



Research report

A comparison of seasonal variation between suicide deaths and attempts in Hong Kong SAR

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Abstract

Background: Seasonal variations in suicide deaths and attempted suicides have been reported for many countries. Recent research has suggested that seasonal patterns of suicide deaths have diminished considerably. The seasonality pattern between attempts and completed ones are not the same. This paper is the first one to examine seasonal variation between suicide deaths and attempts simultaneously. **Method:** Census and Statistics Department and the Hospital Authority provided mortality and morbidity data on suicides for the period 1997–2001 in Hong Kong SAR, respectively. Seasonal patterns of suicide deaths and attempts were examined by a harmonic analysis and a non-parametric chi-square test. **Results:** A significant seasonal variation was detected in suicide attempts with a markedly bi-seasonal pattern was found amongst females with a peak in May and October; only a cyclic pattern was observed for males with a peak in summer. The female attempters who used non-violent suicide methods contributed to the second peak in October. On the other hand, there was no evidence of significant differences in the seasonal distribution among the suicide deaths for males and females. Only a mild pattern was found amongst females involving in violent suicide deaths, while others can be treated as a random event and no significantly pattern was observed in our study. Overall, a significant difference in seasonal variation existed between suicide deaths and attempts (p -value < 0.01). **Conclusions:** This study reinforces the findings that seasonal variation in suicide appears to be diminishing. Also, suicide attempters and completed suicides in Hong Kong seem to arise from two non-identical but overlapping groups in the community.

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Keywords: Hong Kong SAR; Harmonic analysis; Seasonality; Suicide deaths; Suicide attempts

1. Introduction

Many studies in West suggested a bi-seasonal pattern of suicides amongst female population while

a cycle per year and no pattern was observed in males (Parker and Walter, 1982; Micciolo et al., 1989). Seasonal variation does not only exist in suicide deaths but also amongst suicide attempts which is an act of potentially self-injurious with a non-fatal outcome, for which there is evidence of that the person intended at some level to kill himself/herself (O'Carroll et al., 1996). There was high association between these two data sets. Masterton (1991), Barker et al. (1994), De Maio et al. (1982), Bianco et al.

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(1998) and Preti and Miotto (2000) studied the subjects involved in deliberate self-harm and reported significance of seasonality of suicide attempts. Ho et al. (1998) suggested that social and cultural background distinction in Asian countries from West may help account for the difference in seasonality of suicide attempts. Seasonal variation in specific methods of suicide was found (Rasanen et al., 2002; Ajdacic-Gross et al., 2003; Yip et al., 1998). The preference in adoption of suicidal method may be another key factor in accounting for the distinction in seasonal pattern of suicidal behavior (Hawton et al., 1998; Ho et al., 1997).

Brewerton (1989) pointed out the existence of seasonality in serotonin functionality in human being, which regulates mood and impulse control in our brain and its activity in brain is sensitive to the change of climate. The correlation between serotonin functionality or mood disorder and suicide ideation/behavior may somehow help explain the seasonality in suicides or suicide attempts (Malone and Mann, 1998; Atmaca et al., 2002; Maes et al., 1996; Morken et al., 2002). No clear seasonal pattern was reported in suicide deaths for both genders in Hong Kong (Ho et

al., 1997; Yip et al., 2001). This paper is the first of this kind to examine seasonal variation of suicide deaths and attempts simultaneously for the same period and to make comparison of their variation with respect to gender and method used.

