

## SEASONAL CHANGES IN SUICIDE IN THE UNITED STATES, 1971 TO 2000<sup>1</sup>

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*Summary.*—The seasonality of suicides in the USA increased from the 1970s to the 1990s. A significant proportion of suicide variation due to the seasonal component has been reported. Noted increments in seasonal rhythms in the latter part of the 1980s and 1990s seem to support those of Warren, *et al.* but contradict the conclusions of diminishing drawn by Hakko, *et al.*, Rhimer, *et al.*, and Yip, *et al.*

Investigations of the seasonality (seasonal variation) in the incidence of suicide were widely published as early as 1825 (Kevan, 1980). These studies were followed by those of Durkheim (1897/1951) who had noted the spring peak and winter dip of suicides using European data. Later, Voracek, Vintill, Fisher, and Yip (2002) cited documentation of seasonality in suicide from various countries over the world, including the most recent studies of suicide by Lester (1997, 1998, 1999). Actually early in the 1970s, Lester (1979) had reported the temporal variation of suicide incidence in the United States of America and documented the seasonal distribution of suicides in 1980 (Lester, 1988) by expressing the variation in percentage deviation from the expected (or chance) distribution. In addition, Warren, Smith, and Tyler (1983) used periodic regression analysis with monthly United States suicide data for the years 1969 to 1978. They reported that the pattern of suicide was distinctly seasonal; it was above average all spring and below average all winter.

Research from industrialized countries like Finland (Hakko, Räsänen, & Tiihonen, 1998a, 1998b), Sweden (Rhimer, Rutz, Philgren, & Pestality, 1998), Australia and New Zealand (Yip, Chao, & Ho, 1998), and England and Wales (Yip, Chao, & Chiu, 2000) has shown a diminishing pattern in the

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suicide seasonality over the past few decades. In sum, these latter findings stem solely from countries which were politically and socially stable during the study period. In this study we examine whether these trends can be generalized to the USA over the three decades for the period 1971 to 2000.

#### METHOD

Data were made available by the National Center for Health Statistics on all 865,928 suicides (by all methods) in the United States over the study period of 1971 to 2000. The seasonal variation of these suicides were examined in three ways. First, the monthly distribution of suicides in the past three decades, 1970s, 1980s, and 1990s, were plotted. Second, a chi-square test was performed to examine the evenness of the monthly average suicide incidence for the three decades. Third, a harmonic time series model was applied. The nonparametric model assumes that the total variance of the monthly suicide data can be separated into three components, random, seasonal and nonseasonal; as a result the percentage of total variance attributable to seasonal variation as well as to random and nonseasonal variation can then be calculated. The alternative hypotheses are that the variation is purely random for each time period; therefore, the monthly suicide incidence for a time period may be considered as an independent variable following a Poisson distribution. Details of the significance testing for different variation components can be found in Pocock (1974) and Yip, *et al.* (1998).

#### RESULTS AND DISCUSSION

There were a total of 865,928 reported suicides in the USA between 1971 and 2000. Fig 1 gives the 3-mo. moving average of suicide deaths over the period, and a systematic cyclic pattern is observed per year. A slight upward trend was detected ( $p < .01$ ) in the two decades (1971 to 1980 and 1981 to 1990), and the suicide rate remained stable for the period 1991 to 2000. Fig. 1 suggests the presence of seasonal components of suicide incidence in the USA. Fig. 2 shows the monthly average distribution of suicide deaths in the USA by decades in which the calendar month difference was adjusted accordingly. In the 1970s, clearly a bimodal pattern was observed with relatively high incidence in early spring (April and May) and a second peak in September. The monthly distributions of the two decades (1981 to 1990 and 1991 to 2000) are rather similar to each other with a low incidence in winter. The nonparametric chi-squared statistics for testing the even distribution of suicide incidence give significant values of 28.6 ( $p < .01$ ), 450.7 ( $p < .01$ ), and 731.1 ( $p < .01$ ) for the three decades, respectively. The results are consistent with Lester's work (1988) on his suicide study for the years of 1978 to 1979 and 1982 as well.

Table 1 gives the results of harmonic analysis and its proportion of variance which is explained by random, seasonal, and nonseasonal components

