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Seasonal variation in suicides re-examined: no sex difference in Hong Kong and Taiwan

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The seasonal variation in suicides in Hong Kong and Taiwan during the period 1981 to 1993 was examined using harmonic analysis. A single cycle per year with lowest incidence in the winter months was found in both locations and for both sexes. Despite the regional differences in ascertainment procedures and preferred suicide methods, the absence of a biseasonal distribution of female suicides was consistently observed. This finding was contrary to that reported in many Western countries. A non-shared psychosocial process underlying the cross-cultural difference in the seasonality of female suicide is suggested.

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Introduction

During the past 15 years, several papers have consistently suggested that there is a biseasonal distribution of suicides in the female population, but the phenomenon was not reported in men. Meares et al. (1) studied the incidence of suicides in the UK from 1958 to 1974 and found that men had a single 12-monthly cycle, whereas women had two cycles per year. Nayha (2) applied harmonic analysis to suicide data in Finland for the period from 1961 to 1976 and found a second rise in female suicide rate in the autumn. Similarly, Parker & Walter (3) in Australia and Micciolo et al. (4) in Italy reported the existence of a second peak of female suicide in the autumn months. Some previous studies failed to demonstrate a biseasonal peak of female suicide (5, 6), and this could be due to the use of a less powerful Chi-square statistic and the limited number of years studied (4).

The reason for the autumn peak of female suicides is far from clear. Several authors linked the phenomenon to the seasonality of depression (3, 4), but there was no conclusive evidence of a sex difference in the time of onset or admission for depression. More recently, Maes et al. (7) reported a bimodal seasonal pattern in the availability of plasma L-tryptophan, which matched the seasonal patterns of violent suicides. However, no sex difference in the seasonal pattern of the availability of L-tryptophan was evident. Nayha (8) reported that the autumn peak of female suicides was more prominent among married and widowed women. Micciolo et al. (9) demonstrated that the autumn peak of suicides occurred in women living in both rural and urban locations in Italy. Both suggested that this autumn peak of female suicides might be related to the seasonal variation in communal activities found particularly in females.

It has to be noted that female suicides in many Asian countries, including Hong Kong and Taiwan, have different characteristics to those in the West (10). In particular, female subjects in these regions have relatively high suicide rates regardless of age group (11–14). This high female suicide rate has been said to be linked with the low social status of women in these societies (15, 16). If the autumn peak of female suicides found in the West is related to seasonal variation in social activities, studies conducted in different socio-cultural settings where women have different roles and expectations concerning the ways in which they organize their social activities may reveal a different annual cycle of distribution. The aim of this paper is to explore the seasonal variation in suicides in Hong Kong and Taiwan, and to determine whether it shows a similar sex difference to that reported in the West. To our knowledge, this is the first paper to examine

sex differences in the seasonal variation in suicides in non-Western countries.

Material and methods

Data for all deaths by suicide in Hong Kong between 1 January 1981 and 31 December 1993 were available from the Census and Statistics Department (R. Wan, personal communication, 1994). In Hong Kong, a regionalized system of ascertainment of death due to unnatural causes through the Coroner's court has been established since the 1950s (17). Similar data for deaths by suicide occurring in the same period in Taiwan were obtained from the Department of Health of the Executive Yuan of Taiwan (L. L. Yu, personal communication, 1995). In Taiwan, cases of suicide were ascertained by either the Coroner or the medical practitioner, depending on where the death took place. The data were reported to the local registry office. In Taiwan, all births, deaths, migrations and changes of home address must be reported to the local registry office.

The seasonal variations in suicide were examined in two ways. First, the number of suicides for each month during the past 13 years was plotted separately for each sex. Secondly, a harmonic analysis was applied. The method was similar to that employed by Micciolo et al. (4) and described in detail by Pollock (18). According to the time-series model, the variation between the months could be described by the sum of sinusoidal curves. The seasonal variation consisted of components with cycles which repeated themselves an exact number of times each year. We have 13 completed years divided into $12 \times 13 = 156$ monthly intervals. Such intervals are not of constant length, and the suicide numbers of the months were adjusted as follows. Let x^*_{ij} be the suicide number of year i and month j. The adjusted suicide number is calculated by

$$x_{ij} = \frac{x^*_{ij}}{\text{length of month } j \text{ in year } i} \times \frac{4748}{156}$$

