# Seasonality of Birth in Seasonal Affective Disorder

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***Background:*** Season of birth or seasonal changes in putative etiologic factors are thought to influence the development of several psychiatric illnesses. The aim of this investigation was to examine seasonal differences in the frequency of birth in a clinical sample of patients with seasonal affective disorder (SAD).

***Method:*** 553 outpatients suffering from SAD—DSM-IV–defined depressive disorder with winter-type seasonal pattern—who had been diagnosed and treated at the Department of General Psychiatry (University of Vienna, Austria) between 1994 and 2003, were included in this evaluation. We compared the observed number of births in our sample with expected values calculated from the general population.

***Results:*** There was a significant deviation of the observed number of births from the expected values calculated on a monthly basis (p = .009). When comparing quarters (periods of 3 months), we found fewer births than expected in the first quarter of the year and a slight excess of births in the second and third quarters (p = .034). There were also more births in the spring/summer season and fewer than expected in fall and winter (p = .029). Interestingly, patients with melancholic depression were more frequently born in fall/winter and less often in spring/summer compared with patients with atypical depression (p = .008).

***Conclusion:*** Besides genetic factors, season of birth or seasonal changes in environmental factors also could influence the development of SAD. In addition, birth effects seem to be dependent on the symptom profile of the patients, but further studies are needed to elucidate the underlying mechanisms of these observations.

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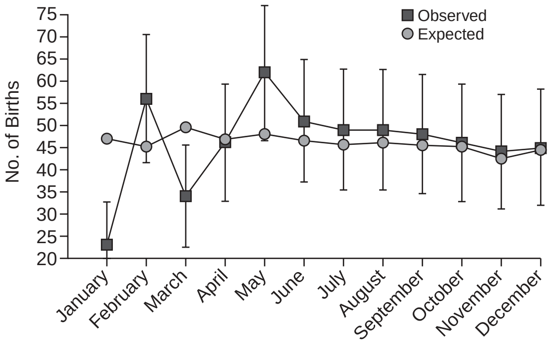
Several investigations have suggested that season of birth may play an important role in the development of mental disorders.[1,2] More than 250 studies have been published on the birth seasonality of individuals with schizophrenia. Despite methodological problems, these studies are remarkably consistent in showing a birth excess during winter and early spring,[3] which has often been hypothesized to be the result of a prenatal infection adversely affecting the maturation of critical brain structural and functional components.[4]

Findings about birth seasonality in individuals with mood disorders have been rather inconsistent, which can probably be attributed to the heterogeneity of the study populations. Dalen[5] found no significant seasonal deviation in a sample of 14,566 individuals with manic-depressive psychosis or involutional melancholia, and other reports have also been negative.[6–8] However, some studies with large sample sizes have been able to demonstrate a winter or spring excess of births.[9–13]

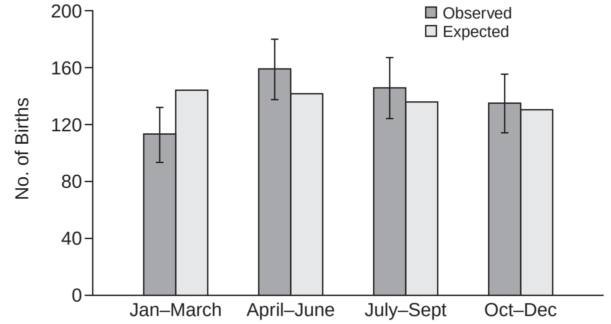
To our knowledge, there is no published scientific investigation on seasonality of birth in seasonal affective disorder (SAD). SAD, which is also called *fall-winter depression*, is defined as a form of recurrent depressive or bipolar affective disorder characterized by affective episodes that occur annually at the same time of the year.[14] The aim of this investigation was to examine seasonal differences in the frequency of birth in a clinical sample of SAD patients.

**Figure 1. Observed and Expected Number of Births for Each Month in a Sample of 553 Patients With Seasonal Affective Disorder[a]**




[a]A correction for different lengths of months has been applied to the data. Bars represent 95% confidence intervals for the observed numbers of births. $\chi^2$ = 24.910, df = 11, p = .009.

**Figure 2. Observed and Expected Number of Births for Each Quarter of the Year in a Sample of 553 Patients With Seasonal Affective Disorder[a]**




[a]A correction for different lengths of quarters has been applied to the data. Bars represent 95% confidence intervals for the observed numbers of births. $\chi^2$ = 8.701, df = 3, p = .034.

