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ORIGINAL PAPER

Edda Pjrek · Dietmar Winkler · Nicole Praschak-Rieder · Matthäus Willeit · Jürgen Stastny
Anastasios Konstantinidis · Siegfried Kasper

Season of birth in siblings of patients with seasonal affective disorder

A test of the parental conception habits hypothesis

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Abstract Recently we have published a report on seasonally varying birth rates in 553 patients with seasonal affective disorder (SAD). The present study is aimed to test the hypothesis of an idiosyncratic seasonal conception pattern of the parents of these patients to explain this phenomenon. We conducted a telephone interview with the patients to obtain information on the birth data of their siblings. Using the method of chart review to acquire information on the family history of our patients, we excluded those siblings with psychiatric disorders. We first compared the birth months and the quarters of birth of 435 healthy siblings with the general population. Secondly, we compared the birth distribution of the index SAD patients with that of their siblings. There was a significant deviation between the birth distribution of the siblings and the general population calculated on a monthly basis ($p = 0.044$). When comparing quarters we found less births than expected in the first (−14.1%) and fourth quarter of the year (−15.1%) and an excess of births in the second (+7.7%) and third quarter (+21.1%; $p = 0.018$). There were no significant differences between the group of SAD patients and their siblings regarding their birth patterns as calculated by months ($p = 0.848$) or quarters ($p = 0.320$). Our study provides support for the hypothesis of specific parental conception habits underlying the birth seasonality in SAD. Further research could be conducted in non-seasonal depression as there is still a lack of studies on seasonality of birth in affective disorders.

Key words seasonal affective disorder · fall-winter depression · mood disorder · seasonality · birth date

E. Pjrek, MD (✉) · D. Winkler, MD · N. Praschak-Rieder, MD
M. Willeit, MD · J. Stastny, MD · A. Konstantinidis, MD
S. Kasper, MD
Department of Psychiatry and Psychotherapy
Medical University of Vienna
Währinger Gürtel 18-20
1090 Vienna, Austria
Tel.: +43-1/40400-3568
Fax: +43-1/40400-3099
E-Mail: edda.pjrek@meduniwien.ac.at

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Introduction

Seasonal deviations of birth rates of psychiatric and neurological patients from the general population have repeatedly been reported in the scientific literature [6, 14, 28, 36]. An excess of 5–8% of winter-spring births in individuals who later develop schizophrenia has been particularly well described [8, 23]. Reports on birth seasonality in affective disorders have been far less consistent [35]. Recently, we have reported on seasonality of birth in a sample of patients with seasonal affective disorder (SAD; fall-winter depression) [26]: We found a birth excess in spring and summer as well as a lack of births especially in the first quarter of the year. The underlying etiological mechanisms for the phenomenon of seasonally varying birth rates in patients with psychiatric disorders remain speculative until now. The most frequently offered interpretation is that season-related factors may have a deleterious effect on the developing nervous system, thus increasing the risk for psychiatric disorders [4, 33]. An alternative explanation is that parents of the patients have an unusually strong tendency to conceive their children during a certain time of the year [3, 12]. This phenomenon might be caused by parental psychiatric morbidity (especially mood disorders) resulting in seasonal fluctuations of their sexual behavior or another biological mechanism, which controls fertility and is tied to the genetic liability to SAD.

There exist only few published articles on the procreational patterns of parents of psychiatric patients and to our best knowledge no study has yet

been performed on this topic in SAD. The aim of this investigation was to examine, if the birth distribution of unaffected siblings of SAD patients resembled the birth pattern of the index patients more than that of the general population, which would lend support to the conception habits interpretation. Specifically we hypothesized a priori that the birth data of the siblings would be different from the general population, while there would be no significant differences between the SAD patients and their healthy siblings.