where 4748 is the total number of days in the period 1981–1993 and $4748/156 = 30.44$ is the adjusted factor. To eliminate the year effect from the data, define the 'residuals' $A_{ij} = x_{ij} - (\bar{x}_{i\cdot} - \bar{x}_{\cdot\cdot})$ where $\bar{x}_{i\cdot}$ is the average number of suicides in year i and $\bar{x}_{\cdot\cdot}$ is the grand total mean. Following Pollock (18), assume A_{ij} are independent and identical Poisson with mean α and relabel the subscript ij as i for 1, 2, ..., 156. According to the theory of Fourier analysis,

$$A_i = a_o + \sum_{j=1}^{78} \left(a_j \cos \frac{2\pi ij}{156} + b_j \sin \frac{2\pi ij}{156} \right)$$

where a_j and b_j are constant, a_o is the mean suicide number and

$$a_j \cos \frac{2\pi ij}{156} + b_j \sin \frac{2\pi ij}{156}$$

is commonly referred to as the jth harmonic of A_i with period $13/j$ years and frequency per annum $j/13$. The harmonics with j=13, 26, 39, 52, 65 and 78 have periods 1, 1/2, 1/3, 1/4, 1/5 and 1/6 years and frequency per annum 1, 2, 3, 4, 5 and 6, respectively. These harmonics have a cycle which repeats an exact number of times per year, and follow the same pattern in years as any combinations of such harmonics. The total variance of A_i under the assumption that A_i are Poisson random variables can be decomposed into three components: random, seasonal and non-seasonal. In this way it is possible to calculate the percentage of total variance attributable to seasonal variation as well as to random and non-seasonal variation.

Results

In total, 7744 subjects (4478 males and 3266 females) and 23 836 suicides (14 808 males and 9028 females) were identified in Hong Kong and Taiwan, respectively, during the study period. Figure 1 shows the number of suicides, for both male and female subjects, in each calendar month during the past 13 years in Hong Kong. Similar data for Taiwan are shown in Fig. 2.

It can be seen that the highest suicide figures usually occur in the summer months, and no autumn peak of female suicide is evident. Overall, there is no obvious sex difference in seasonal variation. In both Hong Kong and Taiwan the lowest suicide rates are recorded in the winter months, irrespective of sex.

Table 1 shows the standardized and crude suicide rates (male and female) per 100 000 members of the population for Hong Kong and Taiwan. The standardized rates have been lower than the crude rates in recent years due to the ageing population in the two locations. During the past 13 years, a small increase in suicide rates has been recorded in Hong Kong, and a more significant decrease has been observed in Taiwan. The long-term linear trends could be expressed in linear regressions of suicide rates against time as follows:

Hong Kong males, $y = 10.6 + 0.149x$
(not significant)
Hong Kong females, $y = 8.45 + 0.109x$
(not significant)
Taiwan males, $y = 16.2 - 0.704x$
(significant at 1%)