2. Methods

Census and Statistics Department provided us with mortality data in HKSAR, whose death had received a verdict of suicide between 1997 and 2001. The Hospital Authority provided information on Accident and Emergency patients with diagnosis of deliberate self-harm upon admission and being admitted inpatients. All of suicide deaths and attempts method were classified and recorded according to the ICD-9 (WHO, 1978). The coverage of suicide attempters by the Hospital Authority is high though there is an insignificant proportion of attempters who were discharged against medical advice and were not recorded and not available for analysis. We examined the seasonal variations of suicide deaths and attempted suicides with respect to gender and method used. The

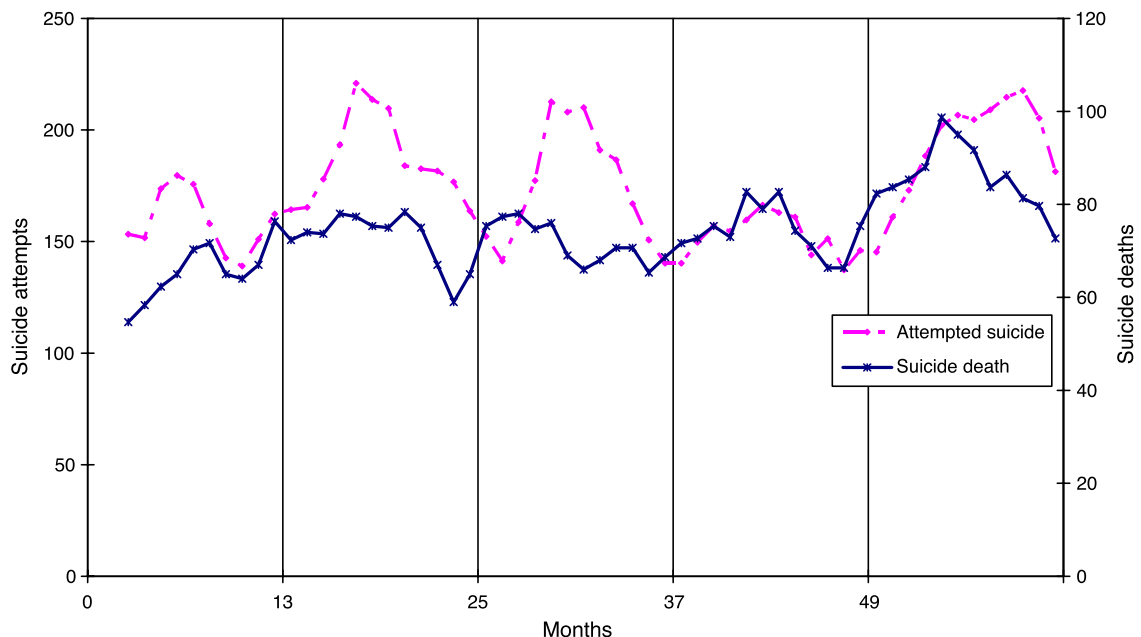


Fig. 1. Three-month moving average number of suicide deaths and attempts in HKSAR for the period of 1997–2001.

seasonal variations were examined in three ways. First, 3-month moving averages of suicides and attempts for the period 1997–2001 for HKSAR were

plotted. Second, a chi-square test was adopted to examine the distribution of the cumulative number of suicide deaths and attempts for each month for the

