



Research report

Seasonality of Chinese rural young suicide and its correlates[☆]Jie Zhang^{a,b,*}, Qi Gao^{c,1}, Cunxian Jia^a^a Shandong University School of Public Health, China^b Department of Sociology, State University of New York College at Buffalo, Buffalo, NY 14222, USA^c Capital Medical University School of Public Health and Family Medicine, China

ARTICLE INFO

Article history:

Received 22 February 2011

Received in revised form 4 May 2011

Accepted 17 May 2011

Available online 12 June 2011

Keywords:

Seasonality

Suicide

Chinese

Logistic regression

Psychological autopsy

ABSTRACT

Background: There had been few studies on seasonality of Chinese suicide especially for Chinese rural youths. In this research, we wanted to find the seasonal pattern and the relationship between personal and behavioral characteristics and seasonal variation of suicide.

Method: We examined Chinese rural young adults aged 15 to 34 years who died by suicide using Psychological Autopsy method to gather information from the informants of suicide victims. Altogether 330 suicide victims were collected among which 144 were female and 186 were male. The χ^2 test was used for comparison, and the multiple logistic regressions and Odds Ratios were adopted to analyze the seasonal preferences of suicide victims.

Result: Seasonal summer peak of suicide emerged in total population and in each subgroup. Four logistic regression models were constructed: in spring, six variables were included in the regression model, which were Gender (OR = 1.627), Pesticide Used (OR = 1.622), Life Events (OR = 2.764), Suicide Intent (OR = 1.641), Marital Status (OR = 0.574) and Family Conflicts (OR = 0.590); in summer, only Marital Status (OR = 1.927) was accepted; in autumn, four variables including Marital Problems (OR = 1.924), Trait Anxiety (OR = 1.758), Gender (OR = 0.518) and Religion (OR = 0.534) were retained; in winter, Pesticide Used (OR = 0.486) and Suicide Intent (OR = 0.614) were retained.

Conclusion: Seasonal variations of personal and behavioral characteristics, combined with social activities, might also play very important roles in suicide seasonality.

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Suicide rates fluctuated over the four seasons as they varied across cultures (Durkheim, 1951; Gabennesch, 1988). Durkheim attributed the seasonal changes to social forces instead of the bioclimatic factors (Durkheim, 1951). Previous seasonality studies of suicide mostly focused on simple demographic characteristics from large epidemiological data with temporal variables (Bando et al., 2009; Oravec et al., 2007; Rocchi et al., 2007). Very few, if any, employed such personal data as mental disorder and life events from a

Psychological Autopsy (PA) study of suicide victims to investigate the seasonality of suicide with its behavioral correlates. Further, seasonality and temporal studies of Chinese suicide were at scarcity, due to the short history of suicide studies in China beginning only about 30 years ago. This study was designed to find the seasonal pattern of Chinese rural young suicide and identify the personal and behavioral characteristics for the suicide victims who chose to kill themselves in a specific season.

In the United States, the National Center for Health Statistics (NCHS) had collected national suicide statistics by month for several decades. Dublin (1963), Massey (1967), Rogot et al. (1976), Lester (1979), Bollen (1983), MacMahon (1983), and Warren et al. (1983) had reported NCHS data which together covered virtually all years between 1950 and 1978. Although these authors did not always use the same analytical techniques,

[☆] The research was supported by the United States National Institute of Mental Health (NIMH): R01 MH68560.

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the results were quite consistent: suicide peaked in the spring months, especially in April and May, and bottomed out in the winter months, especially in December (Gabennesch, 1988). This was essentially the similar result obtained by Barraclough and White (1978) and by Meares et al. (1981), who used national data from Britain for 1968–72 and 1958–74, respectively. The spring peaks of suicide seasonality were also found in other Western countries (Chew and McCleary, 1995; Postolache, et al., 2010; Reutfors, et al., 2009). Iga et al. (1978) found that the suicide rate in Japan from 1968 to 72 peaked in April (no data on a trough were perceived). In short, there appeared to be a consistent seasonal pattern in the suicide statistics gathered on national populations.

Those findings were partially in line with Durkheim on the seasonal effect on the suicide rates. In his classical study on suicide in Europe, Durkheim presented data that showed that suicide increased from January to June and then declined in the second half of the year. He attributed this to variation in the intensity of social activity rather than the climatic temperature. For example, with the arrival of spring, “everything begins to awake; activity is resumed, relations spring up, interchanges increase”; hence, suicide rates climbed (Durkheim, 1951 p. 119).

