SEASONALITY OF BIRTH IN SCHIZOPHRENIA IN TAIWAN

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By

Wai-Cheong Carl Tam, B.S.
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The phenomenon of seasonality of birth in schizophrenia is important in the study of the etiology of this mental disorder because it helps to give directions for further research. Patients’ hospital files from 1981 to 1991 of two of the largest hospitals with psychiatric wards in Taiwan were reviewed, and dates of birth collected on 3346 patients diagnosed with schizophrenia. After adjusting for the variations of the total monthly births in the population, an Auto-Regressive Integrated Moving Average (ARIMA) model was applied. Results support a seasonality phenomenon and indicate a disproportional excess of births in schizophrenia in the cold months (Nov. to Feb.) compared to the hot months (May to Aug.). These findings are compatible with many other studies in other countries and climates. Further investigations of season-related environmental factors in the etiology of schizophrenia are recommended.
ACKNOWLEDGMENTS

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SEASONALITY OF BIRTH IN SCHIZOPHRENIA IN TAIWAN

The seasonality of birth in schizophrenia can be defined as "a tendency for individuals later diagnosed as schizophrenic to be born during certain months or seasons of the year in numbers disproportionate to those from the population at large" (Bradbury & Miller, 1985, p. 569).

The seasonality of birth in schizophrenia is very important in the etiology of this mental disorder because it helps to give directions for further research. This study investigated this phenomenon in Taiwan since there are only a few studies in Asia, none with appropriate statistical controls. The Chinese people make up approximately a quarter of the world's population. The lifetime prevalence of schizophrenia at Metropolitan Taipei in Taiwan was found to be .3% (Hwu, Yeh, & Chang, 1989), which is compatible to those of other countries. Thus this study offered an important cross-cultural comparison with the previous studies. This is further facilitated given that hospitals in Taiwan incorporate the DSM system into the ICD system for diagnosis (Lu, Ho, & Jiang, 1985), as do most Western countries.

Previous Studies

The phenomenon of the seasonality of birth in
schizophrenia was noticed by scientists over 60 years ago. In 1929, a study done by Tramer (1929/1930) found that there were more schizophrenics born in winter than summer in Switzerland. Since then many studies on the seasonality of birth in schizophrenia have been conducted in different countries or areas of the world. In 1985, Bradbury and Miller reviewed the results of 43 studies, and there are many more recent studies (e.g., Baron & Gruen, 1988; Dereef, Mukherjee, Bilder, & Schnur, 1988; Fañanas, Marti-Tusquets, & Bertranpetit, 1989; Hsieh, Khan, & Atwal, 1986; Kendell & Adams, 1991; Kendell & Kemp, 1987; Lo, 1986; Machón, Mednick, & Schulsinger, 1983; Newman & Bland, 1988; O’Callaghan et al., 1991; Woodard & Feldman, 1990). The results of these studies can be generally summarized as follows:

1. There is evidence of a disproportional excess of schizophrenia births in the winter months in the Northern Hemisphere. However, most of the studies in the Southern Hemisphere do not show any seasonality in schizophrenia births (Bradbury & Miller, 1985; DeLisi, Crow, & Hirsch, 1986; Dalén, 1975; Jablensky, 1989; Waddington, Torrey, Crow, & Hirsch, 1991).

2. There is evidence of a disproportional excess of schizophrenia births in the winter months for the low genetic risk group: in other words, persons born into
families without a history of schizophrenia (Bradbury & Miller, 1985; O’Callaghan et al., 1991; Waddington et al., 1991).

3. Several other variables have been investigated in relation to the seasonality of birth with mixed results. These include sex, birth order, birth year, race, marital status, length of hospitalization, sibling size, age at onset, place of birth, place of residence, parents’ ages at birth, socioeconomic status (SES), and subtypes of schizophrenia. With many of these variables, there are conflicting results in different studies. It is likely that there are too few studies that include these variables to lead to reliable conclusions (Baron & Gruen, 1988; Barry & Barry, 1964; Bradbury & Miller, 1985, 1986; Fañanas et al., 1989; Hsieh et al., 1986; Kendell & Kemp, 1987; Machón et al., 1983; Malama et al., 1988; Nasrallah & McCalley-Whitters, 1984; Parker & Neilson, 1976; Pulver, Stewart, Carpenter, & Childs, 1983).

