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Mental Disorder and Season of Birth—A Southern Hemisphere Study

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Summary. Studies on the relationship between season of birth and mental disorder have been substantially confined to northern hemisphere regions. Such studies have generally found an excess of winter births of schizophrenics, and variably an excess of winter births of manic-depressive and mentally retarded patients. In the present study information on sex, diagnosis and date of birth was obtained on all 20,358 patients first admitted to psychiatric facilities in New South Wales between July 1970 and June 1974 and born in New South Wales. The collective 1962–71 monthly live-births for New South Wales were used as a control. A significant winter excess was found for the female schizophrenic group, while a significant spring excess was found for neurotic patients, most marked in those with anxiety neurosis. It is hypothesized that the relationship between schizophrenia and winter birth is consequent upon a greater sensitivity of schizophrenics to those physiological factors which determine conception in the general population.

Introduction

Studies on the relationship between season of birth and mental disorder have been substantially confined to northern hemisphere populations. Tramer (1929) was the first to report an excess of schizophrenics in winter and early spring, and this has subsequently been confirmed by a number of more recent studies utilizing satisfactory methodology (Dalén, 1968; Hare, Price and Slater, 1974; Ødegård, 1974; Hare, 1975b). Apart from an earlier pilot study (Parker *et al*, 1974) the only reported study from the southern hemisphere to examine for a relationship between schizophrenia and season of birth is that by Dalén (1975). In that South African study Dalén found a May-October (winter-spring) excess in the sub-groups of schizophrenics with birth years between 1930 and 1949, with female schizophrenics showing the greater seasonal variation. While only a few northern hemisphere studies have examined for a sex difference, variable findings have been reported. Tramer provided no figures but described a similar winter excess for each sex, and a sex difference in the winter excess is not apparent in the two studies performed by Dalén (1968, 1975) in Sweden. Lang (1931) in Germany and Kline *et al* (1973, cited in Dalén, 1975) in the United States found the winter excess to be more marked in male schizophrenics.

Videbech *et al* commented that studies of the relationship between manic-depressive psychosis and season of birth are fewer, the samples smaller, and the results contradictory. In their own study, seasonality of birth of the manic-depressive patients did not deviate from that of the background population. But Hare (1975a) found a significant excess of winter births of manic-depressive patients, more marked for mania than for psychotic depression, when compared with the general population. Births of patients with neurotic disorders appear to be over-represented in the spring quarter (Dalén, 1975, Hare, 1975a and 1975b). Other diagnostic groups were studied by Hare *et al* (1974). They found an excess of winter births among mentally retarded patients, whereas patients with organic psychosis and the remaining non-psychotic

groups had birth distributions very close to that of the general population.

The aim of the present study was essentially to replicate the England and Wales study of Hare *et al* (1974) within a southern hemisphere region.

Method

The Australian Bureau of Statistics collects data on all admissions to state and private psychiatric hospitals and psychiatric units of general hospitals in the state of New South Wales. Information on sex, diagnosis and date of birth was obtained on all 20,358 indigenous patients first admitted during a four-year period from July 1970 to June 1974 inclusive. When only year of birth has been recorded it is Bureau practice to classify such patients as having been born on 30th June of that year; this required a correction to be made to the number of patients recorded as born on 30 June. Patients classified as born 30 June were not counted, and an additional 1/29 was added to the June figures to correct for that anomaly. The diagnostic categories used by Hare *et al* (1974) were preserved, and the numbers of patients in each category are shown in Table I. Table II shows the numbers of patients by diagnosis and month of birth for the four years.

The Australian Bureau of Statistics publishes figures of monthly live-birth registrations, but actual dates of birth have been collected in New South Wales only since 1962. It is believed that the interval between date of birth and date of registration is in most cases less than a month because of legal requirements and the fact that child endowment and the maternity allowance can be paid only after birth registration. Table III suggests that the use of the 1962-71 date of birth as the principal control is adequate, and

Table I

Number of patients born in NSW and first admitted over the four admission years 1970–74, by diagnosis

Diagnostic group	ICD (8th Rev.)	1970–71	1971–72	1972–73	1973–74	1970–74
Schizophrenia	295	564	572	570	550	2,256
Mania	296.1, 296.3	51	49	58	62	220
Psychotic depression	296.0, 2, 8, 9	273	247	292	285	1,097
All other psychoses	290.0–294.9, 297.0–299.9	736	650	703	724	2,813
Neurotic depression	300.4	1,056	1,086	1,026	872	4,040
All other neuroses	300.0–3, 300.5–9	260	291	281	284	1,116
Personality disorders	301	348	316	422	401	1,487
Mental retardation	310–315	254	280	267	247	1,048
All other non-psychotic mental disorders	All other codes of Section V	1,523	1,547	1,621	1,590	6,281