It was also noted that only populations in the temperate zone with four clear cut seasons exhibit suicide seasonality, suggesting some contextual influence from geographical latitude (Chew and McCleary, 1995). Montesquieu's suggestion that cold, foggy countries were most favorable to suicide was equally discredited by the fact that the suicide rate was higher in spring and summer than in fall and winter (Durkheim, 1951). According to Durkheim (1951), normal or abnormal psychological predispositions were not, by themselves, sufficient causes of suicide. Further, the conjunction of such predispositions with cosmic factors (climate, seasonal temperature etc.) should not have such a determinative effect, either. Recent evidence showed a strong proof that there was suicide seasonality in tropical country though the seasonality pattern was different with which in temperate zones (Bando, et al., 2009).

Previous research on seasonality of suicide had found gender differences, specifically a higher seasonality of suicide in males than in females (Prete, 1997). In addition, there were significant interactions between gender and deliberate self-harm methods (Haukka et al., 2008) and between seasons and deliberate self-harm. Some literatures reported that seasonality of suicide was associated with violent suicide method (Maes and Cosyns, 1993). They found that seasonality presented in violent groups but not in nonviolent groups, and there was significant seasonality for suicide but not for homicide. Similar results were found in Athens (Christodoulou, et al., 2009). Meanwhile, a lot of literatures reported that seasonal variations were associated with various mental illnesses (Postolache, et al., 2010; Rocchi, et al., 2007; Yip et al., 2006), for example: exacerbation of mood disorder, as manifested in hospital admissions, mood disorder severity, electroconvulsive therapy (ECT) use, and worsening of depression scores (Kim, et al., 2004; Maes and Cosyns, 1993; Morken et al., 2002).

Seasonality might have little to do with the methods. In general, suicide frequencies peaked in spring and early summer and depicted a low in autumn and winter months. Suicide seasonality was a ubiquitous phenomenon; however, recent studies had indicated that it was related particularly to violent suicide methods. Different suicide seasonalities by

suicide methods were investigated using Swiss mortality data. Swiss suicide data in 1969–1994 depicted the expected pattern with a peak in May and June and a low in December. However, analyses by suicide methods showed that there was no common pattern. Suicide seasonalities were absent or weak in some violent (firearms, cutting, crashing, poisoning) as well as non-violent methods (hanging, drowning, jumping from high places, unspecified/other). The seasonality of the overall Swiss suicide frequencies was a compound seasonality. It largely depended on specific suicide methods and different cyclical dynamics (Ajdacic-Gross, et al., 2003).

There had been few studies on seasonality of Chinese suicide victims especially on Chinese rural young suicide victims. Besides, the root of suicide seasonality remained undetermined though plenty of researches had been conducted and many bioclimatic and psychological factors had been found. In this study, we planned to discover the seasonal pattern of the Chinese rural suicide victims, and we also wanted to collect information about personal and behavioral characteristics of suicide victims to explore the relationship between these characteristics and the seasonal variation of suicide victims.

1. Methods

1.1. Data

From 2005 to 2008, a national case-control Psychological Autopsy study was conducted to explore possible risk factors for suicide among Chinese rural young adults. We examined rural young adults aged 15 to 34 years who died by suicide in comparison with community living controls from the same location. Results of pilot work showed excellent feasibility of studying suicide using psychological autopsy method in Chinese social and cultural environments (Zhang, et al., 2002; Zhang and Norvilitis, 2002), and that the western developed instruments were reliable and valid among Chinese populations (Zhang, et al., 2003).

Three provinces in China which had similar climate and the same division of four seasons were involved in this study: Liaoning, Hunan and Shandong provinces. A total of sixteen rural counties were randomly selected from the three provinces (6 from Liaoning, 5 from Hunan, and 5 from Shandong). In each selected county, suicide victims aged 15–34 years were consecutively enrolled into the study. From July 2005 to June 2007, 152 suicide victims were consecutively collected in Liaoning province in two full years; from June 2005 to May 2007, 98 suicide victims were consecutively collected in Hunan province in two full years; from November 2006 to October 2007, 80 suicide victims were consecutively collected in Shandong province in one full year. After successful interviews with the informants of the suicide victims, the information of 330 suicide victims was collected among which 144 were female and 186 male.