4. Most of the studies are carried out with samples in Europe or North America. In Asia, there are only a few studies: two in Japan, one in the Philippines, and one in Hong Kong (Bradbury & Miller, 1985; Lo, 1986).

Proposed Explanations for the Seasonality of Birth

Although the phenomenon of excess schizophrenia births in the winter months is far from conclusively established,
there are some explanations offered to account for this seasonality:

1. Infectious agents: Some studies indicate that the seasonality of birth in schizophrenia correlates with the seasonal epidemics of certain infectious diseases such as diphtheria, rubella, pneumonia, influenza, measles, varicella-zoster and poliomyelitis. Thus it is inferred that schizophrenia might be related to infections of the above diseases or of some unknown antigen either prenatally or neonatally (Baron & Gruen, 1988; Bradbury & Miller, 1985; Hare, 1986; Kendell & Adams, 1991; O’Callaghan et al., 1991; Torrey, Torrey, & Peterson, 1977; Watson, Kucala, Tilleskjon, & Jacobs, 1984).

2. Perinatal brain damage: As seasonal distributions of stillbirths or premature deliveries are found in some studies, it is inferred that infants born in certain months of the year might be more likely to incur brain damage (Boyd, Pulver, & Stewart, 1986; Bradbury & Miller, 1985; Degrefe et al., 1988; Hare, 1986; Müller & Kleider, 1990).

3. Nutritional deficiencies: It has also been proposed that infants born in winter might have nutritional deficiencies (e.g., protein, calcium, vitamins C, D, or K) that lead to eventual onset of schizophrenia (Bradbury & Miller, 1985; Delisi et al., 1986).

4. Genetic-environment interaction: It is proposed that
some genetic factors might lead to vulnerability to environmental factors such as infections, perinatal brain damage or nutritional deficiencies as discussed above (Baron & Gruen, 1988; Bradbury & Miller, 1985).

**Methodological Problems**

In the studies on the seasonality of birth in schizophrenia, some methodological problems arise:

1. **Control groups:** Some studies do not have control groups (e.g., Lo, 1986; Woodard & Feldman, 1990), or use control subjects with birth years that are only partly overlapped with those of the schizophrenics being studied (Bradbury & Miller, 1985, 1986; Norris & Chowning, 1962). For example, Parker and Neilson (1976) studied the seasonality of birth of the schizophrenics who were born in the period from 1905 to 1959. However, they used the number of births in the general population from 1962 to 1971 as the control group. Therefore the results of these studies are suspect. Since birth rates, in general, vary with time, the total number of births in the same months and years of the schizophrenia births should be used as control variables in the analyses.

2. **Hospital data:** Many studies rely on hospital chart diagnoses and patients' demographic information from record files (to be termed "hospital data" in the present paper). Relying solely on these data might provide some reliability
or validity problems: for example, diagnoses made by junior staff, accuracy of family history, unknown number of non-hospitalized cases, duplications of cases in different hospitals, or representativeness of samples (Baron & Gruen, 1988; Hare, 1975, 1986; Kendell & Adams, 1991; Kendell & Kemp, 1987; O'Callaghan et al., 1991; Torrey et al., 1977). Nevertheless, hospital data provide conveniently large numbers of cases for statistical analysis (Hare, 1986), and are being used abundantly in many areas of research.

3. Statistical analysis: Although many studies use the chi-square test to analyse seasonality data, this method cannot detect cyclic trends efficiently (Bradbury & Miller, 1985; Edwards, 1961; Shensky & Shur, 1982). In order to detect the seasonality reflected by the data accurately, time-series strategies seem more appropriate (Catalano, Dooley, & Jackson, 1983; Makridakis & Wheelwright, 1978; Pankratz, 1983; SPSS Inc., 1990).