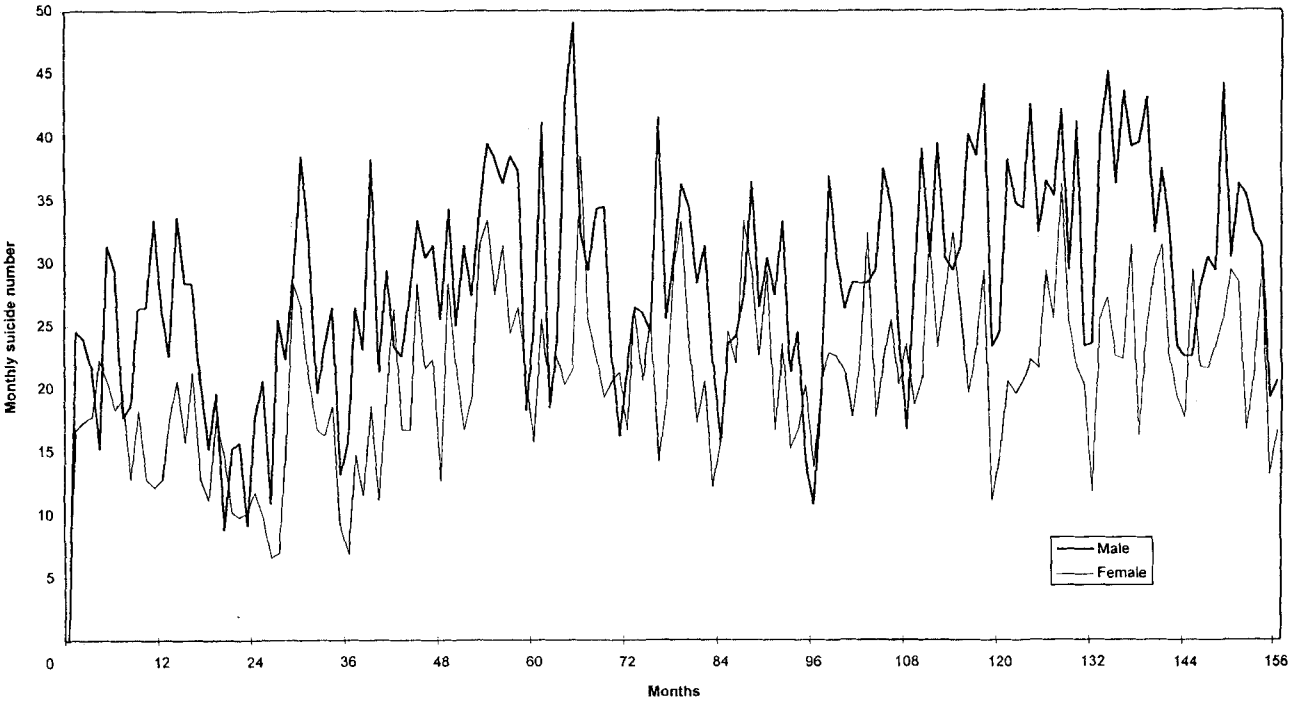

Fig. 1. Hong Kong monthly data for deaths by suicide, for the period 1981–1993.

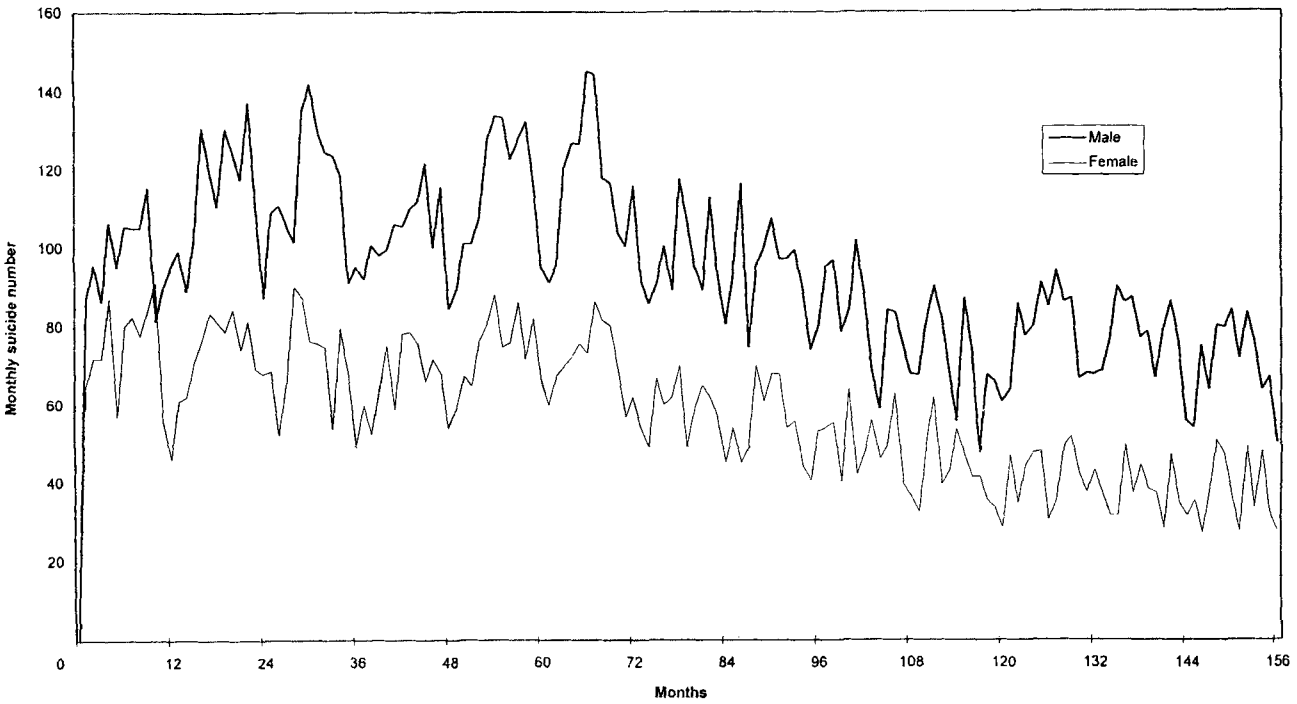

Fig. 2. Taiwan monthly data for deaths by suicide, for the period 1981–1993.