Methods

Study subjects

We sought to conduct a telephone interview with 553 SAD patients to obtain information on the birth data of their siblings. These SAD patients (mean year of birth: 1959.2), who had visited the outpatient-clinic for SAD at the Department of General Psychiatry (Medical University of Vienna, Austria) between 1994 and 2003, had been diagnosed according to the Diagnostic and Statistical Manual of Mental Disorders, 4th edition (DSM-IV) [1], and have already been described before [26]. Subjects with subsyndromal SAD [17] were excluded from this study. 166 patients could not be reached by phone, 13 patients refused to participate in the study, and 2 patients had already died. We employed measures to ensure a high reliability of the sampled data: 34 out of 372 cases were eliminated from the evaluation, because patients were not able to remember the full set of birth data of their siblings. Of the remaining 338 cases, who were classified as reliable, 267 patients had at least one sibling. The average number of siblings per patient (mean ± SD) was 1.6 ± 1.5. Furthermore, we performed a chart review of our SAD patients to obtain information on their family history: Of a total of 536 siblings, we excluded 101 siblings (18.8%) with known psychiatric disorders from further analyses. Thus, our sample of well siblings consisted of 435 subjects (220 brothers and 215 sisters). It was important to only include siblings without psychiatric disorders because the factor of psychiatric illness could have distorted the birth curves: Affective disorders in general and SAD in particular show a high heritability and familiality [15, 16, 40]. Including a substantial number of siblings with SAD would inevitably have led to a birth pattern similar to that of the index patients.

Data processing and statistical analysis

For comparison, monthly birth data of the general population were obtained from Austria's governmental statistics. Our sample mainly comprised subjects from the Viennese population, so we compared the observed number of births in our siblings 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%.

As part of our primary hypotheses we compared the distribution of births of the unaffected siblings of our patients with that of the general population. Additionally, we compared the birth distribution of our index patients with that of their healthy siblings. We made our analysis on a monthly basis. However, secondary hypotheses included calculations on the basis of quarters by grouping of the data (January to March, April to June, July to September, October to December). Statistical analysis was carried out with SPSS for Windows [29] using Pearson's Chi-Square test. The $p \leq 0.05$ level of significance was adopted; no correction for multiple comparisons was applied. All statistical comparisons were two-tailed. The study was approved by the Ethics Committee of the Medical University of Vienna.

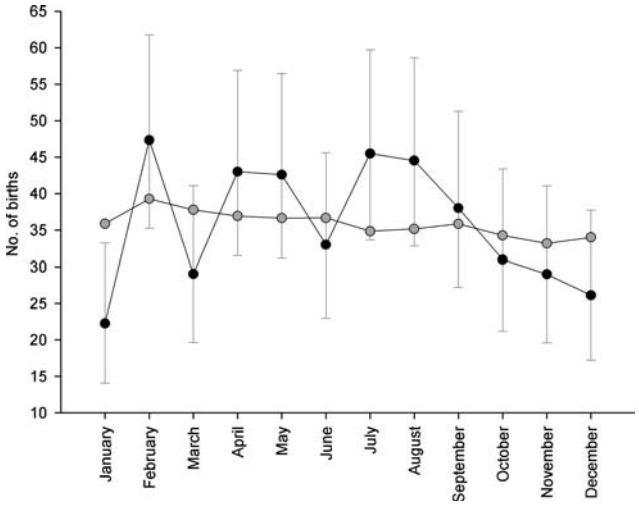

Fig. 1 Observed (black circles) and expected number of births (gray circles) for each month in a sample of 435 unaffected siblings of patients with seasonal affective disorder. A correction for different lengths of months has been applied to the data. Error bars represent asymmetrical 95% confidence intervals for the observed numbers of births. $\chi^2 = 20.117$, df = 11, $p = 0.044$

Results

The analysis of our data showed that there was a significant deviation between the birth distribution of the unaffected siblings of our SAD patients and the general population calculated on a monthly basis ($\chi^2 = 20.117$, df = 11, $p = 0.044$) (Fig. 1). When comparing quarters (Fig. 2) we found less births than expected in the first (−14.1%) and fourth quarter of the year (−15.1%) and an excess of births in the second (+7.7%) and third quarter (+21.1%; $\chi^2 = 10.090$, df = 3, $p = 0.018$).