4. Age-incidence and age-prevalence effects: If the risk of onset of schizophrenia of individuals is assumed to be related to age, this can lead to two effects that generate artificial excesses of schizophrenia births at the beginning of each year (Lewis, 1989a, 1990; Lewis & Griffin, 1981): (a) Age-incidence effect: In the span of a year, for example, 1970, the people born in January are at least 10 months older than those born in December of the same year.
Thus if the incidence of schizophrenia is considered in a particular year afterwards, say, 1990, there will be more schizophrenics born in January, 1970, than in December of the same year. This is because the period of time of risk for the former is longer than that of the latter. This effect is shown in Figure 1. (b) Age-prevalence effect: This effect is closely related to the age-incidence effect. Following the above example, people born in 1969 and 1968 also have age-incidence effects respectively when the prevalence of schizophrenia is considered in 1990. This is illustrated in Figure 2. Thus the total numbers of schizophrenics born in January, 1968, 1969 and 1970 respectively, are more than that born in December of the respective years. Since there exists a time lag between onset of schizophrenia and first hospital admission, there are persons with schizophrenia who have not yet been hospitalized. Among these, more were born in January than in December. The influence of this community pool on a season of birth study depends on the numbers of schizophrenics in the community and their ages. This effect is called the age-prevalence effect.

However, appropriate mathematical methods, or July to June reporting periods, can eliminate the age-incidence and age-prevalence effects. When this is done, the phenomenon of the seasonality of births in schizophrenia still seems to
**Figure 1.** Example of age-incidence effect with people born in 1970 and examination for incidence of schizophrenia in 1990.

**Figure 2.** Example of age-prevalence effect with people born in 1968 to 1970 and examination for prevalence of schizophrenia in 1990.
exist (O’Callaghan et al., 1991; Pulver et al., 1983; Pulver, Moorman, Brown, McGrath, & Wolyniec, 1990; Shur & Hare, 1983; Watson, Kucala, Angulski, & Brunn, 1982). In addition, several studies in the Northern Hemisphere indicate that there are birth excesses in December (Bradbury & Miller, 1985; Torrey et al., 1977; Watson, 1990). Thus the age-incidence and age-prevalence effects cannot fully account for the apparent seasonality phenomenon (Dalén, 1990; Shur & Hare, 1983; Torrey & Bowler, 1990; Watson, 1990).

The Present Study

The findings and problems of previous studies of the seasonality of schizophrenia births have been reviewed and summarized. The remainder of the present paper will describe a seasonality study conducted in Taiwan. The hypotheses of the present study are:

1. There is a seasonality phenomenon in the monthly birth rates of schizophrenics after the effects of the total number of births per month in the population are taken into account.

2. There is a disproportional excess of schizophrenics born in the cold months compared to the hot months.

Method

Subjects and Procedure

The computerized hospital data from 1981 to 1991 of the
Taipei City Psychiatric Center and Tri-Service General Hospital (also located in Taipei City) were reviewed and the sex, date of birth, and diagnosis were collected on patients with schizophrenia. Since the data set of the Taipei City Psychiatric Center contained the dates of diagnosis while that of the Tri-Service General Hospital contained the dates of admission, these dates were collected in each hospital respectively. Table 1 shows the demographic characteristics for the subjects at each of the study sites. The numbers of schizophrenics born in each month from 1955 to 1966 were tabulated for the present study. The cases were checked carefully to avoid duplications. The age of the patients covered a range from adolescence to early adulthood—the usual onset period of schizophrenia (American Psychiatric Association, 1987; Beiser & Iacono, 1990; Department of Health, Taiwan Provincial Government, Republic of China, 1981, 1982, 1983, 1984; Folnegović-Smalc, Folnegović, & Kulčar, 1990; Jablensky, 1989; Lewis, 1989b; Rin, 1987). This is shown in Table 2.

