SEASONAL DIFFERENCES IN SUICIDE BIRTH RATE IN ALASKA NATIVES COMPARED TO OTHER POPULATIONS

Paul A. Kettl, M.D., Tracy Collins, M.D., Michelle Sredy, M.D.,
and Edward O. Bixler, Ph.D.

Abstract: Seasonal differences in suicide birth rates among Alaska Natives and for populations at different latitudes (residents of the Yukon, Saskatchewan, Montana, Wyoming, and Pennsylvania) were investigated. Seasonal birth rates for the general population were similarly examined. Suicide birth rates showed small seasonal variations for Alaska Natives with summer births showing more suicides. However, at lower latitudes, suicide birth rates among other populations showed no seasonal differences. Hours of daily sunlight at the summer and winter solstice correlated with the proportion of suicide victims born during those seasons. Seasonal differences in birth rates of suicide victims correlated strongly with latitude and seasonal differences in daylight. General population birth rates did not show significant seasonal differences, and did not correlate with differences in latitude or sunlight length at the summer or winter solstice.

Examining the season of birth of those with psychiatric disorders is not a new idea. It has long been recognized that patients suffering from schizophrenia are more likely to be born in the first three months of the year (Barry & Barry, 1961; Editorial,1978; Hare & Price, 1968; Pulver, Stewart, Carpenter, & Childs, 1983; Torrey, Torrey, & Peterson, 1977). Similar data is available showing a higher winter birth rate for those with Bipolar Disorder (Barry & Barry, 1961, Hare & Price, 1968; Hare, Price, & Slater, 1973) and for those with mental retardation (Knobloch & Pasamanick, 1958). Because 44% (Robins, Murphy, & Wilkinson, 1959; Roy, 1982) to 64% (Barraclough, Bunch, Nelson, & Sainsbury, 1974) of all suicide victims suffer from depression, and an additional fraction ranging from 2% (Barraclough et al.,

1974; Robins et al., 1959) to 38% (Roy, 1982) suffer from schizophrenia, the authors were interested to see if a seasonal difference in birth rate exists for suicide victims.

Previous work on month of birth of suicide victims produced inconsistent results. Two studies showed an excess of summer births in suicide victims. Pokorney (1960) in a survey of only 44 suicide victims showed a marked increase in a July birth month. Lester, Reeve, and Priebe (1970) showed no significant difference in month of birth of suicide victims, but found a slight excess of summer births. However, others did not find a seasonal difference. Sanborn and Sanborn (1974) found no significant differences in month of birth of suicide victims, and Beck and Lester (1973) found no significant differences in month of birth of suicide attempters. All of these studies examined suicide birth month at only one location. We examined suicide birth rates in different seasons among Alaska Natives.

Seasonal suicide rates for Alaska Natives were initially examined because of high suicide rates for that population—both compared to the general U.S. population as well as to suicide rates for the Alaska state population as a whole. The non-native population of the state is relatively transient and would have been far less likely to be born in Alaska compared to Alaska Natives who were born and lived in their native state. So the authors did not examine birth dates of non-native Alaskan suicide victims since they were less likely to be born in Alaska.

To study seasonal differences in suicide birth month, however, it would clearly be most advantageous to study suicide birth rates at different locations, at different latitudes, where seasonal influences would vary. More northern latitudes have larger differences between seasons than more southern latitudes. Should any seasonal difference in suicide birth rate occur, the effects should be most prominent where seasonal differences are most prominent. Accordingly, these differences should gradually decrease as latitude and intensity of seasonal differences decrease.

Others have suggested that seasonal effects on mood vary by latitude. Rosenthal et al. (1988) demonstrated different seasonal changes of mood at different latitudes. Latitude may even influence the cortisol response in depression. Dexamethasone suppression test (DST) results show a positive relationship between degree of latitude and rate of abnormal DST response in Europe (Rihmer, 1987) and in the United States (Stokes et al., 1984). Rihmer (1987) observed the further north the patient lived, the more abnormal the DST.

To explore the question of seasonality of suicide birth in Alaska Natives and for other populations, we examined suicide birth data for all four seasons at a variety of locations in North America.

Material and Methods

Birth date of suicide victims was obtained for Alaska Natives, and residents of the Yukon, Saskatchewan, Montana, Wyoming, and Pennsylvania from death certificate data furnished by each jurisdiction. Population in the arctic and subarctic is relatively small, and so data was collected for both the Yukon and for Alaska Natives even though these two areas are at the same latitude. Representatives of the government of the Northwest Territories in Canada could not furnish us with suicide data.