Taiwan females, $y=11.8-0.625x$
(significant at 1%)

where y is the suicide rate and x is the number of years since 1981. The regression coefficients in the regression equations for Taiwan's male and female subjects had P-values lower than 0.001, whereas non-significant results were obtained for Hong Kong.

Table 2 shows the results of harmonic analysis and the proportion of variance in suicide accounted for by random, seasonal and non-seasonal components.

Table 1. Standardized suicide rates in Hong Kong and Taiwan, for the period 1981–1993[a]

Years	Hong Kong subjects		Taiwan subjects	
	Male	Female	Male	Female
1981	11.7 (10.8)[b]	8.7 (8.1)	13.3 (12.4)	10.6 (10.0)
1982	9.0 (8.6)	7.3 (6.8)	15.1 (14.2)	10.6 (10.1)
1983	9.0 (10.0)	7.3 (7.1)	14.9 (14.3)	9.7 (9.4)
1984	12.3 (12.0)	8.7 (8.5)	13.0 (12.6)	9.0 (8.8)
1985	13.9 (13.7)	11.4 (11.3)	14.1 (13.9)	9.8 (9.6)
1986	12.9 (12.9)	10.2 (10.2)	13.9 (13.9)	9.1 (9.1)
1987	11.7 (11.9)	9.4 (9.5)	11.1 (11.3)	7.3 (7.4)
1988	10.1 (10.4)	9.7 (9.8)	10.6 (10.9)	6.7 (6.9)
1989	11.1 (11.7)	9.5 (9.7)	9.0 (9.4)	5.8 (6.1)
1990	12.8 (13.7)	9.7 (10.1)	7.7 (8.1)	4.9 (5.2)
1991	13.0 (14.1)	9.3 (9.8)	8.4 (9.0)	4.8 (5.1)
1992	13.7 (14.7)	9.7 (10.2)	8.0 (8.7)	4.1 (4.5)
1993	10.8 (12.0)	8.9 (9.5)	7.1 (7.8)	4.1 (4.5)

[a] Standardized by the mid-year 1986 population of Hong Kong and Taiwan, respectively.
[b] Values in parentheses are the crude suicide rates.

Table 2. Harmonic analysis of monthly suicide data for Hong Kong and Taiwan, for the period 1981–1993

	Component of variance	
	Male subjects	Female subjects
Hong Kong		
All seasonal harmonics	12.32 (26.7)	7.65 (25.9)
1 cycle	7.54 (16.4)	5.66 (19.2)
2 cycles	1.90 (4.1)	0.06 (0.2)
3 cycles	2.06 (4.5)	1.38 (4.7)
4 cycles	0.82 (1.7)	0.22 (0.7)
5 cycles	0	0.33 (1.1)
6 cycles	0	0
Non-seasonal harmonics	5.12 (11.1)	0.90 (3.1)
Random variation	28.70 (62.2)	20.93 (71.0)
Total variance	46.14 (100)	29.48 (100)
Taiwan		
All seasonal harmonics	50.37 (31.6)	28.72 (33.2)
1 cycle	46.92 (29.4)	21.12 (25.1)
2 cycles	0.13 (0.1)	3.33 (3.9)
3 cycles	3.32 (2.1)	0
4 cycles	0	3.05 (3.6)
5 cycles	0	0.67 (0.8)
6 cycles	0	0.55 (0.6)
Non-seasonal harmonics	14.04 (8.8)	0
Random variation	94.94 (59.6)	57.85 (66.8)
Total variance	159.35 (100)	84.23 (100)

[a] Percentage values are shown in parentheses.

Only 26.7% and 25.9% of the total variation can be explained by the seasonal components for male and female subjects, respectively, in Hong Kong. Nevertheless, it can be seen that the only important seasonal harmonic was the one cycle per year (in males accounting for 16.4% of the total variance and 61% of the seasonal variance, and in females accounting for 19.2% of the total variance and 74% of the seasonal variance). A strikingly similar picture emerges from the data for Taiwan. About one-third of the total variance could be explained by the seasonal components for both sexes in Taiwan. Again, the first harmonic (one cycle per year) was the most important (in males 29.4% of the total variance and 93.1% of the seasonal variance, and in females 25.1% of the total variance and 73.5% of the seasonal variance). In both locations, and for both sexes, the second harmonic (two cycles per year) accounted for a non-significant proportion of the total variance and was much smaller than the first harmonic. In short, irrespective of sex, the pattern of one cycle per year was the only important cycle we could identify in our suicide data for both Hong Kong and Taiwan.