Regarding the importance of clearly defined criteria for suicide as a manner of death (Younger et al., 1990), we excluded cases of accidental or natural death based on suicidal intent and other information. In rural China where villages were often far away from the nearest hospital, village doctors were in charge of the death certificate and were required to report the death to the *Xiang* (township) health

agency which then forwarded the death report to the county Center for Disease Control and Prevention (CDC). In our study, all suicidal deaths were required to be reported to the county CDC by telephone or fax within 24 h after the suicide incidence happened, and the suicide information gathered at the county CDCs were transferred monthly to the provincial CDC. For the suicidal deaths that were not identified by any health agency, the village treasurer was allowed to notify the *Xiang* health agency or the county CDC. Whenever necessary, an investigation was conducted to figure out the cause of death with the help of village board and villagers. These procedures were implemented to make sure no suicide cases were missed, or erroneously reported, and to minimize false classifications.

1.2. Information sources

For each suicide case, two informants were interviewed. However, recognizing the fact that the type of informants rather than the number of informants in psychological autopsy studies was an important and complex consideration (Kraemer, et al., 2003), we selected the informants based on the context or environment (how people observed the target, e.g. home vs. non-home setting). Thus, each informant was carefully selected and the information of their home, work, family and non-family aspects were also collected.

Based on the above considerations, the following four guidelines were used for the inclusion of informants: (1) Suicide informants were recommended by the village head and the village doctor and then selected by the research team based on familiarity with the suicide person's life and circumstances, availability for and willingness to consented to in-person interviews, while control group informants were recommended by the controls themselves and then selected by the research team with similar principles. (2) Although target persons could be as young as 15 years of age, informants had to be 18 years of age or older. Characteristics of the informants were noted in a standardized fashion (i.e., most recent contact, number of contacts in the last month, frequency of contacts in the last year, number of years informant had known the target, relationships). (3) Informant #1 was always a parent, spouse, or another important family member, and informant #2 was always a friend, co-worker, or a neighbor. (4) Wherever possible we avoided recruiting spouses and in-laws of suicide victims associated with family disputes. Interviewing these people could result in very biased reports, if marital infidelity and family oppression were possible causes of suicide.

1.3. Interviewing procedures

Informants were first approached by the local health agency or the village administration and notified about the upcoming interview. Upon their agreement by written informed consent, the interview was scheduled 2–6 months after suicide incident to avoid bereavement actions. The study was in accordance with the guideline laid down in the current version of the Declaration of Helsinki. All the interviewers were trained before the investigation and the face-to-face interview was done in a private place where only the

interviewer and interviewee were present. The average time for each interview was 2.5 h.

Inter-rater reliability was established and maintained by limiting the principal data collection role to the 24 trained interviewers and by comparison of duplicate ratings of the interviewers on a regular basis. The same interviewers participated in data collection, promoting inter-rater reliability across the study, and the inter-rater reliability (κ) of the instruments ranged from 0.72 to 0.90.

1.4. Measures

Most of previous studies (Bando, et al., 2009; Benedito-Silva et al., 2007; Brådvik and Berglund, 2002; Dixon, et al., 2007; Lin et al., 2008; Postolache, et al., 2010; Reutfors, et al., 2009; Rocchi, et al., 2007; Weaver and Munro, 2009) set the four seasons serially from January to December: Spring was from January to March, and so on. Some researchers set the four seasons as follows: winter consisted of November, December and January, and so on (Ajdacic-Gross, et al., 2003; Lahti, et al., 2006). In our study we fully considered the Chinese climate and traditions, and we divided the four seasons as follows (Kalediene et al., 2006): Winter consisted of December, January and February in which the temperatures were much colder than other months; Spring was from March to May which was just after the Chinese Spring Festival; Summer was from June to August in which the temperatures were much hotter than other months; Autumn was from September to November.