By using the age span for each birth year as shown in the table, the age-incidence effect was eliminated. For example, people born in January, 1955, were age 26-0 in January, 1981, and age 36-0 in January, 1991. If they were diagnosed as schizophrenia or admitted to hospitals after January, 1991, they were not included in this study. On the
Table 1  
Demographic Characteristics of Subjects

<table>
<thead>
<tr>
<th>Hospital</th>
<th>Taipei City Psychiatric Center</th>
<th>Tri-Service General Hospital</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>1329</td>
<td>745</td>
</tr>
<tr>
<td>Female</td>
<td>1076</td>
<td>196</td>
</tr>
<tr>
<td>Marital Status(^a)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single(^b)</td>
<td>2072</td>
<td>No</td>
</tr>
<tr>
<td>Married(^c)</td>
<td>309</td>
<td>Data</td>
</tr>
<tr>
<td>Diagnostic Subtypes of schizophrenia</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paranoid</td>
<td>315</td>
<td>317</td>
</tr>
<tr>
<td>Non-paranoid</td>
<td>2090</td>
<td>624</td>
</tr>
</tbody>
</table>

\(^a\) There are 24 unknown cases for the Taipei City Psychiatric Center.  
\(^b\) Includes divorced or widowed subjects.  
\(^c\) Includes separated subjects.
Table 2

The Age Span of Patients Listed by Birth Year

<table>
<thead>
<tr>
<th>Birth Year</th>
<th>N</th>
<th>Age Span</th>
</tr>
</thead>
<tbody>
<tr>
<td>1955</td>
<td>239</td>
<td>26-0 -- 36-0</td>
</tr>
<tr>
<td>1956</td>
<td>232</td>
<td>25-0 -- 35-0</td>
</tr>
<tr>
<td>1957</td>
<td>264</td>
<td>24-0 -- 34-0</td>
</tr>
<tr>
<td>1958</td>
<td>231</td>
<td>23-0 -- 33-0</td>
</tr>
<tr>
<td>1959</td>
<td>324</td>
<td>22-0 -- 32-0</td>
</tr>
<tr>
<td>1960</td>
<td>270</td>
<td>21-0 -- 31-0</td>
</tr>
<tr>
<td>1961</td>
<td>302</td>
<td>20-0 -- 30-0</td>
</tr>
<tr>
<td>1962</td>
<td>328</td>
<td>19-0 -- 29-0</td>
</tr>
<tr>
<td>1963</td>
<td>326</td>
<td>18-0 -- 28-0</td>
</tr>
<tr>
<td>1964</td>
<td>306</td>
<td>17-0 -- 27-0</td>
</tr>
<tr>
<td>1965</td>
<td>290</td>
<td>16-0 -- 26-0</td>
</tr>
<tr>
<td>1966</td>
<td>234</td>
<td>15-0 -- 25-0</td>
</tr>
</tbody>
</table>

other hand, people born in December, 1955, were age 26-0 in December, 1981, and age 36-0 in December, 1991. Thus both groups had the same age span in the study and there was no age-incidence effect. This was true for every birth year from 1955 to 1966. Due to the elimination of age-incidence effect, the age-prevalence effect was also minimized.

There were 2405 and 941 cases from the Taipei City
Psychiatric Center and Tri-Service General Hospital respectively. Of the 3346 cases, 2074 were males and 1272 were females.

The useful number of cases per month from 1955 to 1966 in both hospitals were then added together. The number of schizophrenics born in each month and year was divided by the respective number of births of the population (from Department of Health, Taiwan Provincial Government, Republic of China, 1973) to obtain monthly birth rates for schizophrenics. Thus a time series of 144 terms (Figure 3) was obtained.

Overview of Data Analysis

The Auto-Regressive Integrated Moving Average (ARIMA) model of time-series analysis was used to test for a seasonal component in the data. A summary of the ARIMA model is given below.