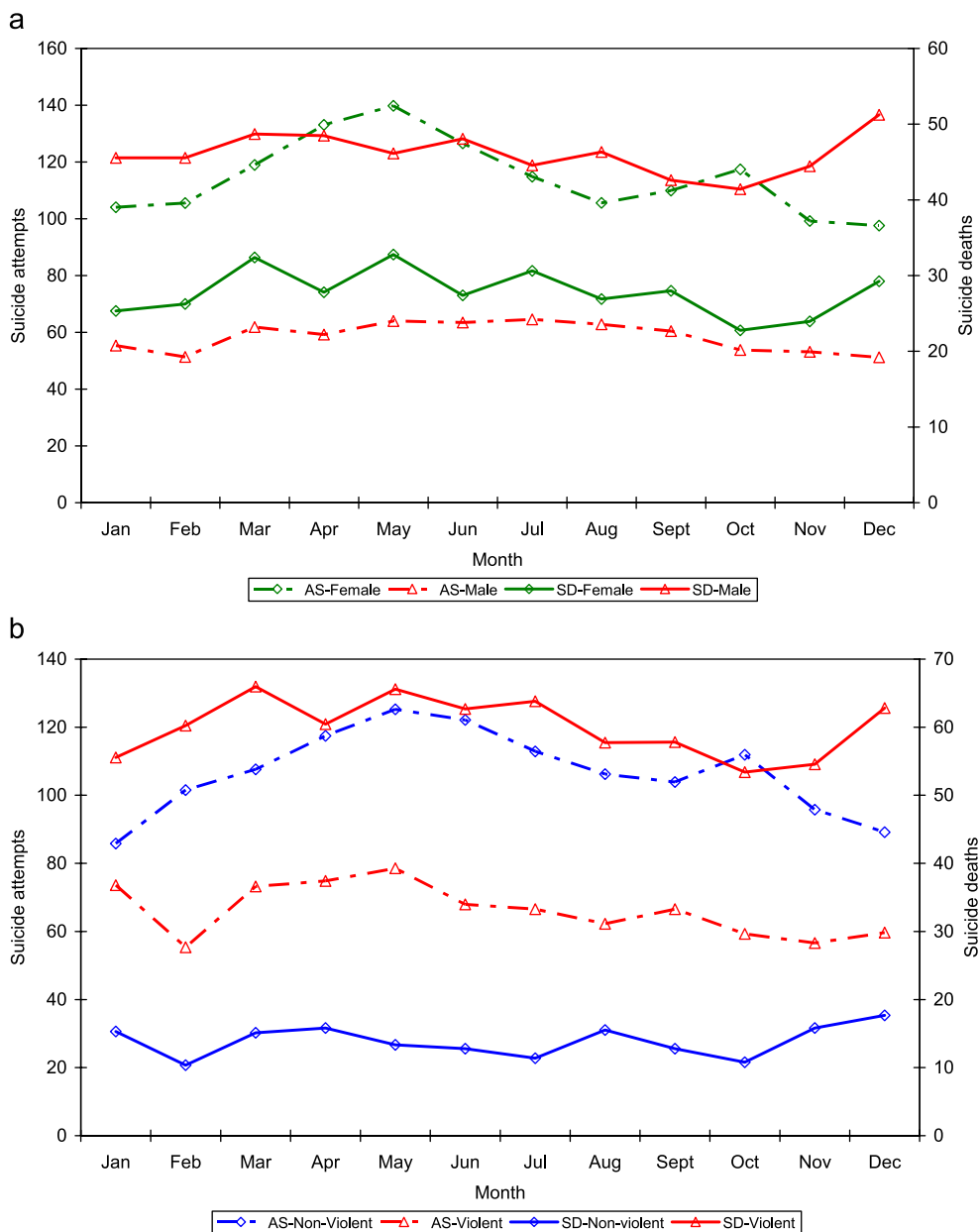


Fig. 2. (a) Monthly average of suicide deaths and attempts by gender in HKSAR. (b) Monthly average of suicide deaths and attempts by method in HKSAR.

period 1997–2001. Third, we employ a harmonic analysis, which assumes the total variance of the distribution of the monthly suicide data can be decomposed into three components: random, seasonal and non-seasonal. Thus, the attributed percentage of each component could be calculated in explaining the variation. Detailed description of harmonic analysis and the significance testing of various harmonics can be found in Pocock (1974) and Yip et al. (1998).

3. Results

There were 4429 (1663 females and 2766 males) suicide deaths and 10,376 (6866 females and 3510 males) suicide attempts in Hong Kong between 1997 and 2001. Fig. 1 shows 3-month moving averages of the number of suicide deaths and attempts for each month for the period 1997–2001 separately. Suicide

deaths appear to have a summer peak with an increasing trend (p -value < 0.01). Also, a relatively consistent seasonal pattern holds amongst suicide attempts with a peak in early summer and a trough in winter time. No increasing trend was detected in suicide attempts ($p < 0.26$). Fig. 2a and b gives adjusted monthly average of suicide deaths and attempts (adjusted by the number of days for different months in a year) by gender and methods, respectively. Female attempters have a peak in May and a minor peak in October, whereas the seasonality for male is not so significant. Also, the non-violent method attempters display more seasonality than their violent counterparts. Overall, a significant seasonal variation exists for suicides and suicide attempts for the period of study. A χ^2 test for an evenly distribution of suicide attempts gives significant results with the values of 92.44 (p -value < 0.01) and 24.71 (p -value = 0.01) for females and males, respectively. However, for completed suicides, only females