As stated in the introduction, we are examining birth date of suicide victims only for Alaska Natives for that state since other state residents would be unlikely to be born in Alaska. At other locations there is a more stable population, and fewer Native peoples, so suicide rates for all its citizens are examined.

Death certificates of all Alaska Natives who died between 1979 and 1984 were examined, revealing 90 suicides. For comparison, the offices of Vital Statistics of other locations were asked for suicide data for the latest five year period available. They furnished us with the following information: month of birth for all 39 suicide victims in the Yukon from 1983 to 1987 was obtained. Data for Saskatchewan for 1982 through 1987 revealed 837 suicides. Montana data from 1984 to 1988 revealed 768 suicides. Wyoming data from 1984 to 1988 revealed 480 suicides; month of birth for 6,859 Pennsylvania suicides between 1981 and 1985 was examined as well. While the information listed comes from different time periods for different locations, there is no reason to suspect that suicide data from a few years earlier or later would be any different.

Total number of suicide victims born in the three months surrounding the summer solstice (May-July), the winter solstice (November-January) as well as the fall (August-October) and spring (February-April) equinox was summed for each state or province. The percentage of all suicide victims for each state or province born in each season was then calculated.

To serve as a control, data for all births for each jurisdiction was similarly divided according to season. The office of vital statistics for each state or province was asked to provide *all available* monthly birth data from their computer records. Birth date for all residents was obtained as chronologically far back as the state or province maintained computer records. For Alaska Natives, data on 24,447 births between 1978 and 1987 was obtained in this way. Included were 8,935 births in the Yukon from 1968 to 1986, as were 318,482 births from Saskatchewan for the same period. Data for 485,720 births for Montana from 1954 to 1987, and data for 74,591 births in Wyoming from 1981 through 1988 were studied. Finally, 4,581,616 births in Pennsylvania from 1961 through 1986 were included in the analysis.

Seasonal differences, including light, temperature, and severity of climate clearly vary by latitude. To examine differences between latitude and seasonal suicide rate, we compared the seasonal suicide rate and general

birth rate for each state or province with the latitude of the largest city in each locale. In this way, the latitudes for Anchorage, Alaska (61 degrees), Whitehorse, Yukon (61 degrees), Saskatoon, Saskatchewan (52 degrees), Great Falls, Montana (47 degrees), Casper, Wyoming (43 degrees), and Philadelphia, Pennsylvania (40 degrees) were compared to seasonal differences in suicide birth rates and general birth rates.

Seasonal differences among these locations include temperature, rainfall, length of daylight, as well as other variables. We sought to determine the relationship between daylight length for season of birth and the suicide birth rates (and for general birth rates as a control) at each location. To do this, data was obtained about the length of daylight for the largest population center for each state or province for the summer and winter solstice and spring and fall equinox from the U.S. Naval Observatory.

The percentage of suicide victims born during each season at each location was then paired with latitude, and the length of daylight for each location. As a control, the percentage of all births for the same periods was also paired with latitude or daylight length in the same manner. The pairs were statistically evaluated with Pearson correlation coefficients, using one-tailed analysis. $P = 0.05$ was chosen as the level of significance for analysis.

Results

Alaska Natives did show seasonal differences in suicide birth rate. Month of birth of suicide victims in other locations showed small seasonal differences which reached statistical significance. These differences were strongest at the highest latitudes where great seasonal differences occurred. At lower latitudes, no strong seasonal differences in suicide birth rate occurred.

To examine the effect of available sunlight at birth, the authors examined suicide birth rates for those born at the time of greatest possible sunlight—the summer solstice (June 21) to those born at the time of least possible sunlight—the winter solstice (December 21).

Small but opposite effects of suicide birth rates were found surrounding the summer solstice, the period of greatest sunlight and for the winter solstice, the period of least sunlight. General population birth rates showed no such trend. Birth rates for suicide victims were slightly higher for the time surrounding the summer solstice than for the winter solstice at each location regardless of the latitude.

The further north, the greater are the seasonal differences. To see if there were greater seasonal differences at higher suicide rates, we compared the proportion of suicide victims born at each season with the latitude.

The proportion of suicide victims born surrounding the summer solstice at each location did not quite significantly correlate with latitude of each population center ($r = .67$, $p = 0.07$). The correlation for the proportion of suicide victims born surrounding the winter solstice is roughly equivalent in magnitude, but opposite in direction ($r = -0.76$, $p = 0.04$). The seasonal difference in suicide births between summer and winter at each location very strongly correlated with latitude ($r = 0.93$, $p = 0.004$).