Altogether 16 variables were measured to explore the suicide seasonality: Gender, Marital Status, Mental Disorder, HAMD Depression, Trait Anxiety, Pesticide Used, Life Events, Marital Problems, Family Conflicts, Work/School Difficulties, Health Problems, Legal Issues, Physical Illness, Religion, Suicide Intent, and Dysfunctional Impulsivity. All of the variables were dimidiate. Thereinto, Gender was divided into Female (0) and Male (1); Marital Status was divided into Never Married (0) and Ever Married (1); Mental Disorder was identified by SCID and it was divided into No (0) and Yes (1); HAM-D (Hamilton, 1960) was used to evaluate the depression level of suicide victims and according to the median scores it was divided into Low (score < 10) and High (score \geq 10); STAI Trait-Anxiety scale (Spielberger et al., 1983) was used to evaluate the trait anxiety level of suicide victims and according to the mean score it was divided into Low (< 53) and High (\geq 53); Pesticide Used was divided into No (0) and Yes (1); Life Events was used to measure the negative life events that happened in one year and impacted suicide victims very much, and it was divided into No (0) and Yes (1); Marital Problems was used to evaluate negative marital events in suicide victims and it was divided into No (0) and Yes (1); Family Conflicts was used to measure negative family events of suicide victims and it was divided into No (0) and Yes (1); Work/School Difficulties was used to measure negative events happened in company or school and it was divided into No (0) and Yes (1); Health Problems was used to measure negative health events and it was divided into No (0) and Yes (1); Legal Issues was used to assess negative legal events of suicide victims and it was divide into No (0) and Yes (1); Religion was used to assess whether cases believed in God or supernatural beings and it was divided into No (0) and Yes (1); Physical Illness was used to evaluate

whether cases had physical illness and it was divided into No (0) and Yes (1); Suicide Intent Scale (Beck et al., 1974) was used to evaluate the suicide intent level of suicide victims and according to the mean score it was divided into Low (<8) and High (≥ 8); Dikman Impulsivity Inventory Dysfunctional-Scale (Dickman, 1990) was used to evaluate the dysfunctional impulsivity of suicide victims and according to the mean score it was divided into Low (<7) and High (≥ 7).

1.5. Integrating the information from different sources

There were two proxy interviews for each suicide case and each living control. The vast majority of the responses for the target person were the same or quite similar. For different responses pertaining to the target person, data were integrated with the following three principles based on previous experiences (Kraemer, et al., 2003). For demographic information, we relied on the answers by the informant who had the best access to the information. For example, a family member should be able to tell the target person's age and birth date more accurately than does a friend. Second, in estimating the cultural values of the target person, we used the higher score of the two informants' responses if they were different. Finally, to determine a diagnosis with the SCID, we selected the response representing a positive symptom, because the other informant might not have had an opportunity to observe the specific characteristic or behavior. These three guidelines were applied in integrating responses of both cases and controls.

1.6. Data analysis

The chi-square test was used for multinomials in order to detect seasonal fluctuation of the frequency of suicides in one group as well as for two-by-four tables in order to test sex differences in suicide seasonality for statistical significance. The multiple logistic regression and computed Odds Ratios (ORs) were adopted to analyze the seasonal preference of suicide victims using the SPSS (version 16.0), and Nagelkerke's R Square and the Hosmer and Lemeshow Test were adopted to test the goodness of models. Alpha=0.05 was adopted to identify statistical significance.

2. Analyses and findings

2.1. Characteristic distribution among four seasons

Seasonal summer peak of suicide prominently emerged in total population, and it also appeared in both male and female suicide victims and there were no significant differences between male and female suicide victims ($\chi^2=3.82$, $P=0.281$). The summer peaks were also found significant in most of other subgroups. Suicide victims with Ever Married ($\chi^2=5.27$, $P=0.153$), without Pesticide Used ($\chi^2=2.11$, $P=0.549$), with Work/School Difficulties ($\chi^2=4.36$, $P=0.225$) and with Legal Issues ($\chi^2=3.29$, $P=0.349$) were four subgroups that did not present significant seasonal variation.

Marital Status (Ever Married vs. Never Married, $\chi^2=8.32$, $P=0.04$), Pesticide Used (Yes vs. No, $\chi^2=8.03$, $P=0.45$) and Suicide Intent (High vs. Low, $\chi^2=6.77$, $P=0.04$) showed

significant differences between two subgroups regarding seasonal differences. More details were shown in Table 1.

2.2. Logistic regression

In order to identify the reason why suicide happened in a defined season rather than in other three seasons. Four logistic regressions models were separately established to analyze all the variables by comparing suicide victims in a certain season (1) with the other three seasons (0). Conditional Backward method was adopted to iterate the 16 variables (the entry level was 0.05, the removal level was 0.01, and the classification cutoff level was 0.5). The four logistic regression models were constructed and different variables were included in these four models. All of the included ORs for each of these variables were computed as were shown in Table 2.