Table 1
Harmonic analysis of monthly distribution of suicide attempts and deaths by gender (1997–2001)

Component of variances	Overall	Female	Male
<i>Attempted suicides</i>			
All seasonal harmonics	242 (42%)	149 (43%)	21 (21%)
One cycle	212.6*** (88%)	109.5*** (73%)	18.7*** (89%)
Two cycle	28.0** (12%)	34.1*** (23%)	0 (0%)
Three cycle	1.4 (1%)	4.7 (3%)	0 (0%)
Four cycle	0 (0%)	0.7 (0%)	0 (0%)
Five cycle	0 (0%)	0 (0%)	0 (0%)
Six cycle	0 (0%)	0 (0%)	2.3 (11%)
Non-seasonal harmonics	161.9 (28%)	79.6 (23%)	18.6 (19%)
Random variation	172.8 (30%)	114.4 (33%)	58.5 (60%)
Total variance	576.7 (100%)	343 (100%)	98 (100%)
<i>Suicide deaths</i>			
All seasonal harmonics	13.5 (15%)	5 (18%)	1.1 (2%)
One cycle	7.5* (56%)	2.4* (48%)	0.8 (72%)
Two cycle	0 (0%)	0 (0%)	0 (0%)
Three cycle	3.3 (24%)	0.1 (2%)	0.3 (28%)
Four cycle	2.7 (20%)	0.3 (6%)	0 (0%)
Five cycle	0 (0%)	0.7 (14%)	0 (0%)
Six cycle	0 (0%)	1.5 (30%)	0 (0%)
Non-seasonal harmonics	2.6 (3%)	0 (0%)	4.3 (8%)
Random variation	73.8 (82%)	23.2 (82%)	46.1 (89%)
Total variance	89.8 (100%)	28.2 (100%)	51.5 (100%)

*** $p < 0.001$.

** $p < 0.01$.

* $p < 0.05$.

had a statistically significant result ($\chi^2=20.19$, p -value=0.04), which was mainly contributed by violent suicides ($\chi^2=21.8$, p -value=0.026).

Table 1 gives the results of using a harmonic analysis and the proportion of variances in suicide deaths and attempts explained by random, seasonal and non-seasonal components for both genders. For suicide attempts, about 43% of the total variances can be explained by the seasonal components and the first two harmonic cycles are found to be significant. About 43% and 21% of the total variances can be explained by the seasonal components for female and male attempters, respectively. A bi-seasonal pattern is detected amongst females on suicide attempts, while only a cyclic pattern is found amongst males. However, for completed suicides, the seasonal components could only account for 18% and 2% of the total variation for females and males for the study period, respectively, whereas the random component for females and males

are 82% and 89%, respectively. Only a mildly cyclic pattern could be found amongst females in suicides and others can be seemed as a random event and no significant seasonal pattern is found.

Table 2 shows that about 42% and 17% of total variance can be explained by the seasonal components for females and males engaging in non-violent suicide attempts (e.g. poisoning), respectively, where the first two harmonics are found to be significant amongst female attempters. Two cycles for women but only a cyclic pattern is detected for males. For violent suicide attempts (e.g. jumping, hanging, etc.), about 30% and 16% of total variance can be explained by the seasonal components for females and males, respectively. For suicide deaths, however, the seasonal components for the period 1997–2001 can only account for 17% and 15% of the total variance for non-violent and violent suicides overall, which is mainly contributed by males engaging in non-violent suicides and

Table 2
Harmonic analysis of monthly distribution of suicide attempts and deaths by gender and method (1997–2001)