No significant seasonal correlation was found for general birth rates at these locations. The proportion of all births born surrounding the summer solstice at each location was not related to latitude ($r = 0.03$, ns). The same was true for the proportion of all births surrounding the winter solstice ($r = 0.17$, ns), and for the seasonal difference in general birth rates ($r = 0.11$, ns).

Hours of sunlight available at the time of birth did correlate with the numbers of suicide victims born at that time. The seasonal differences in suicide birth rates at each site correlated with the seasonal difference in daylight length at each location ($r = 0.96$, $p = 0.001$, Figure 1). See Table 1 for the seasonal distribution of suicides at each location. The proportion of suicide victims born around the summer and winter solstice correlated with the hours of sunlight at the summer ($r = 0.74$, $p = 0.04$, Figure 2) and winter ($r = 0.78$, $p = 0.03$, Figure 3) solstice at each location.

Figure 1
Seasonal Change in Light and Suicide Birth Rate

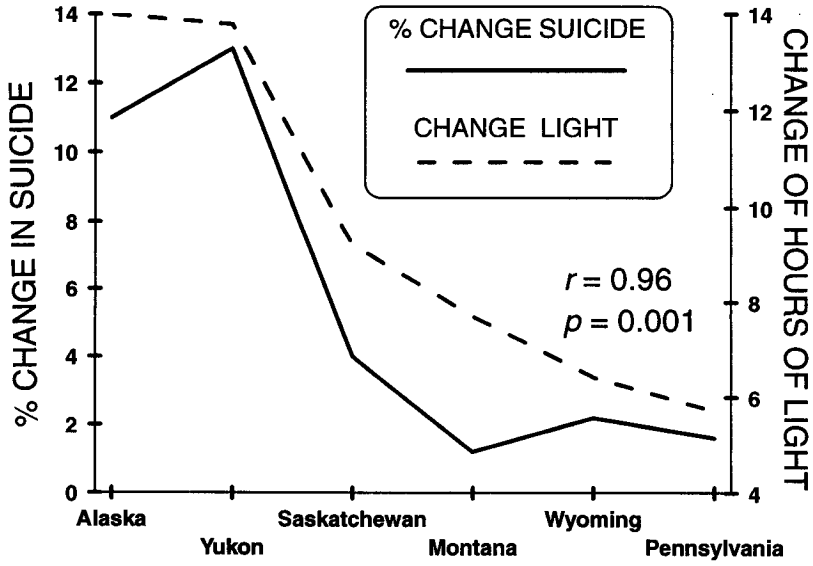

Figure 2
Summer Solstice

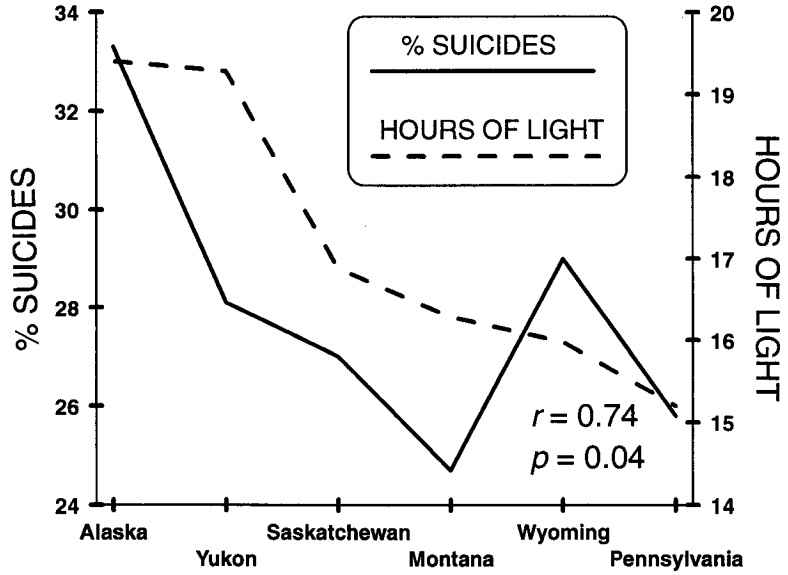

Figure 3
Winter Solstice

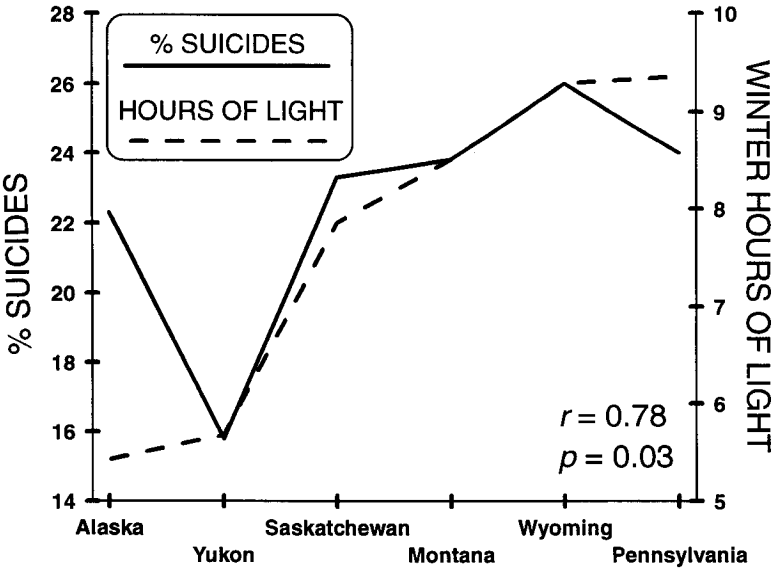

Table 1
Seasonal Difference in Suicide Birth Month

	Summer	Fall	Winter	Spring
Alaska 61°				
Suicides (%)	33.3%	21.2%	22.2%	23.4%
Hours of light	19.4	12.2	5.5	12.2
Yukon 61°				
Suicides (%)	28.2%	25.7%	15.5%	30.7%
Hours of light	19.2	12.2	5.6	12.2
Saskatchewan 52°				
Suicides (%)	26.8%	23.7%	22.9%	26.5%
Hours of light	16.8	12.2	7.7	12.2
Montana 47°				
Suicides (%)	24.6%	24.8%	23.7%	27.0%
Hours of light	16.0	12.2	8.5	12.2
Wyoming 43°				
Suicides (%)	28.3%	23.6%	26.1%	22.0%
Hours of light	15.7	12.4	9.3	12.4
Pennsylvania 40°				
Suicides (%)	25.5%	25.6%	24.1%	24.8%
Hours of light	15.0	12.1	9.3	12.1

General population seasonal birth rates did not correlate with differences in daylight length at the summer (r = -0.03, ns) or winter (r = -0.25, ns) solstice. Seasonal difference in general birth rates did not correlate with differences in seasonal daylight length (r = 0.26, ns) (Table 2).

Large differences in suicide birth month are not seen at the spring or fall equinox at any location. These times, which get equal amounts of sunlight, show roughly equal frequencies of suicide birth.

Small, but significant differences in birth month of suicide victims were evident at higher latitudes, but this effect disappears at lower latitudes where the seasonal difference in available daylight also diminishes.