Furthermore, we compared the group of SAD patients with the sample of healthy siblings: There were

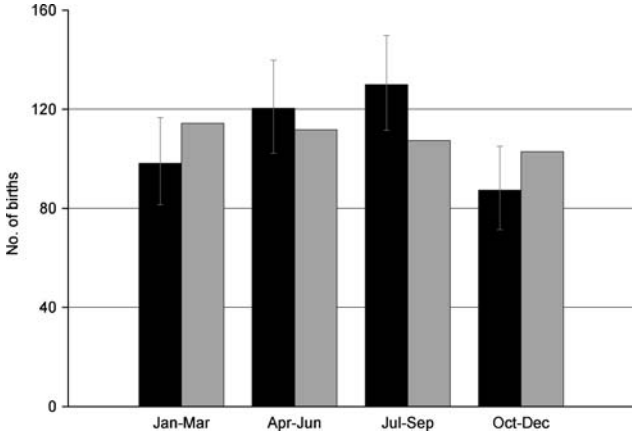

Fig. 2 Observed (black bars) and expected number of births (gray bars) for each quarter of the year in a sample of 435 healthy siblings of patients with seasonal affective disorder. A correction for different lengths of quarters has been applied to the data. Error bars represent asymmetrical 95% confidence intervals for the observed numbers of births. $\chi^2 = 10.090$, df = 3, $p = 0.018$

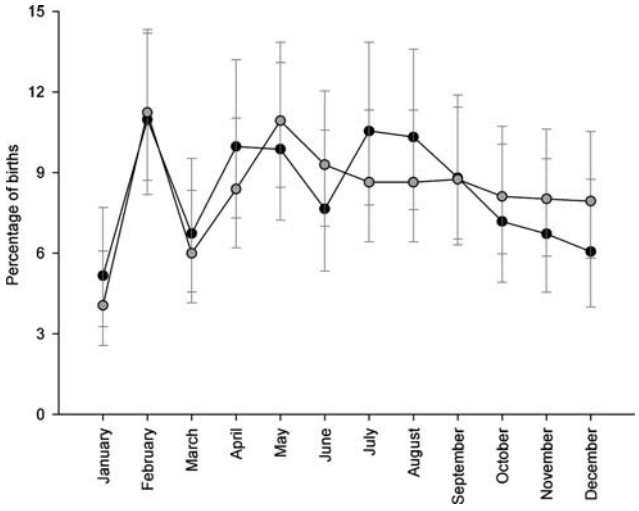

Fig. 3 Season of birth in 553 patients with seasonal affective disorder (gray circles) and 435 unaffected siblings of these patients (black circles). Error bars represent asymmetrical 95% confidence intervals. A correction for different lengths of months has been applied to the data. $\chi^2 = 6.364$, df = 11, $p = 0.848$

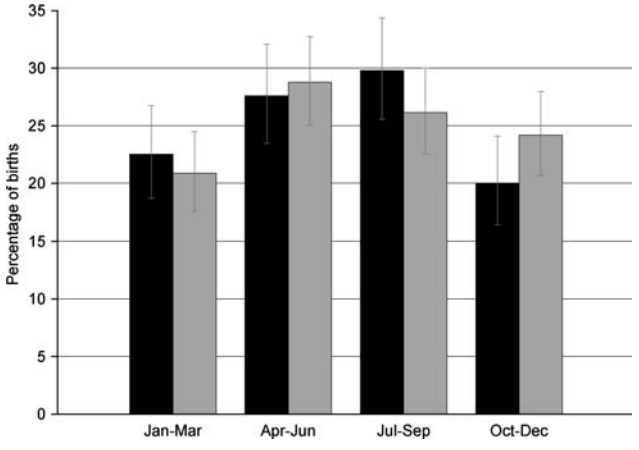

Fig. 4 Season of birth in 553 patients with seasonal affective disorder (gray bars) and 435 healthy siblings of these patients (black bars). Error bars represent asymmetrical 95% confidence intervals. A correction for different lengths of quarters has been applied to the data. $\chi^2 = 3.509$, df = 3, $p = 0.320$

no significant differences regarding their birth pattern as calculated by months ($\chi^2 = 6.364$, df = 11, $p = 0.848$) (Fig. 3) or quarters ($\chi^2 = 3.509$, df = 3, $p = 0.320$) (Fig. 4). We calculated a retrospective power analysis [19] with the GPower program [11] for these two non-significant comparisons to determine the power of the tests. A minimum effect size according to Cohen [7] was computed for a prespecified type I ($\alpha = 0.05$) and type II error ($1 - \beta = 0.80$): Our results show that our tests were powerful enough to detect a minimum effect size of w = 0.130 (for monthly comparisons) and w = 0.105 (for comparisons on the basis of quarters of the year), which is fairly small (effect size convention for w: small = 0.1, medium = 0.3, large = 0.5).