Component of variances	Non-violent			Violent		
	Overall	Female	Male	Overall	Female	Male
<i>Attempted suicides</i>						
All seasonal harmonics	126.3 (39%)	83.0 (42%)	8.3 (17%)	51.5 (38%)	21.3 (30%)	5.5 (16%)
One cycle	103.3*** (82%)	55.7*** (67%)	8.3*** (100%)	24.2*** (47%)	11.5*** (54%)	2.1* (38%)
Two cycle	18.4** (15%)	19.8*** (24%)	0 (0%)	0.0 (0%)	0.8 (4%)	0 (0%)
Three cycle	3.7 (3%)	4.7 (7%)	0 (0%)	7.6* (15%)	4.5** (21%)	0 (0%)
Four cycle	0.0 (0%)	0 (0%)	0 (0%)	2.9 (6%)	0 (0%)	0.9 (17%)
Five cycle	0.0 (0%)	0 (0%)	0 (0%)	1.0 (2%)	0 (0%)	0.2 (3%)
Six cycle	0.8 (1%)	2.8 (3%)	0 (0%)	15.7*** (31%)	4.6** (22%)	2.3* (42%)
Non-seasonal harmonics	91.5 (28%)	39.0 (20%)	8.0 (17%)	17.8 (13%)	10.8 (15%)	1.1 (3%)
Random variation	106.6 (33%)	75.0 (38%)	31.6 (66%)	66.2 (49%)	39.4 (55%)	26.9 (80%)
Total variance	324.2 (100%)	197.0 (100%)	47.9 (100%)	135.4 (100%)	71.5 (100%)	33.5 (100%)
<i>Suicide deaths</i>						
All seasonal harmonics	2.9 (17%)	0 (0%)	1.1 (12%)	11.8 (15%)	4.8 (21%)	1.5 (3%)
One cycle	0.1 (2%)	0 (0%)	0.1 (6%)	8.9** (76%)	2.1* (44%)	1.5 (100%)
Two cycle	0 (0%)	0 (0%)	0.2 (17%)	0 (0%)	0 (0%)	0 (0%)
Three cycle	2.7** (93%)	0 (0%)	0.8* (70%)	0 (0%)	0 (0%)	0 (0%)
Four cycle	0 (0%)	0 (0%)	0 (0%)	1.1 (9%)	0 (0%)	0 (0%)
Five cycle	0.1 (5%)	0 (0%)	0.1 (7%)	1.8 (15%)	1.6* (33%)	0 (0%)
Six cycle	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1.1 (23%)	0 (0%)
Non-seasonal harmonics	0 (0%)	0 (0%)	0 (0%)	5.4 (7%)	0 (0%)	6.3 (14%)
Random variation	13.6 (83%)	4.2 (100%)	8.7 (88%)	59.9 (78%)	17.8 (79%)	37.4 (83%)
Total variance	16.5 (100%)	4.2 (100%)	9.8 (100%)	77.1 (100%)	22.6 (100%)	45.2 (100%)

*** $p < 0.001$.

** $p < 0.01$.

* $p < 0.05$.

females in violent suicides respectively. Others involving in suicides can be treated as a random event and no significant pattern is found.

4. Discussion

Seasonality in suicide deaths and attempts has been extensively studied. However, it is the first paper to investigate seasonality of suicides and attempted suicides simultaneously. Seasonality between suicides and attempts is different. In an earlier study of seasonality of Hong Kong, clearly a cyclic pattern per year of suicides was reported in males and no bi-seasonal pattern observed amongst females with a tendency of diminishing in seasonal amplitude (Yip et al., 2001). The mild and insignificant seasonal component reported amongst suicides in this study confirms the results of diminishing seasonality (Yip et al., 2000). However, the diminishing phenomenon has yet to be seemed in other countries with extreme weather condition and/or less developed countries (Partonen et al., 2003; Rasanen et al., 2002).

