: F (3, 1695) = 8.4, p < 0.001. Post-hoc analysis with a Bonferroni correction showed that there was a significant difference in mean GSS between summer and spring (p=0.043), summer and winter (p <0.001), and autumn and winter (p=0.001).
Discussion

This study clearly showed the existence of seasonal variation in depressive symptoms in patients with depressive and anxiety disorders and healthy controls. We compared the months of the year by assessing the presence or absence of symptoms for every month of the year within all participants, retrospectively. Using this method we could demonstrate a clear seasonal pattern in mood and behavior and showed that 30-65 percent of the participants felt worst in a particular month of the year, mostly in the winter months.

A, DA and DA were in ascending order more likely to feel worst in a particular month compared to HC. This finding is in line with the study of Mersch et al.\cite{20} who found more seasonal variability in mood for depressed outpatients as compared to non-depressed outpatients and normal controls.

These results are in contrast to our earlier study in which we did not find a clear seasonal variation in depressive and anxiety symptoms\cite{16}. An explanation for this might be that in our previous study seasonal variation in severity of symptoms was missed because a comparison was made between different participants who were included in successive months of the year and were measured once. Thus, seasonal variation within individuals was not assessed in that study.

The GSS, a composite measure of six items of seasonality in mood and behavior, showed a picture similar to the item of feeling worst in a particular month, with lowest scores for HC, followed by A, D, and highest scores for DA. These results are in line with the findings of Hardin et al.\cite{29}, who reported higher GSS for respondents with a major affective disorder compared to healthy controls. However in that study the mean GSS of the patients with a major depressive disorder was lower than for patients with SAD and they concluded that patients with a major depression or dysthymia were not more seasonal than normal controls.

The season of administration significantly influenced the GSS in this study. The GSS was lowest for those participants who completed the questionnaire in summer and highest for those who did this in winter, with intermediate scores in spring and autumn. This finding is in line with the study of Lund and Hansen\cite{30} who administered the SPAQ in the four different seasons to the same subjects and found highest GSS in March en lowest GSS in September. In a prevalence study of SAD in the general population in the Netherlands Mersch et al.\cite{1} also found higher GSS when the SPAQ was completed between December and May (winter and spring) than between June and November (summer and autumn). Contrary to these results Hardin et al.\cite{29} did not find a significant difference between GSS obtained during the spring and summer and those obtained during the fall and winter in a winter SAD group, patients with an eating disorder and healthy controls. Finally, Rohan et al.\cite{31} found no differences between initial and 3-month follow-up GSS in a student sample.

Although we assessed seasonal fluctuation in symptoms of mood and behavior in both depressed and anxious patients, we did not assess seasonal variation in symptoms of anxiety. The number of studies on seasonal variation in anxiety disorders and specific anxiety symptoms is limited. In a Dutch study
in the General population de Graaf et al.[5] found a small seasonal variation in the prevalence of anxiety disorders: a prevalence of 8.9% (summer) vs. 10.9% (winter) for the total group of anxiety disorders. This figure was 1.1% (summer) vs. 2.5% (winter) for panic disorder and 0.7% (summer) vs. 1.8% (winter) for generalized anxiety disorder. In a sample of patients who were treated for panic attacks Marriot et al.[32] found seasonal changes in anxiety and panic attacks. In his study the items anxiety and panic were highly correlated (0.68 resp. 0.58) to the GSS. Othani et al.[33] found peaks of panic attacks in August and December in a sample of Japanese outdoor patients suffering from panic attacks.

Limitations

A limitation of this study is that mood and behavior were not measured longitudinally within the same individual at different moments during the year. Seasonal variation in the prevalence and severity of symptoms and clinical syndromes is a longitudinal phenomenon by nature and therefore repeated measures within individuals (longitudinal data collection) are more suitable for assessing this condition than cross-sectional methods.

Although the NESDA study provides repeated measures by design, the diagnostic interviews generally took place in successive years but within the same season for each participant. The small number of repeated measurements and the lack of variation in the season of assessment within individuals provided insufficient data for a longitudinal analysis of the seasonality of symptoms within the individuals. As second best to the method of repeated measures we used the SPAQ.

A second limitation was that the SPAQ questionnaire is a self-report form that measures seasonality retrospectively, which makes it vulnerable to recall bias.[34].

A limitation of the SPAQ is its vulnerability to recall bias because it is a self-report questionnaire that measures seasonality of mood and behavior retroactively over the course of the year.[34].

Clinical implications

A practical implication of this study is that clinicians should take into account that the time of the year influences the feelings of well- and ill-being and may result in a seasonal increase in depression-specific health service use.[20,35-37]. This means that for patients who present themselves with seasonal fluctuation of physical and emotional complaints like fatigue, sleepiness and depressed mood, the diagnosis of SAD should be considered and adequate treatment should be installed.[38]. For patients with a depressive disorder who suffer from a worsening of symptoms in autumn and winter, treatment with light therapy or changes in medication (either dose adjustment or switch to another antidepressant) should be considered.[39,40].
Conclusions
In this study we found a clear seasonal variation in mood and behavior among participants with depressive and anxiety disorders and healthy controls. Fifty three-four percent of the participants reported that they usually feel worst in a particular month of the year, with highest percentages in the winter months. Participants with anxiety and/or depressive disorder were more likely to experience seasonal fluctuation in mood and behavior than healthy controls.

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