Discussion

In a similar manner to findings reported for many Western countries, male suicides in Hong Kong and Taiwan showed a clear circannual rhythm, and the lowest suicide rates were recorded in the winter months. Unlike their Western counterparts (1–4), female suicides in both Hong Kong and Taiwan did not show a biseasonal distribution. The number of female suicides recorded showed the same winter trough as that found in men, and there was no strong evidence for a second peak of female suicides.

The finding reported here is unlikely to be due to ascertainment bias. Ascertainment of suicide through the Coroner's court probably underestimates the true suicide rate, but is unlikely to introduce seasonal variation. If an autumn peak of female suicides is masked by the ascertainment procedure, it must be postulated that the bias varies systematically with seasonality and operates in different ways in male and female subjects. According to the present authors, this is highly improbable. Furthermore, given that the ascertainment of suicide differs in Hong Kong and Taiwan, it is difficult to conclude that ascertainment bias alone could account for the consistent findings in both locations. Nor can the differences in the results be explained by variation in statistical methods. We deliberately followed quite closely the reported procedures to detect seasonality in the previous study (4), but we cannot identify the biseasonal distribution of female suicides found in the West. In short, we consider that the lack of a biseasonal distribution of female suicides in the present study is a fairly robust finding.

Both Massing & Angermeyer (19) and Lester & Frank (20), in their respective German and US samples, noted that the seasonal distribution of

suicides varied according to the method of suicide. Maes et al. (21), in their Belgium sample, reported that seasonality was present in the case of violent but not non-violent suicides. These findings gave rise to the suggestion that a sex difference in the seasonality of suicides could be confounded by a sex difference in suicide methods. It is noteworthy that in Hong Kong there was no obvious sex difference in suicide methods (the incidence of jumping from a height was 44.2% in males and 44.8% in females, hanging was 39.6% in males and 35.6% in females, and self-poisoning was 7.2% in males and 11.2% in females) (11). For the Taiwan data there was a clearer sex difference in suicide methods, and different methods were preferred (self-poisoning, 50.2% in males and 60.7% in females; hanging, 40.8% in males and 32.6% in females; jumping from a height, 1.7% in males and 2.1% in females). If a regional difference in suicide methods and sex distribution of suicide methods exists, the method of suicide alone may not adequately explain the consistent absence of a biseasonal distribution of female suicides observed in both locations. However, the possibility remains that one particular suicide method (or a small number of methods) preferred by Western females, but rarely employed by Hong Kong and Taiwan females, accounted for the biseasonal pattern. Separate analysis of seasonality specific to suicide methods across different settings will help to unravel the role of suicide methods in the seasonal distribution of suicide.

Despite the confirmation of a biseasonal distribution of female suicides in different Western countries (1–4), the present study suggests that the phenomenon is not universal. It also points towards a non-shared psychosocial process underlying the seasonality of female suicides across different socio-cultural settings. It can be argued that females in both Hong Kong and Taiwan may experience high levels of social stress which contribute to a uniformly high suicide rate (15, 16) throughout the year and thus eliminate the possibility of an autumn peak. On the other hand, Western females may experience additional stresses in the autumn, particularly in the case of married and widowed women (8), possibly related to a reduced number of social contacts in that season (4). In the present study, as well as those reporting a biseasonal distribution of female suicides, the findings were based on official statistical data, and unfortunately the relevant social data that would allow an empirical test of the above hypothesis were not available.

Admittedly, the precise reasons why Chinese female suicides do not show the biseasonal distribution found in the West are far from clear. In the present study we have attempted to replicate the results in two different locations. The hypothesis that variation in ascertainment of suicides and statistical methods could account for the present findings is highly unlikely. If the autumn peak of female suicides is related to socio-cultural factors that are absent in Chinese societies, we postulate that the seasonality of female suicides in other Asian or patriarchal societies will produce similar findings to those reported in the present study. Further research on the seasonal variation of suicide deaths, particularly among female subjects, needs to explore the influence of social status, the effect of seasonal variation in social stressors, and the method of suicide employed.

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