In spring, 6 variables were included in the regression model, and four ORs were significantly larger than 1 and the other two were smaller. Compared with other three seasons, suicide victims in spring were more likely to be those who were male (compared with females, OR=1.627), who used pesticide (compared with those who did not, OR=1.622), who suffered from life events (compared with those who did not, OR=2.764), who got higher suicide intent scores (compared with those who got lower scores, OR=1.641); suicide in spring were less likely to be those who were never married (compared with those who were ever married, OR=0.574) and who suffered family conflicts (compared with those who did not, OR=0.590).

In summer only one variable was accepted, which was Never Married. Suicide victims who were never married (rather than who were ever married, OR=1.927) preferred killing themselves in summer.

In autumn there were four variables included in the model. Compared with other seasons, suicide victims in autumn were more likely to be those who suffered from marital problems (compared with those who did not, OR=1.924) and who got higher trait anxiety scores (compared with those who got lower scores, OR=1.758); suicide victims who were male (compared with female, OR=0.518) and who believed in God or supernatural beings (compared with those who did not believe in God or supernatural beings, OR=0.534) were less likely to commit suicide in autumn.

Compared with other three seasons, people who used pesticide (compared with those who did not, OR=0.486) were less likely to suicide in winter, and people who got higher suicide intent scores (compared with those who got lower scores, OR=0.614) were also less likely to suicide in winter.

2.3. Odds Ratios predicting the season preference

According to Table 2, 10 variables (Ham-D Depression was added because we found it was significant when logistic regression was conducted in males and females separately) were selected, and we computed the ORs of each variable separately for males and females. More details were shown in Table 3.

Compared with other three seasons, male suicide victims who were never married (OR=0.501) and who had ever suffered family conflicts (OR=0.524) were less likely to

Table 1

Characteristic distribution of the Chinese rural young suicides among the four seasons (N = 330).