Two cycles for female attempts were observed in Hong Kong, which has a similar pattern among female suicides in West with two peaks. Meares et al. (1981) investigated suicides in UK and reported a single annual cycle in males but two cycles per year in females. Nayha (1982) studied data from Finland and reached a similar conclusion that a second peak of female suicides observed in autumn. Other studies like Micciolo et al. (1989) in Italy and Parker and Walter (1982) in Australia also pointed out the existence of a second rise of female suicide in autumn in their studies. Nayha and Micciolo et al. suggested the incident may due to the seasonal variation in communal and social activities found particularly in females. However, only a cycle for female completed suicides was observed. Also, reason for the phenomenon of autumn peak in female suicides in west countries is still far from clear.

Beautrais (2001) investigated the act of suicides and serious suicide attempts and suggested a very consistent pattern found amongst these two populations in terms of psychiatric risk factors and life processes but still could be distinguished by gender and patterning of psychiatric disorder. Certainly, suicide attempt is a risk factor of suicides and a consid-

erable excess mortality was reported among suicide attempters (Ostamo and Lonnqvist, 2001; Jenkins et al., 2002) but not all of attempters will die from suicide. The difference on the seasonality of the attempters and completed suicides, i.e. one cycle for completed suicides and two cycles for attempters suggest that these two groups are not identical but overlapping with one another. The existence of similarity and distinction between two populations found may help explain the variation of seasonal rhythm on suicidal behavior.

5. Limitations

The observed seasonality on suicide death and attempts are fairly robust, which is unlikely caused by the ascertainment bias through the Coroner's Court or Accident and Emergency Department of Hospital Authority (HKSAR). If the seasonality of suicide deaths and attempts for any particular groups are masked by the ascertainment procedures, it has to be postulated that the bias varies systematically with seasonality and operates in different ways of different gender, age groups or suicide methods, which is not likely. Hence, ascertainment procedure probably underestimates the true rate but not the seasonal variation. The underestimation is more serious among the attempters since for those with minor injuries or non-fatal attempts might not be captured by the Accident and Emergency Departments of the hospitals. The information on the number of the attempters with minor injuries, who had not been admitted to the hospital as inpatients, was not available. The completed suicides data using the ICD classification based on the Census and Statistics Department registered death files are almost complete though there could have some suicides in the undetermined death categories.