Discussion

Our results demonstrate that the group of unaffected siblings shows a birth pattern much closer to the SAD group than to the general population, which further supports the procreational habits hypothesis. The phenomenon of birth seasonality in psychiatric disorders has received considerable attention: since the first publication in 1929 [38] there have been over 250 publications on this topic in the literature. However, only seven studies have examined the possibility of idiosynchratic conception habits of parents of psychiatric patients. With the exception of Hare [13], who examined a mixed sample of psychotic patients (schizophrenia and manic depressive disorder), these studies all compared schizophrenic patients and their sibs. The results of these studies have been rather inconsistent, which is possibly due to methodological difficulties. Three studies lent support to the conception habits theory: Hare [13] and McNeil et al. [24] analyzed quarterly data in samples with 670 and 332 siblings, while Suvisaari et al. [32] analyzed monthly data in a representative sample of 37819 siblings. The other four studies [5, 18, 27, 34] with 558, 1039, 401 and 1321 siblings of schizophrenic patients failed to find a seasonal birth deviation.

When trying to further elucidate our results, the question arises, what might be the cause for the postulated procreational patterns of the parents of SAD patients. Some authors have claimed that SAD might simply be a genetic predisposition to an insufficient adaptation to higher latitudes [30], while others have suggested that the SAD pattern of attenuated hibernation might have constituted an evolutionary advantage in the context of reproduction [10]. Davis and Levitan [9] have also proposed an evolutionary perspective for this phenomenon: Seasonal variations in mood and behavior might be considered an adaptive response, occurring primarily in women of childbearing age, which once contributed to optimal reproductive success for humans living in areas with climatic changes severe enough to cause annual variations in access to energy resources. As SAD is considerably heritable [22, 31], the parents of our patients might also display increased physiological responsiveness to seasonal changes. Giving birth to children in spring and summer, as reflected by our birth excess in this time of the year, might have evolved as a reproductive strategy because it grants the best long-term survival outcome for the species [21]. Furthermore, recent research has suggested that season of birth might interact with genetic traits and trigger the later pattern of SAD during fetal development probably by a distinct maternal melatonin signal [20].

Our study is limited insofar as the patient sample is not a representative cross-section of the general population, but comprises outpatients from an urban

area referred to a university clinic. Furthermore, it is possible that our data were influenced by a memory bias, but we have made efforts to minimize this possibility and a systematic memory bias in our sample of siblings seems rather unlikely. As the psychiatric diagnoses in the sample of siblings were established by chart review, we might have underestimated the prevalence of mental disorders in this subsample. Moreover, it has been impossible to obtain the birth data of the general population of Vienna before 1951, so the mean year of birth in our sample and in the general population could not be matched exactly. Due to the relatively small number of subjects in the group of patients and siblings we were unable to employ more advanced methods of statistical examination such as time series analysis. The number of subjects used in this study might be small compared with other birth seasonality studies, but it still represents one of the largest samples yet published for SAD, and we were able to confirm our a priori hypotheses: This may be because the magnitude of the seasonal birth effect in SAD seems to be rather large compared with schizophrenia [26].

This study, which is the first to test the parental conception habits hypothesis in affective disorders and more specifically in SAD, leads to the conclusion that seasonal deviations of birth frequency in SAD patients are at least partly caused by specific procreational patterns of the parents of these patients. However, since other studies have also found some evidence for the importance of seasonally varying environmental factors, such as temperature and weather effects [2, 39] or infectious agents [25, 37], it is likely that seasonal variations of birth frequency are influenced by multiple factors. As there are still insufficient data on birth seasonality in mood disorders in general it would be worthwhile to clarify the role of parental conception habits in non-seasonal unipolar depression and bipolar disorder.

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