Characteristics	Season				χ^2	P	Total	
	Spring f(%)	Summer f(%)	Autumn f(%)	Winter f(%)			χ^2	P
Total	87 (26.4)	113 (34.2)	66 (20.0)	64 (19.4)	27.82	0.003		
Gender								
Female (0)	32 (22.2)	52 (36.1)	34 (23.6)	26 (18.1)	10.44	0.015	3.82	0.281
Male (1)	55 (29.6)	61 (32.8)	32 (17.2)	38 (20.4)	12.15	0.007		
Marital Status								
Ever Married (0)	59 (29.8)	56 (29.3)	41 (20.7)	42 (21.2)	5.27	0.153	8.32	0.04
Never Married (1)	28 (21.2)	57 (43.2)	25 (18.9)	22 (16.7)	23.82	<0.001		
Mental Disorder								
No (0)	38 (22.9)	61 (36.7)	32 (19.3)	35 (21.1)	12.65	0.005	2.72	0.437
Yes (1)	49 (29.9)	52 (31.7)	34 (20.7)	29 (17.7)	9.22	0.027		
HAMD Depression								
Low (<10) (0)	34 (21.2)	59 (36.9)	36 (22.5)	31 (19.4)	12.35	0.006	4.68	0.197
High (\geq 10) (1)	53 (31.2)	54 (31.8)	30 (17.6)	33 (19.4)	11.51	0.009		
Pesticide Used								
No (0)	25 (21.7)	34 (29.6)	25 (21.7)	31 (27.0)	2.11	0.549	8.03	0.045
Yes (1)	62 (28.8)	79 (36.7)	41 (19.1)	33 (15.3)	24.16	<0.001		
Life Events Total								
No (0)	4 (12.9)	13 (41.9)	7 (22.6)	7 (22.6)	5.52	0.138	3.24	0.357
Yes (1)	83 (27.8)	100 (33.4)	59 (19.7)	57 (19.1)	16.97	0.001		
Marital Problems								
No (0)	49 (27.4)	64 (35.8)	28 (15.6)	38 (21.2)	15.97	0.001	4.81	0.187
Yes (1)	38 (25.2)	49 (32.5)	38 (25.2)	26 (17.2)	7.01	0.036		
Family Conflicts								
No (0)	39 (28.5)	43 (31.4)	23 (16.7)	32 (23.4)	6.74	0.041	4.06	0.255
Yes (1)	48 (24.9)	70 (36.3)	43 (22.3)	32 (16.6)	15.85	0.001		
Work/School Difficulties								
No (0)	64 (26.3)	84 (34.6)	47 (19.3)	48 (19.8)	14.86	0.002	0.29	0.962
Yes (1)	23 (26.5)	29 (33.3)	19 (21.8)	16 (18.4)	4.36	0.225		
Health Problems								
No (0)	37 (24.2)	55 (35.9)	28 (18.3)	33 (21.6)	10.84	0.013	1.864	0.601
Yes (1)	50 (28.2)	58 (32.8)	38 (21.5)	31 (17.5)	9.87	0.020		
Legal Issues								
No (0)	57 (25.1)	83 (36.6)	42 (18.5)	45 (19.8)	18.41	<0.001	2.46	0.482
Yes (1)	30 (29.1)	30 (29.1)	24 (23.4)	19 (18.4)	3.29	0.349		
Religion								
No (0)	60 (25.5)	80 (34.1)	52 (22.1)	43 (18.3)	12.71	0.005	2.58	0.462
Yes (1)	27 (28.4)	33 (34.8)	14 (14.7)	21 (22.1)	8.37	0.039		
Physical Illness								
No (0)	54 (25.0)	75 (34.7)	43 (19.9)	44 (20.4)	12.26	0.007	0.79	0.851
Yes (1)	33 (28.9)	38 (33.3)	23 (20.2)	20 (17.5)	7.47	0.029		
Suicide Intent								
Low (<8) (0)	28 (20.2)	52 (37.4)	26 (18.7)	33 (23.7)	12.17	0.007	6.77	0.040
High (\geq 8) (1)	59 (30.9)	61 (31.9)	40 (20.9)	31 (16.3)	13.46	0.004		
Dysfunctional Impulsivity								
Low (<7) (0)	47 (29.7)	49 (31.0)	33 (20.9)	29 (18.4)	7.57	0.028	2.53	0.470
High (\geq 7) (1)	40 (23.3)	64 (37.2)	33 (19.2)	35 (20.3)	14.28	0.003		
Trait Anxiety								
Low (<53) (0)	42 (25.3)	59 (35.5)	28 (16.9)	37 (22.3)	12.27	0.007	3.39	0.330
High (\geq 53) (1)	45 (27.4)	54 (32.9)	38 (23.2)	27 (16.5)	9.51	0.023		

commit suicide in spring, while male suicide victims who got higher suicide intent scores (OR = 1.930) preferred committing suicide in spring; female suicide victims who used pesticide (OR = 2.225) preferred spring.

Compared with other three seasons, male suicide victims who were ever married (OR = 2.158), who used pesticide (OR = 1.895) and who ever had family conflicts (OR = 1.951) preferred summer, while female suicide victims who were never married (OR = 2.616) and who got higher impulsivity scores (OR = 2.214) preferred summer.

Compared with other three seasons, male suicide victims who got higher depression scores (OR = 0.456) were less likely to commit suicide in autumn, while female suicide

victims who had ever gotten life events (OR = 0.191), who got higher impulsivity scores (OR = 0.456) and who believed God or supernatural beings (OR = 0.349) were less likely to commit suicide in autumn. Female suicide victims who ever had marital problems (OR = 3.290) and who got higher trait anxiety scores (OR = 2.315) were more likely to commit suicide in autumn.

Male suicide victims in winter were more likely to be those who got higher depression scores (OR = 2.267), and those who used pesticide (OR = 0.262) and who got higher suicide intent scores (OR = 0.359) were less likely to commit suicide in winter. There were no significant preferences in female suicide victims in winter.

Table 2

Logistic regressions predicting the season preference (this season rather than the other three seasons) for Chinese rural young suicides (N = 330).