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References

- Ajdacic-Gross, V., Wang, J., Bopp, M., Eich, D., Rossler, W., Gutzwiller, F., 2003. Are seasonalities in suicide dependent on suicide methods? A reappraisal. *Soc. Sci. Med.* 57, 1173–1181.
- Atmaca, M., Kuloglu, M., Tezcan, E., Ustundag, B., Gecici, O., Firidin, B., 2002. Serum Leptin and cholesterol values in suicides attempters. *Neuropsychobiology* 45, 124–127.
- Barker, A., Hawton, K., Fagg, J., Jennison, C., 1994. Seasonal and weather factors in parasuicide. *Br. J. Psychiatry* 165, 375–380.
- Beautrais, A.L., 2001. Suicides and serious suicide attempts: two populations or one? *Psychol. Med.* 31, 837–845.
- Bianco, G., D'Alessandro, G., Tarquini, E., Rossi, G., Mazzoccoli, G., 1998. Epidemiology and chronorhythmicity of recurrences of attempted suicide (in Italian). *Rec. Prog. Med.* 89, 114–117.
- Brewerton, T., 1989. Seasonal variation of serotonin function in humans: research and clinical implications. *Ann. Clin. Psychiatry* 1, 153–164.
- De Maio, D., Carandente, F., Riva, C., 1982. Evaluation of circadian, circaseptan, and circannual periodicity of attempted suicides. *Chronobiologia* 9, 185–193.
- Hawton, K., Fagg, J., Simkin, S., Harriss, L., Malmberg, A., 1998. Methods used for suicide by farmers in England and Wales: the contribution of availability and its relevance to prevention. *Br. J. Psychiatry* 173, 320–324.
- Ho, T.P., Chao, A., Yip, P.S.F., 1997. Seasonal variation in suicide re-examined: no sex difference in Hong Kong and Taiwan. *Acta Psychiatr. Scand.* 95, 25–31.
- Ho, B.K.W., Kua, E.H., Hong, C., 1998. Temporal variation in parasuicide among Singaporean Chinese. *Australian and New Zealand J. Psychiatr.* 32, 500–503.
- Jenkins, G.R., Hale, R., Papanastassiou, M., Crawford, M.J., Tyrer, P., 2002. Suicide rate 22 years after parasuicide: cohort study. *Br. J. Med.* 325, 1155.
- Maes, M., Scharpe, S., D'Hondt, P., Peeters, D., Wauters, A., Neels, H., Verkerk, R., 1996. Biochemical, metabolic and immune correlates of seasonal variation in violent suicide: a chronoepidemiologic study. *Eur. Psychiatr.* 11, 21–23.
- Malone, K., Mann, J.J., 1998. Serotonin and the suicidal brain: American Foundation for Suicide Prevention, Research Report. *Nat. Med.* 4, 25–30.
- Masterton, G., 1991. Monthly and seasonal variation in parasuicide: a sex difference. *Br. J. Psychiatr.* 158, 155–157.
- Meares, R., Mendelsohn, F.A.O., Milgrom-Friedman, J., 1981. A sex difference in the seasonal variation in of suicide rate: a single cycle for men, two cycles for women. *Br. J. Psychiatr.* 138, 321–325.
- Micciole, R., Zimmermann-Tansella, Ch., Williams, P., Tansella, M., 1989. Seasonal variation in suicide: is there a sex difference. *Psychol. Med.* 19, 199–203.
- Morken, G., Lilleeng, S., Linaker, M.O., 2002. Seasonal variation in suicides and in admission to hospital for mania and depression. *J. Affect. Disord.* 69, 39–45.
- Nayha, S., 1982. Autumn incidence of suicide re-examined: data from Finland by sex, age and occupation. *Br. J. Psychiatr.* 141, 512–517.
- O'Carroll, P.W., Berman, A.L., Maris, R.W., Moscicki, E.K., Tanne, B.L., Silverman, M.M., 1996. Beyond the tower of Babel: a nomenclature for suicidology. *Suicide Life-Threat. Behav.* 26, 3.
- Ostamo, A., Lonnqvist, J., 2001. Excess mortality of suicide attempters. *Soc. Psychiatry Psychiatr. Epidemiol.* 36, 29–35.
- Parker, G., Walter, S., 1982. Seasonal variation in depressive and suicidal deaths in New South Wales. *Br. J. Psychiatr.* 140, 626–632.
- Partonen, T., Haukka, J., Nevanlinna, H., Lonnqvist, J., 2003. Research report: analysis of the seasonal pattern in suicide. *Affect. Disord. Artic.* (in Press).
- Pocock, S.J., 1974. Harmonic analysis applied to seasonal variations in sickness absence. *Appl. Stat.* 23 (2), 103–120.
- Preti, A., Miotto, P., 2000. Influence of method on seasonal distribution of attempted suicides in Italy. *Neuropsychobiology* 41, 62–72.
- Rasanen, P., Hakko, H., Jokelainen, J., Tiihonen, J., 2002. Seasonal variation in specific methods of suicide: a national register study of 20,234 Finnish people. *J. Affect. Disord.* 71, 51–59.
- World Health Organization, 1978. The Ninth Revision of the International Classification of Diseases and Related Health Problems, 9th ed. WHO, Geneva (ICD-9).
- Yip, P.S.F., Chao, A., Ho, T.P., 1998. A re-examination of seasonal variation in suicides in Australia and New Zealand. *J. Affect. Disord.* 47, 141–150.
- Yip, P.S.F., Chao, A., Chiu, C.W.F., 2000. Seasonal variation in suicides: diminished or vanished: experience from England and Wales, 1982–1996. *Br. J. Psychiatr.* 177, 366–369.
- Yip, P.S.F., Yam, H.K., Chau, P.H., 2001. A re-visit on seasonal variations in suicides in the Hong Kong Special Administrative Region (HKSAR). *Acta Psychiatr. Scand.* 103, 315–316.