Table II

Number of patients, by diagnosis and month of birth

Diagnosis	J	F	M	A	M	J	J	A	S	O	N	D
Schizophrenia	210	170	187	154	210	203	199	199	184	195	175	170
Mania	24	17	21	21	18	20	16	16	14	16	17	20
Psychotic depression	100	96	93	89	92	105	86	101	74	89	83	89
Other psychoses	251	209	222	253	249	237	238	240	247	239	196	232
Neurotic depression	351	329	333	335	313	366	332	358	368	342	325	288
Other neuroses	94	80	98	88	100	80	87	81	107	128	91	82
Personality disorder	150	110	127	143	121	141	114	129	132	106	103	111
Mental retardation	97	91	91	86	87	65	79	97	92	89	81	93
Other non-psychotic mental disorders	545	494	569	500	534	559	519	518	510	544	513	476

that seasonal variation of birth is minimal in New South Wales.

TABLE III

Percentage variations in NSW births and birth registrations, by three- and four-monthly groupings

	Birth registrations*		Actual dates of birth†
	1905–1961	1962–1971	1962–1971
Dec.–Feb. (Summer) ..	24·1	23·9	24·3
Mar.–May (Autumn) ..	25·0	25·6	25·4
Jun.–Aug. (Winter) ..	25·5	25·3	25·3
Sep.–Nov. (Spring) ..	25·4	25·2	25·0

* Seasonal variation when examined for each year ranged from 0·4%–6·0% (mean 2·1%).

† Seasonal variation when examined for each year ranged from 1·1%–1·9% (mean 1·4%).

RESULTS

Table IV reveals the seasonal distribution of births of the various diagnostic groups. For the group of neuroses other than neurotic depression the distribution differs significantly from that of the general population ($p<0·001$), the spring excess being in the order of 17 per cent. While an excess of winter (June–August) births was found in a number of diagnostic groups, in no case did this reach statistical significance.

Although the season of birth distribution of the general population of New South Wales varies minimally from year to year, observed schizophrenic births were compared in ten-year groupings with that expected from live-birth registration in New South Wales from 1910 to 1959. A winter excess was found in four of the five periods and was significant in two (1920–29 and 1950–59). Comparison of quinquennial groupings from 1905 to 1959 revealed a winter excess in seven of the eleven periods and was significant in two (1920–24 and 1950–54).

TABLE IV

Observed seasonal distribution of patients' births compared with expected

Diagnosis		Season: Sep.–Nov. 'Spring'	Dec.–Feb. 'Summer'	Mar.–May 'Autumn'	Jun.–Aug. 'Winter'	χ^2 *	χ^2 †
Schizophrenia	Obs.	554	550	551	601	2·15	2·64
	Exp.	564·0	548·2	573·0	570·7		
Manic-depressive psychosis ..	Obs.	293	346	334	344	0·47	6·43
	Exp.	329·2	320·1	334·4	333·2		
Mania‡	Obs.	47	61	60	52	0·33	2·78
	Exp.	55·0	53·5	55·8	55·7		
All other psychoses	Obs.	682	692	724	715	0·02	0·88
	Exp.	703·2	683·6	714·5	711·7		
Neurotic depression	Obs.	1,035	968	981	1,056	1·50	3·92
	Exp.	1,010·0	981·7	1,026·2	1,022·1		
Other neuroses	Obs.	326	256	286	248	5·58	12·96
	Exp.	279·0	271·2	283·5	282·3		
Personality disorder ..	Obs.	341	371	391	384	0·21	3·43
	Exp.	371·7	361·3	377·7	376·2		
Mental retardation	Obs.	262	281	264	241	2·93	4·92
	Exp.	262·0	254·7	266·2	265·1		
All other non-psychotic mental disorders	Obs.	1,567	1,515	1,603	1,596	0·04	0·16
	Exp.	1,570·0	1,526·3	1,595·4	1,589·1		

* Comparing winter season against the remaining nine months ($\chi^2 = 2·706$, df = 1, p = 0·05, one-tailed).

† Comparing each season ($\chi^2 = 7·815$, df = 3, p = 0·05, two-tailed).

‡ The psychotic depression distribution can be derived by subtracting the manic figures from the manic-depressive figures.

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A marked sex difference was found in the schizophrenic group when comparison was made with live-birth registrations of the same sex in New South Wales from 1962 to 1971. Female schizophrenics revealed a winter excess of 13·1 per cent, which is significant at the 0·01 level (Table V) and a winter excess over expectation held true in each decade from 1910 to 1959. Male schizophrenics did not reveal a winter excess. In the manic-depressive psychosis group a similar sex difference was found, female patients principally contributing to the winter excess of 3·2 per cent, but neither sex revealed a significant winter excess.