Discussion

The data in Table 1 shows that in the continental United States, there is no clear difference in seasonal suicide birth rate. However, in Alaska Natives, and in the Yukon, the summer and spring evidence slightly higher

Table 2
Seasonal Difference in General Population Birth Month

	Summer	Fall	Winter	Spring
Alaska	25.6%	25.5%	24.7%	24.3%
Yukon	25.9%	25.7%	23.5%	24.9%
Saskatchewan	25.8%	25.0%	24.1%	25.1%
Montana	26.2%	25.5%	24.0%	24.3%
Wyoming	26.3%	25.3%	23.3%	25.1%
Pennsylvania	25.2%	26.2%	24.3%	24.3%

suicide birth rates than other seasons. It is possible, of course, that this effect simply is the result of a smaller population producing more variability in birth rates. However, because both Alaska Natives and the Yukon Territory show higher suicide birth rates in the spring and summer than in the winter and fall, we must consider possible reasons for this difference besides simple statistical variability. In the arctic, seasonal changes bring harsh environmental differences including changes in weather, temperature, different cultural practices as well as the differences in daylight length. Of all of these differences, in considering suicide, light may well be the key variable. Light is already an established treatment for seasonal affective disorder, and light is being investigated as a treatment for other rhythm disturbances.

Seasonal differences in available sunlight vary by latitude, and differences in available sunlight, especially above the arctic circle can be quite extreme. In the arctic at the summer solstice, light is present 24 hours per day, and at the winter solstice, sunlight is absent for the entire day. This extreme difference in available sunlight is present only in the arctic, but it is in the arctic and subarctic where the most extreme seasonal differences in suicide birth rate occur.

Exposure to large amounts of sunlight at birth may increase risk for suicide decades later in life. Alternatively, exposure to very small amounts of sunlight at birth may be protective against death from suicide. This suggests that light exposure in the birth environment, or pre-natal environment may play a role in later behavior leading to suicide.

Therefore, one can postulate that being born in a setting with large amounts of available sunlight would affect the still developing brain to predispose those individuals to suicide later in life. This effect could occur at birth, or earlier in prenatal brain development where maternal exposure to light could affect the still developing brain.