Variable	Spring		Summer		Autumn		Winter	
	OR	P	OR	P	OR	P	OR	P
Male Gender	1.627	0.038			0.518	0.014		
Never Married	0.574	0.024	1.927	0.005				
Pesticide Used	1.622	0.044					0.486	0.006
Life Events	2.764	0.041						
Suicide Intent	1.641	0.033					0.614	0.042
Family Conflicts	0.590	0.028						
Marital Problems					1.924	0.011		
Trait Anxiety					1.758	0.028		
Religion					0.534	0.032		
Constant	0.095	<0.001	0.394	<0.001	0.223	<0.001	0.484	0.005
Nagelkerke R Square	0.081		0.032		0.067		0.044	
Hosmer and Lemeshow Test	$\chi^2 = 7.533$	$P = 0.480$	$\chi^2 = 2.680$	$P = 0.749$	$\chi^2 = 2.979$	$P = 0.936$	$\chi^2 = 7.618$	$P = 0.267$

2.4. Monthly frequencies

From the monthly frequencies for male and female suicide victims (Fig. 1), we could detect that there were more male suicide victims in March, May, June and July and it appeared bimodal in the monthly trend. We could also find that the peak months for female suicide victims were June, July and August.

3. Discussion and conclusion

This research discovered the summer peak of Chinese rural young male and female suicide victims. It seemed that the seasonal peak for the male suicide victims was more salient than that of females (Fig. 1), which was also found by Preti (1997) and on which we should gather more evidence. It was quite clear that most of the troughs of suicide seasonal trend was in winter months (Björkstén et al., 2005; Björkstén et al., 2009; Hakko et al., 1998; Kalediene, et al., 2006; Kim, et al., 2004; Räsänen et al., 2002; Zonda et al., 2005), which indicated that suicide victims were more likely to happen in relatively warmer seasons rather than in much colder winter in which there were fewer social activities. The seasonal peaks of suicide varied with different countries or populations, and former literature contributed seasonal peaks of suicide to certain physical or psychological factors, and correlations

between seasonal variations and these factors were also found. But, Durkheim ascribed seasonal peaks to social activities which might impact individual's mood or behaviors. Pendse also found that there was a considerable social impairment in seasonal affective disorder (Pendse et al., 2003). We wanted to preliminarily explore the sociological correlations of suicide seasonal variation in this study.

Four logistic regression models were established and ORs were computed to compare suicide victims in a certain season within other three seasons for the total population (shown in Table 2), and ORs of ten variables were separately computed for male and female suicide victims to predict seasonal preferences (shown in Table 3), from which we could also cautiously trace the root of suicide seasonality. There were different variables included in four regression models, and the significant ORs indicated that there were risk factors (OR>1) and protective factors (OR<1) for people who committed suicide in one season rather than others. We could also indicate that which group preferred committing suicide in a particular season, and we could partially surmise why people chose a certain season to commit suicide.

For the whole population, people who were male, who had ever married, who used pesticide, who had ever had life events, who had higher suicide intent scores and who had never had family conflicts contributed great roles in spring suicide; people who had never married contributed a main

Table 3

Logistic regressions (Odds Ratios) predicting the season preference (this season rather than the other three seasons) comparatively for males (n = 186) and females (n = 144).

Variable	Spring		Summer		Autumn		Winter	
	Male	Female	Male	Female	Male	Female	Male	Female
Never Married	0.501*	0.627	2.158*	2.616*	1.124	0.828	0.770	0.434
HAM-D Depression	1.318	1.515	0.770	1.116	0.456*	0.664	2.267*	0.787
Pesticide Used	1.489	2.225*	1.895*	0.843	1.070	0.486	0.262**	1.036
Marital Problems	0.664	0.874	1.069	0.668	1.770	3.290**	0.973	0.544
Family Conflicts	0.524*	0.774	1.951*	1.031	2.066	1.783	0.592	0.754
Life Events	6.091	1.958	0.409	1.443	1.094	0.191*	0.517	1.642
Trait Anxiety	0.806	1.179	1.317	0.529	1.718	2.315*	0.599	0.745
Suicide Intent	1.930*	1.025	0.686	0.981	1.963	1.139	0.359**	0.943
Dysfunctional Impulsivity	1.036	0.606	0.774	2.214*	1.113	0.456	1.197	1.392
Religion	0.808	1.620	1.026	1.464	0.618	0.349*	1.865	0.973

* Significant level lower than 0.05.