In the simplest terms, the purpose of a univariate ARIMA model is to identify a mathematical equation that fits into a set of measurements of an independent variable x which varies with time t. This model applies to a stationary time series only, which means that the series has a mean and variance that are essentially constant through time. If a time series is not stationary, one of the mathematical methods to transform it into a stationary series is called "differencing." For example, a first order differencing
Figure 3. Monthly birth rates of schizophrenics (1955-1966).
A series is given by $x'_t = x_{t+1} - x_t$, a second order differencing series is given by $x''_t = x'_{t+1} - x'_t$, and so on. If $y_t$ denotes an element in a stationary time series of order $d$, then the general equation of the ARIMA(p,d,q) model is

$$y_t = c + \phi_1 y_{t-1} + \phi_2 y_{t-2} + \ldots + \phi_p y_{t-p} + \varepsilon_t - \theta_1 \varepsilon_{t-1} - \ldots - \theta_q \varepsilon_{t-q}$$

(1)

where $c$, $\phi_i$, and $\theta_i$ are constants, and $\varepsilon_t$ denotes the random component of the value $y_t$. If $d > 1$, $c$ is equal to zero.

In order to estimate the values of $p$ and $q$, the autocorrelation function and partial autocorrelation function are calculated and their patterns are compared to theoretical standards. The autocorrelation function $r_k$ is given by the following formula:

$$Y_k = \frac{\sum_{t=1}^{n-k} (y_t - \bar{y})(y_{t+k} - \bar{y})}{\sum_{t=1}^{n} (y_t - \bar{y})^2}$$

(2)

where $n$ denotes the total number of terms $y_t$ in the series, and $\bar{y}$ denotes the mean of $y_t$.

The partial autocorrelation function $\phi_k$ is given by the following equation:

$$y_{t+k} = b_1 y_{t+k-1} + b_2 y_{t+k-2} + \ldots + \phi_k y_t + u_k$$

(3)
where $b$ and $u$ are constants.

Once the values of $p$ and $q$ are estimated, the constants $c$, $\phi_i$, and $\theta_i$ in equation 1 can also be estimated. For the ARIMA($p,d,q$) model to be valid, the estimated constants must satisfy the conditions of stationarity and invertibility. Moreover, the values of the component $e_i$ must be random.

Different valid ARIMA models for a time series can be compared with each other by means of their predictability and goodness of fit.

The above time-series analysis techniques can also be applied to a time series $z_t$ having both seasonal and nonseasonal components. For this case, the mathematical model is

$$z = \text{ARIMA}(p,d,q) \text{ model of nonseasonal components} \times \text{ARIMA}(p',d',q') \text{ model of seasonal components},$$

or more simply,

$$z = \text{ARIMA}(p,d,q)(p',d',q')_s$$

where $s$ denotes the cyclical period.

Results

When the time series given in Figure 3 was differenced once with a period of 12 months, a fairly stationary series (Figure 4) was obtained. The first 120 terms of the series were used for estimation of the model, and the last 24 terms were used for checking the predictability of the model. The autocorrelation function and partial autocorrelation
Figure 4. Monthly birth rates of schizophrenics after one 12-month period differencing (1956-1966).
Figure 5. Autocorrelation function of monthly birth rates of schizophrenics.
Figure 6. Partial autocorrelation function of monthly birth rates of schizophrenics.
function are shown in Figures 5 and 6 respectively. In these figures, the correlations are plotted against the lag numbers (i.e., the various time intervals used in the analysis). These functions were then compared to a set of standards (Makridakis & Wheelwright, 1978; Pankratz, 1983) to determine the appropriate statistical model. The best model found to fit this time series was ARIMA(0,0,0)(0,1,1)$_{12}$. This indicated that the time series had a seasonal component with period of 12 months and no nonseasonal component. In other words, as can be seen by the large correlation at lag 12, there was a seasonal pattern which repeated itself at a 12 month interval. The mean absolute percentage error of this model was 22.6%, which means that, on average, 77.4% of each value of the birth rate series was accounted for by the model.