## METHOD

Five hundred fifty-three outpatients (426 women, 127 men) suffering from SAD, winter type, who had visited the outpatient clinic for SAD at the Department of General Psychiatry (University of Vienna, Austria) between 1994 and 2003, were included in this evaluation. Patients were diagnosed with depressive disorder with winter-type seasonal pattern according to the *Diagnostic and Statistical Manual of Mental Disorders*, Fourth Edition (DSM-IV) of the American Psychiatric Association.[15] Subjects had to obtain a Global Seasonality Score (GSS) measured by the German version of the Seasonal Pattern Assessment Questionnaire[16,17] of 10 or higher. Subjects with subsyndromal SAD[18] were excluded from this evaluation. The mean ± SD GSS in our sample was 15.7 ± 3.2. Mean year of birth was 1959.2. Among these patients, 77.4% were diagnosed with unipolar depression, 20.1% with bipolar II disorder, and 2.2% with bipolar I. Three hundred seventy-eight patients (68.4%) fulfilled the DSM-IV criteria for the atypical features specifier, and 72 patients (13.0%) were diagnosed with melancholic depression.

For comparison, monthly birth data of the general population were obtained from Austria's governmental statistics. Our sample mainly comprised patients from the Viennese population, so we compared the observed number of births in our sample with expected values calculated from all 414.185 births between 1951 and 1975 in Vienna (mean year of birth: 1963.7). Expected proportions of monthly births from January to December were 8.5%, 8.2%, 9.0%, 8.5%, 8.7%, 8.4%, 8.3%, 8.3%, 8.2%, 8.1%, 7.6%, and 8.1%. We performed our analysis on a monthly basis but also grouped the data and made calculations on the basis of quarters (January–March, April–June, July–September, and October–December) and halves (April–September, October–March) of the year. Our definition of halves of the year was based on the daily duration of sunshine in Vienna (16° 19' eastern longitude and 48° 12' northern latitude), which is longest from April to September (spring/summer, 6.9 hours per day) and shortest from October to March (fall/winter, 2.8 hours per day) as compared with all other 6-month periods.

Our primary hypothesis was a difference between the distribution of births of our sample and the general population. Secondary hypotheses included a deviation on the basis of quarters and halves of the year as well as differences between the atypical and melancholic features specifiers, the clinical subtypes and the general population, and patients with unipolar depression and bipolar disorder. Statistical analysis was carried out with SPSS for Windows[19] using Pearson $\chi^2$ test. The $p \leq .05$ level of significance was adopted; no Bonferroni correction was applied. All statistical comparisons were 2-tailed.

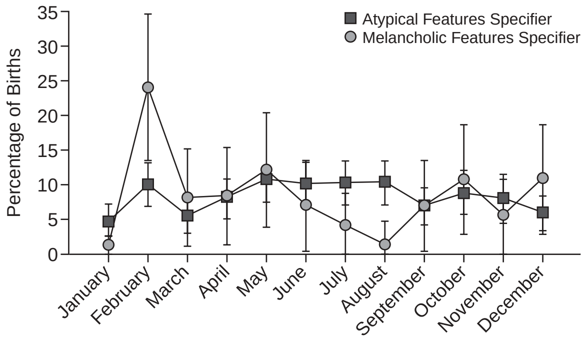
## RESULTS

The analysis of our data indicates that there was a significant deviation of the observed number of births from the expected values calculated on a monthly basis ($\chi^2$ = 24.910, df = 11, p = .009) (Figure 1). When comparing quarters (Figure 2), we found fewer births than expected in the first quarter of the year (–20.5%) and an excess of births in the second (+12.3%) and third quarters (+6.2%; $\chi^2$ = 8.701, df = 3, p = .034). There were also more births than expected in the spring/summer season (+9.3%) and fewer than expected in fall and winter (–9.5%; $\chi^2$ = 4.791, df = 1, p = .029).

We found differences between the distribution of births of the different clinical subtypes of SAD; patients who had been diagnosed as suffering from melancholic depression exhibited a different pattern of birth than patients with atypical depression (calculation on the basis of

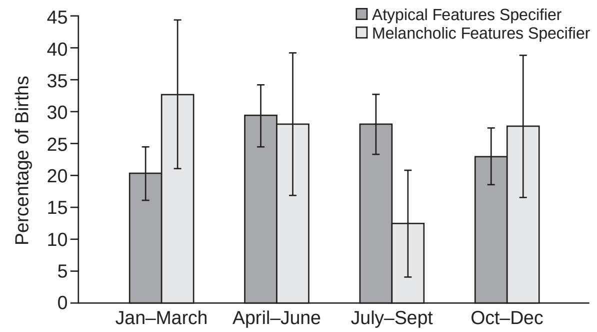
  

Figure 3. Season of Birth in Patients With the Atypical (N = 378) and Melancholic (N = 72) Features Specifier According to DSM-IV[a]




[a]Bars represent 95% confidence intervals. A correction for different lengths of months has been applied to the data. $\chi^2$ = 23.450, df = 11, p = .015.