If light is the environmental agent that causes this change, a variety of factors could mediate it in brain development. The eyes, as an extension of the brain, would be the likely mediator of the effect. Hormonally, these effects may be mediated by melatonin. Light affects the production of melatonin and functioning melatonin receptors have been found in the proposed "biologic clock" in the suprachiasmatic nuclei even in fetuses (Reppert, Weaver, Rivkees, & Stopa, 1988).

No real seasonal differences in suicide birth rate occur at lower latitudes which are more populated. However, small seasonal differences in suicide birth rate do occur in the arctic and subarctic. These seasonal differences in suicide birth rate occur where the seasonal differences climatically are the most harsh. In these settings any effect on the seasonal suicide birth rate may be mediated by amount of available light.

Suicide is a final behavior with many biological, psychological, and social precipitants. Much available data lists the importance of depression, substance abuse and social change in the genesis of suicide. This paper examines the environmental variables of latitude and available sunlight at birth on suicide rates. The data shows that areas that have large seasonal differences in available sunlight may have larger seasonal differences in birth rates of suicide victims.

Department of Psychiatry
Pennsylvania State University
College of Medicine
Milton S. Hershey Medical Center
P.O. Box 850
Hershey, PA 17033

References

Barraclough, B., Bunch, J., Nelson, B., & Sainsbury, P. (1974). A hundred cases of suicide: Clinical aspects. *British Journal of Psychiatry, 125,* 355-373.

Barry, H., & Barry, H. (1961). Season of birth—An epidemiological study in psychiatry. *Archives of General Psychiatry, 5,* 100-108.

Beck, A.T., & Lester, D. (1973). Attempted suicide and month of birth. *Psychological Reports, 33,* 506.

Editorial: Seasonality of birth in schizophrenia. (1978). *Lancet, i,* 481-482.

Hare, E. H., & Price, J. S. (1968). Mental disorder and season of birth: Comparison of psychoses with neurosis. *British Journal of Psychiatry, 115,* 533-540.

Hare, E. H., Price, J. S., & Slater, E. (1973). Mental disorder and season of birth. *Nature, 241,* 480.

Knobloch, H., & Pasamanick, B. (1958). Seasonal variation in the births of the mentally deficient. *American Journal of Public Health, 48,* 1201-1208.

Lester, D., Reeve, C., & Priebe, K. (1970). Completed suicide and month of birth. *Psychological Reports, 27,* 210.

Pokorney, A. (1960). Characteristics of forty-four patients who subsequently committed suicide. *Archives of General Psychiatry, 2,* 314-323.

Pulver, A. E., Stewart, W., Carpenter, W. T., & Childs, B. (1983). Risk factors in schizophrenia: Season of birth in Maryland, USA. *British Journal of Psychiatry, 143,* 389-396.

Reppert, S. M., Weaver, D. R., Rivkees, S. A., & Stopa, E. G. (1988). Putative melatonin receptors in a human biological clock. *Science, 242,* 78-81.

Rihmer, Z. (1987). The geography of DST. *Biological Psychiatry, 22,* 1043-1052.

Robins, E., Murphy, G. E., & Wilkinson, R. H. (1959). Some clinical consideration in the prevention of suicide based on a study of 134 successful suicides. *American Journal of Public Health, 49,* 888-899.

Rosenthal, N. E., Targum, S. D., Docherty, J. P., Hoffman, H. A., Hamovit, J. R., Bryant, M. J., & Kasper, S. F. (1988). Seasonal changes in mood at three latitudes. In: Program and Abstracts of the 141st Annual Meeting of the American Psychiatric Association; May 7-13. Montreal, Canada.

Roy, A. (1982). Risk factors for suicide in psychiatric patients. *Archives of General Psychiatry, 39,* 1089-1095.

Sanborn, D. E., & Sanborn, C. J. (1974). Suicide and months of birth. *Psychological Reports, 34,* 950.

Stokes, P. E., Stoll, P. M., Koslow, S. H., Maas, J. W., Davis, J. M., Swann, A. C., & Robins, E. L. (1984). Pretreatment DST and hypothalamic-pituitary-adrenocortical function in depressed patients and comparison groups. *Archives of General Psychiatry, 41,* 257-267.

Torrey, E. F., Torrey, B. B., & Peterson, M. R. (1977). Seasonality of schizophrenic births in the United States. *Archives of General Psychiatry, 34,* 1065-1070.

Author Note

This article was presented at the 144th Annual Meeting of the American Psychiatric Association, New Orleans, Louisiana, May 16, 1991.