In consideration of the monthly temperature variations in Taiwan (Central Weather Bureau, Republic of China, 1991), the numbers of schizophrenics born in November through February and in May through August from 1955 to 1966 were summed together respectively, and a chi-square test was calculated (Table 3). The result was $\chi^2(1, N = 2211) = 3.91$, $p < .05$. This confirms that significantly more schizophrenics were born in the cold months than the hot months.

In addition, the ratios of male to female subjects for
Table 3

Births of Schizophrenics from Nov. through Feb. and May through Aug. (1955-1966)

<table>
<thead>
<tr>
<th>Births of Schizophrenics</th>
<th>Nov. to Feb.</th>
<th>May to Aug.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observed numbers</td>
<td>1252</td>
<td>959</td>
</tr>
<tr>
<td>(Male/Female)</td>
<td>(776/476)</td>
<td>(588/371)</td>
</tr>
<tr>
<td>Expected numbers</td>
<td>1205.69</td>
<td>1005.31</td>
</tr>
</tbody>
</table>

\[ \chi^2 (1, N = 2211) = 3.91, \ p < .05 \]

the entire sample, Nov. to Feb. birth group and May to Aug. birth group were 1.63, 1.63, and 1.58 respectively. This might indicate that the seasonality phenomenon holds for both males and females.

Discussion

The results of this study support the above hypotheses that there would be a seasonality phenomenon in the monthly birth rates of schizophrenics and a disproportional excess of schizophrenics born in the cold months compared to the hot months. These findings are compatible with many former studies (cf. review papers by
Although the etiology of schizophrenia is complex (Mirsky & Duncan, 1986), these studies reveal that there are some season-related environmental factors which seem to be independent of races and geographical locations. These factors may include infectious agents, perinatal brain damage, nutritional deficiencies, or genetic-environment interaction. However, it is too early at present to identify exactly what the factors are, and further research is needed.

The seasonality phenomenon in this study is detected by using the ARIMA models of the time-series analysis techniques. However, if the data had been analysed by using the chi-square test, as most former studies do, no significant results would have been obtained ($\chi^2 [11, N = 3346] = 10.57, p = .5$). This is because the chi-square test can only be applied to data collapsed across years for each month, making it more highly influenced by outliers. Time-series analysis deals with the measurements separately, and is thus able to take outliers into account in detecting seasonality. Therefore time-series analysis techniques should be used in future studies.

Since this study is based on hospital data, the generalization to the population of Taiwan depends on the representativeness of the selected hospitals. Although two
of the largest hospitals with psychiatric wards are selected, there is no clear way to assess the representativeness of the sample. In addition, the accuracy of the hospital data, such as diagnosis, date of birth, date of admission or diagnosis, might contain substantial errors. It is assumed that in this study these errors are randomly distributed and therefore do not seriously affect the results obtained.

At present, the effects of certain mediating variables on the seasonality of birth in schizophrenia are not clear. These variables include sex, birth order, birth year, marital status, length of hospitalization, sibling size, age at onset, place of birth, place of residence, parents' ages at birth, SES, or subtypes of schizophrenia. For example, Torrey et al. (1977) divided their sample of schizophrenics into paranoid and "process" (includes simple, hebephrenic, catatonic, and chronic undifferentiated schizophrenia) subgroups, and found no significant differences with regard to seasonality of birth. On the other hand, a study by Hsieh et al. (1986) revealed that male paranoid schizophrenics showed a significant larger proportion of births than controls during the first quarter of the year. Thus it seems clear that further investigation is needed to elucidate the parameters of this phenomenon.
REFERENCES


Department of Health, Taiwan Provincial Government, Republic


Hare, E. (1986). Aspects of the epidemiology of schizophrenia. British Journal of Psychiatry, 149, 554-