Figure 4. Season of Birth in Patients With the Atypical (N = 378) and Melancholic (N = 72) Features Specifier According to DSM-IV[a]




[a]Bars represent 95% confidence intervals. A correction for different lengths of quarters has been applied to the data. $\chi^2$ = 10.398, df = 3, p = .015.

months: $\chi^2$ = 23.450, df = 11, p = .015) (Figure 3). Melancholic patients had higher birth rates in the first quarter (31.9% vs. 19.8%) and lower rates in the third quarter (12.5% vs. 28.0%; $\chi^2$ = 10.398, df = 3, p = .015) (Figure 4). Accordingly, compared with patients with atypical depression, melancholic patients were born more frequently in fall/winter (59.7% vs. 42.9%) and less often in spring/summer (40.3% vs. 57.1%) ($\chi^2$ = 6.936, df = 1, p = .008).

Based on these findings, we analyzed differences between the clinical subtypes and the general population: for monthly data, there was a significant deviation from the expected figures for both the atypical ($\chi^2$ = 22.613, df = 11, p = .020) and the melancholic subtypes ($\chi^2$ = 30.703, df = 11, p = .001). Moreover, we found fewer births in the first quarter (–22.8%) and a birth excess in the second (13.6%) and third quarters (12.8%) for atypical depression ($\chi^2$ = 8.455, df = 3, p = .037). Consequently, patients with atypical depression had higher birth rates than expected in spring/summer (+11.7%) and lower rates in the fall/winter season (–15.6%; $\chi^2$ = 6.673, df = 1, p =.010). The number of subjects in our melancholic subgroup was too small to yield statistically significant results when we performed the calculation on the bases of quarters ($\chi^2$ = 6.151, df = 3, p = .105) and seasons ($\chi^2$ = 3.010, df = 1, p = .083). We also observed no differences in the monthly distribution of birth dates of patients suffering from unipolar depression and bipolar affective disorder ($\chi^2$ = 13.694, df = 11, p = .250).

## DISCUSSION

The present study is the first one to examine seasonal variations of birth rates in patients suffering from SAD in relation to the general population and thus contributes to the literature on seasonality of birth in affective disorders. Based on the analyses conducted, a seasonal effect was detected, yielding fewer births than expected in the first quarter and a birth excess in the second and third quarters of the year.

Interestingly, patients with different clinical subtypes exhibit quite different patterns of birth. To our knowledge, there are no studies in affective disorders that have investigated the relationship between the DSM-IV melancholic and atypical features specifiers and the season of birth. Our results in patients with seasonal melancholic depression are similar to the findings in patients with schizophrenia and bipolar disorder and show high birth rates in February and diminished rates from June to August. However, patients with atypical depression have rather inverted birth characteristics, with low birth rates in winter and a birth excess in spring and summer. These findings would suggest that SAD patients with different clinical subtypes differ also in regard to some yet-unknown etiopathologic factor.

Regarding the magnitude of the winter/spring birth excess in birth seasonality studies in schizophrenia and bipolar disorder conducted to date, the magnitude consistently ranges between 5% and 8% in the larger studies,[3,20,21] whereas in studies with smaller sample sizes, the magnitude of the birth excess is more variable. Compared with these figures, the magnitude of the birth seasonality effect in our sample seems to be quite large: we have found a deficit of births of nearly 20% in the first quarter. When looking at the different clinical subtypes, the highest birth rate in February was 2.8-fold higher than expected for melancholic depression (22.2% of all melancholic patients); in the first quarter, there was a birth deficit of 21.6% and a surplus of 26.4% for atypical and melancholic depression, respectively. In the third quarter, our subsample of melancholic patients yielded more than 50% fewer births than expected (only 1.4% of all melancholic patients were born in August).