An attempt was made to confirm the suggestion of Pasamanick and Knobloch (1961) of a higher incidence in births of schizophrenics after hot summers as contrasted with cool summers. The winter birth rate for schizophrenics born after the ten hottest (mean temperature 25°C) and the ten coldest (mean temperature 21°C) summers from 1905 to 1959 was compared with the winter birth rate of the general population. In the general population, winter births formed 25·7 per cent of yearly births after the ten hottest summers and 25·4 per cent after the ten coldest summers. In the schizophrenic group, winter births formed 28·8 per cent of yearly births after hot and 27·8 per cent after cold summers, but the distribution was not significantly different from that for the general population for the same years.

In order to examine further for seasonal variation in births of neurotic patients, seasonal distributions were made of births of patients belonging to various neurotic sub-groups and these were compared with those expected from the general population control (Table VI). The significant spring excess of anxiety neurosis patients appeared to contribute most to the significant over-representation of spring births in the whole neurosis group. Comparison of observed anxiety neurosis births was made with live-birth registrations in New South Wales in ten year groupings; in five of the six periods an excess of anxiety neurosis births over expectation was found in the spring quarter. No sex difference was observed in the seasonal distribution of the anxiety neurosis patients.

TABLE V

Observed distribution of schizophrenic births in winter season against the remaining nine months compared with expectation from all live-births of the same sex in New South Wales 1962–71, by sex

Diagnostic group	Sex		Period: Winter	Period: Other nine months	χ^2
Schizophrenia	Male	Obs.	263	798	0·14
		Exp.	268·4	792·6	n.s.
	Female	Obs.	338	857	5·64
		Exp.	302·3	892·7	p<0·01

TABLE VI

Observed seasonal distribution of births of neurotic patients compared with expectation from all live-births in New South Wales 1962–71

Number			Season: Spring	Summer	Autumn	Winter	χ^2 *
Depressive neurosis ..	4,040	Obs.	1,035	968	981	1,056	0·82
		Exp.	1,010·0	981·7	1,026·2	1,022·1	ns
Anxiety neurosis ..	584	Obs.	183	132	143	126	12·49
		Exp.	146·0	141·9	148·3	147·7	p < 0·00025
Other neuroses ..	532	Obs.	143	124	143	122	1·00
		Exp.	133·0	129·3	135·1	134·6	ns
Total neuroses ..	5,156	Obs.	1,361	1,224	1,267	1,304	5·36
		Exp.	1,289·0	1,252·9	1,309·7	1,304·4	p < 0·0125

* Comparing spring season against the remaining nine months on a one-tailed test.

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Discussion

Studies of northern hemisphere populations have generally found an excess of winter births of schizophrenics, variably found an excess of winter births of manic-depressive psychosis patients and variably described seasonal deviations for other mental disorders. The present southern hemisphere study has revealed a significant excess of spring births in neurotic patients and winter births of female schizophrenics.

A significant spring excess of 5·6 per cent was found for the neurosis group. When the neurotic group was divided a spring excess was found in each of the three sub-groups: 25·3 per cent for those with an anxiety neurosis, 2·5 per cent for those with a depressive neurosis and 7·5 per cent for the remaining neurotic patients. There are few studies with which these findings can be compared, as it has generally been considered that neurotic patients do not show a season of birth distribution significantly different to that of the general population. In fact a neurotic control group was used in the first British study investigating season of birth of schizophrenics (Hare and Price, 1969), and a group of neurosis plus personality disorder was used as the control group in a later study to determine the effect of taking different combinations of birth-months on the season of birth distribution of schizophrenia and of manic-depressive psychosis (Hare, Price and Slater, 1974). However, in a Swedish study Dalén (1975) provided data on 39,104 patients with a diagnosis of neurotic depression. Examining those data we find a slight spring excess when comparison is made against the general population control. Hare (1975a, 1975b) has provided data on 23,649 neurotic patients in England and Wales. These revealed a significant seasonality of birth ($p<0·02$) with a spring excess of approximately 3 per cent when compared against the general populations control. Hare divided the neurotic patients into two sub-groups, depressive neurosis and 'other neurosis' (including anxiety neurosis) and in both groups the distribution was not significantly different to the control. But both groups revealed a spring excess of approximately 3 per cent, which we calculate to be significant at the 5 per cent level. As no study apart from our own has specifically looked for an association between season of birth and anxiety neurosis, that finding requires confirmation. Further examination of the possibility of an association between neurosis and spring birth would appear warranted by these recent findings. Certainly the use of neurotic patients as a control group in future studies of seasonality of birth would appear unwise.