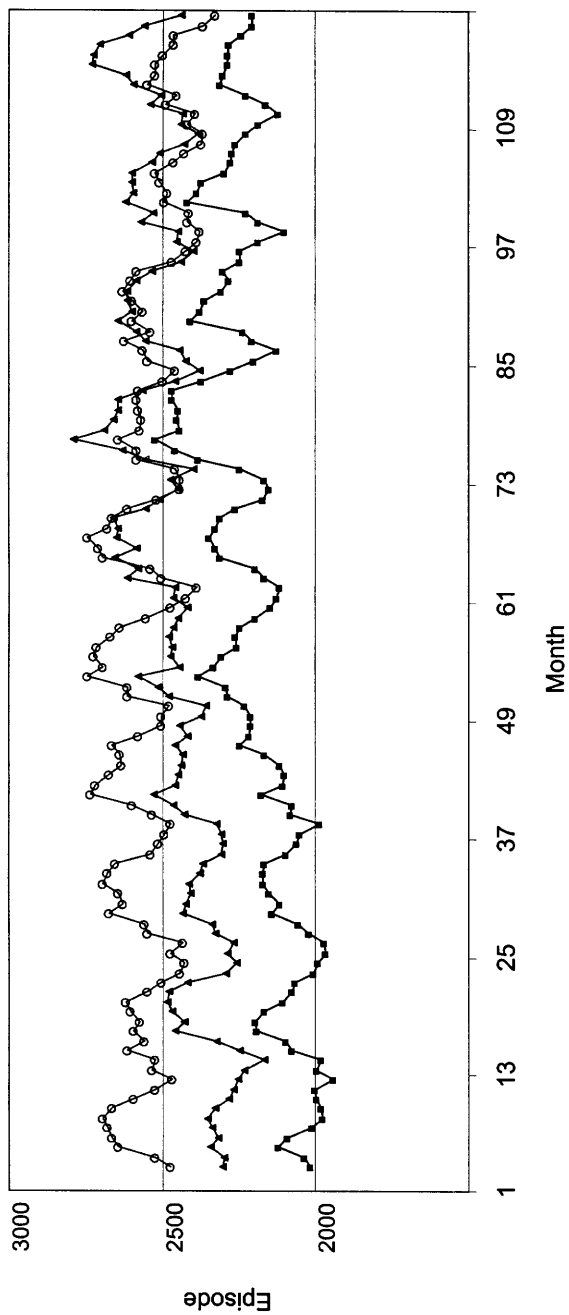


FIG. 1. Three-month moving average of suicide deaths in the United States 1971-1980 (■), 1981-1990 (▲), 1991-2000 (○)

TABLE 1  
HARMONIC ANALYSIS OF MONTHLY DISTRIBUTION OF SUICIDES FOR  
THREE DECADES IN USA 1971–2000

Components of Variance	1971–1980		1981–1990		1991–2000	
	<i>f</i>	%	<i>f</i>	%	<i>f</i>	%
All seasonal harmonics	4172.6	47	7057.6	60	7327.9	63
One-cycle	2808.3	67	4580.2	65	5094.1	70
Two-cycle	1260.1	30	1220.2	17	967.8	13
Three-cycle	37.4	1	221.9	3	208.8	3
Four-cycle	0.0	0	209.4	3	199.3	3
Five-cycle	39.1	1	287.0	4	775.4	11
Six-cycle	30.7	1	539.0	8	82.5	1
Nonseasonal harmonics	2435.9	28	2335.9	20	1833.9	16
Random variation	2200.7	25	2467.8	21	2547.9	22
Total variance	8809.3	100	11861.3	100	11709.7	100

† $p < .01$ . ‡ $p < .001$ .

for the three decades. For the time period of 1971 to 1980, about 47% of the total variances can be explained by the seasonal components, and the two cycles are significant, indicating a biseasonal pattern during this period. In the meantime about 28% and 25% of the total variance are attributed to the nonseasonal and random components, respectively. The seasonal component of suicide incidence for the time period 1981 through 1990 is clearly significant and records about a 27.7% increase in seasonal contribution by comparison with the previous period. This accounts for about 60% of the total variation in which all six harmonic cycles are statistically significant. It

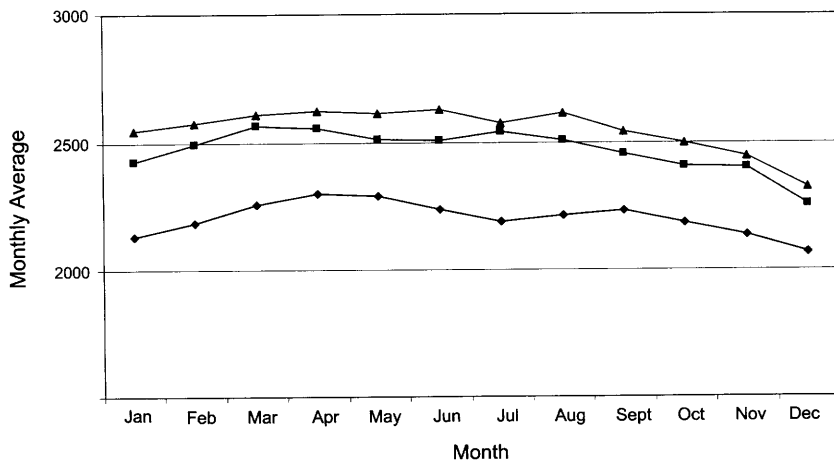


FIG. 2. Average monthly suicide deaths in the United States 1971–1980 (◆), 1981–1990 (■), 1991–2000 (▲)

suggests greater monthly fluctuation of incidence of suicide. Both nonseasonal and random components during this period account for about 21% of the total variance. The significant seasonal rhythm in the 1980s was also found for the period 1991 to 2000 which explained 63% of the total variation.

There is still a significant seasonal rhythm of suicide occurrence in United States for the period 1971 to 2000. The significant rhythm and an increment in seasonal variation supports the study by Warren, *et al.* but contradicts the studies of others (Hakko, *et al.*, 1998a, 1998b; Rhimer, *et al.*, 1998; Yip, *et al.*, 2000). Since there are significant regional differences in suicide rates in the United States, it might be worthwhile to examine the seasonality in a more regional context.

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