Several explanations have been proposed for the phenomenon of birth seasonality. It has been widely accepted[3] that it is not a mere statistical artifact[22] or an exaggeration of normal seasonal birth curves.[23] It has been postulated that seasonality of birth is due to an idiosyncratic seasonal conception pattern of the parents of psychiatric patients. Some reports have indeed supported the hypothesis of special procreational habits,[24,25] but there are also negative findings.[26–28] The conception dates (266 mean days prior to birth) for atypical patients in our sample do not correspond very well to the time of fall/winter depression and spring hypomania. However, if we look at the data for melancholic depression (Figure 3), the peak in February corresponds very well to a conception date in May or June and the nadir in August to very low parental sexual activity in November and December, which has been described as the time of feeling worst for SAD patients in middle Europe.[29]

A variety of genetic hypotheses have been offered to explain the seasonal birth patterns of patients with schizophrenia and bipolar disorder. In individuals with genes predisposing to certain psychiatric disorders, a seasonally varying factor might increase the risk of fetal loss or, on the other hand, may be associated with increased robustness of pregnancy.[30,31]

Some studies have reported that later development of schizophrenia is associated with an increased number of pregnancy and birth complications.[32,33] As these complications are in part also seasonal in nature, it has been speculated that "the excess proportion of births during the early months of the year might have been due to prematurity."[9(p1170)]

Since it is known that the developing nervous system is sensitive to minor changes in its chemical environment, it has been postulated that seasonal variations in external toxins[34–36] or nutritional deficiencies[5,37] might be responsible for the winter/spring birth excess in schizophrenia. However, the nutritional deficiency hypothesis would predict that the seasonality of births was more pronounced in developing countries or at the beginning of the 20th century, when nutrition was less adequate, but the data that exist[3] do not appear to support either of these assumptions.

Several researchers have postulated that the birth seasonality observed in schizophrenia and bipolar disorder might be caused by variations in (maternal) internal chemistry or neural development brought about by seasonal changes in the photoperiod.[38,39] It is known from animal experiments (rearing of study creatures in constant darkness or constant light) that light influences the functional properties of cortical neurons and that light imprinting is essential for a normal postnatal neuronal development.[40,41] Possibly, environmental light shortly after birth has a formative influence on the individual vulnerability for the development of certain psychiatric disorders.[42] This individual vulnerability may also be dependent on genetic factors, such as the serotonin transporter gene *5-HTTLPR* polymorphism.[43]

Temperature and weather effects have been proposed as further causes for the seasonality of birth: attempts to correlate temperature at birth or during pregnancy with the birth pattern in schizophrenic patients have met mixed success: Hare and Moran,[44] Kinney et al.,[45] and Bark and Krivelevich[46] have been able to demonstrate a significant relationship between the rate of birth of individuals with schizophrenia and weather conditions, whereas other authors[47–49] found no association.

Infectious agents, which have seasonal variations in their incidence, have been a popular explanation for the birth seasonality in psychiatric disorders. Viruses have been especially well studied in this regard.[50] Fourteen studies have found a link between in utero exposure to influenza and later development of schizophrenia, whereas 5 others have been negative.[51] Watson et al.,[48] Torrey et al.,[52] and O'Callaghan et al.[53] have been able to show a correlation between schizophrenia births and the incidence of several infectious diseases, including diphtheria, pneumonia, influenza, measles, polio, varicella zoster, and bronchopneumonia.

Finally, when considering possible causes of the seasonality of birth in psychiatric disorders, it should be remembered that there may be an interaction between the factors mentioned above. There have also been speculations about a "2-hit" hypothesis in which certain psychiatric disorders might be predisposed by a seasonally varying factor and then precipitated many years later by another (nonseasonal) factor.[3]

As for the limitations of our study, it should be kept in mind that the sample under consideration was not a representative cross-section of the general population, but comprised patients who were seeking help at our outpatient clinic. This makes a selection bias possible but rather unlikely. Furthermore, our patient sample is quite small as compared with those of other published reports on birth seasonality. Nevertheless, it represents one of the largest samples yet published for SAD.[29] Moreover, we were not able to control for immigration and emigration in the selection of patients and controls. In fact, it is possible that migration could have influenced our results to some extent. We were also limited to using months as the basis of our analysis because only monthly birth data were available for the general population. Finally, it was impossible to obtain the birth data of the general population before 1951, so the mean year of birth in our sample and in the general population could not be matched exactly. This is a possible limitation of our study because the monthly birth distribution could have been different before and after 1951.

In conclusion, in a European patient sample with SAD, we found a birth excess in spring and summer as well as a lack of births in the first quarter of the year, especially for patients with atypical depression. Patients with melancholic depression, on the other hand, showed a marked birth excess in February and reduced birth rates in summer. Possible explanations for these findings are subject to speculation and must be ascertained in further investigations.

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