As the present study replicated much of the methodology utilized in the England and Wales study of Hare *et al* (1974), comparison of our findings in regard to schizophrenia should first be made with that study. While Hare *et al* found a 7 per cent winter excess of schizophrenic births, our study found a 5·3 per cent excess, although the 95 per cent confidence interval for any real increase in the winter quartile for our data ranges from zero to 11 per cent. If a 7 per cent excess of schizophrenic births exists in New South Wales we calculate that a sample size of approximately 1600 should detect it; in fact our schizophrenic sample numbered 2,256. If, however, the effect is of the order of 5·3 per cent as indicated in our study, a sample of approximately 3000 schizophrenics would be required for 0·05 significance to be achieved. But it is unlikely that the winter excess in New South Wales should be similar to that in England and Wales where there are considerable climatic differences and where a similar sex differential effect may not operate. Although Hare *et al* did not examine for a sex difference, previous northern hemisphere studies have either found no sex difference or the winter excess to be more marked in male schizophrenics.

While there are some methodological differences between our study and that by Dalén (1975) in South Africa, these two southern hemisphere studies of schizophrenic populations born in similar climates reveal very similar findings. We calculate the winter excess in Dalén's study group to be 3·8 per cent against our 5·3 per cent, while in both studies the trend for a winter excess failed to reach significance. In both South African and the New South Wales studies female schizophrenics accounted for most of the seasonal deviation, the male sub-group revealing little seasonal variation.

Data from northern hemisphere studies suggest that there is an association between

schizophrenia and winter birth and that if there is any sex difference then that association is stronger in male schizophrenics. Data from two southern hemisphere studies suggest that the association between schizophrenia and winter birth is present for the whole group in a weakened form, but almost entirely accounted for by female schizophrenics. While many explanations of the association between schizophrenia and winter birth have been considered (Dalén, 1975) we believe that recent findings allow another hypothesis to be entertained.

In the general population of any region seasonality of birth is probably most influenced by seasonality of conception, as there is no definite evidence of seasonal variation in the frequency of spontaneous abortions (Dalén, 1975). Conception rates in the general population appear to be influenced chiefly by meteorological factors (Cowgill, 1966; Macfarlane, 1969) and Macfarlane has suggested that ambient temperature affects the neuroendocrine responses of the female. In any region there appears to be an optimal temperature for conceptions, conception being inhibited at temperature extremes. As optimal and inhibiting temperatures for conception differ from region to region, Macfarlane suggests that this is *prima facie* evidence of reproductive adaptation to different environmental temperatures.

Data from three northern hemisphere studies performed in Sweden (Dalén, 1968), England and Wales (Hare *et al*, 1974) and Norway (Ødegård, 1974) suggest that schizophrenics have the same seasonal patterns in births as the general population, but have a greater amplitude in their deviation from the steady level. In those countries, the general population shows a major peak in births from February to April, which presumes a summer maximum of conception. The schizophrenic distribution reveals a similar seasonal pattern but of greater amplitude, suggesting that more schizophrenic conceptions occur in summer and fewer in winter.

In the general population of New South Wales conceptions peak at a mean monthly temperature of 18°C and are depressed when the temperature exceeds 22°C or is less than 16°C. Although the fluctuation is small, the peak in New South Wales births occurs in late winter and early spring. As in the northern hemisphere studies, the schizophrenic populations studied in South Africa and New South Wales appear to show the same seasonal deviations as the general population but again reveal a greater amplitude in their deviations.

The sex difference in the winter excess of the schizophrenics studied in South Africa and New South Wales is difficult to interpret. The sex ratio of live births in any population depends on the primary sex ratio of zygotes and subsequent differential losses by sex *in utero* whether by failure to implant, early death and resorption, abortion or stillbirth. In the general population male zygotes are probably more favoured at implantation, and while more male fetuses die *in utero* the sex ratio remains above unity at birth. The sex ratio at birth shows some seasonal variation, being highest in the spring quarter (Slatis, 1953; Lyster, 1968; Sarkar, 1969 and Rantakallio, 1971). Examination of the New South Wales control group used in our study revealed a highly significant difference in the seasonal distributions of male and female births ($\chi^2 = 94{\cdot}57$, df = 3, $p<0{\cdot}0005$) and while the sex ratio was also highest in the spring its winter low (i.e. when proportionally most females were born) was more striking. Similar seasonal deviations but of greater amplitude were revealed in the schizophrenic group (Table VII).

TABLE VII

Sex ratio at birth

	Live-births in New South Wales 1962–71	Schizophrenic group
Summer ..	105·9	102·3
Autumn ..	105·0	92·7
Winter	100·6	76·5
Spring	106·1	95·7

We thus hypothesize on the basis of studies from the northern and southern hemispheres that the association between schizophrenia and winter birth is consequent on a greater sensitivity of the schizophrenic individual at the time of

his conception to those physiological factors which determine conception in the general population. The sex difference in the schizophrenics' seasonality in New South Wales might suggest that schizophrenics in this region are also more sensitive to those factors which determine the sex ratio at birth, but as those factors have as yet resisted clear interpretation (Stevenson and Bobrow, 1967,) any further hypotheses would be extremely speculative.

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