** Significant Level lower than 0.01.

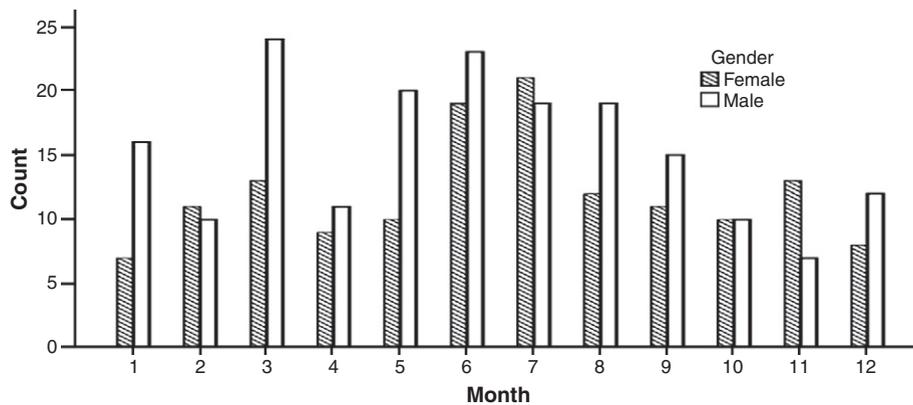


Fig. 1. Suicide frequencies in each of the 12 months by gender (males = 186 and females = 144, $\chi^2 = 10.47$, $df = 11$, $P = 0.488$).

role in summer suicide; people who were female, who suffered from marital problems, who got higher trait anxiety scores, who did not believe in God or supernatural beings played great roles in autumn suicide; people who used pesticide and who got higher suicide intent scores were less likely to commit suicide in winter.

We found that males (compared with females) were more likely to kill themselves in spring ($OR = 1.627$) and they were less likely ($OR = 0.518$) to commit suicide in autumn. It indicated that maybe after a long winter and the Spring Festival (for Chinese traditions every family should pay much money, maybe most of the annual revenue, to this New Year celebration; families should buy stuffs including pesticide, seeds, instruments etc. for their farm in spring), men bore greater responsibility to these and thus they may have suffered more strains which led to suicide.

For rural families there were more chances of exposure to pesticide in spring than in winter, maybe that was why there were more suicide victims who used pesticide to kill themselves in spring ($OR = 1.622$) rather than in winter ($OR = 0.486$). The variable of Suicide Intent showed similar characteristics with Pesticide Used. The OR ($OR = 2.764$) for Life Events (include all negative life events) were much larger than others in spring suicide victims, which indicated that Life Events plays a more important role in these risk factors for the whole population.

Never Married and Family Conflicts were two protective factors in spring suicide. People who were never married ($OR = 0.574$) and who had ever suffered family conflicts ($OR = 0.59$) were also less likely to commit suicide. In spring all the family members (include parents, husband and wife, children, or brother's own family) should make concerted effort to work for the beginning of the year. So family conflicts might less likely to occur. People who were single should pay more attention on family work in spring and they could join in more social activities (such as blind date, go to work in cities) in summer. So people who were never married were more likely to commit suicide in summer and less likely in spring.

In autumn, for many rural Chinese families, how to sell out agricultural products to earn money was a most important problem, and it might cause anxiety. Meanwhile, the disputes of interest may emerge in this harvest season, and it might

result in marital problems. That was why people who had ever suffered marital problems ($OR = 1.924$) and who had higher anxiety scores ($OR = 1.758$) were more likely to commit suicide in autumn. Females were more intolerable to suffer marital problems ($OR = 3.29$) and anxiety ($OR = 2.315$), which was similarly found by Abdel-Khalek that females attained higher anxiety scores than their male peers (Abdel-Khalek & Al-Damaty, 2003; Hakko, et al., 1998), so females were more likely to commit suicide in autumn. However, there were no significant preferences in male suicide victims who had ever suffered marital problems and who had higher anxiety scores. For those who had religious beliefs, females turned to endure more anxiety in their lives, so they were relatively less likely to commit suicide in autumn ($OR = 0.349$), while there were still no significant preferences in males.

Both male and female suicide victims who were never married preferred committing suicide in summer rather than in spring. It might be that suicide victims who were single should pay more attention on family work in spring and they could join in more social activities in summer. Higher rates of depression disorder were found in spring or autumn (Posternak and Zimmerman, 2002; Sher et al., 2005). Johan Reutfors et al. found significant spring/early summer peaks in male suicide victims with a history of depression (Reutfors, et al., 2009). In this study we found that male suicide victims who got higher depression scores were more likely to commit suicide in winter rather than in autumn, and there were no significant preferences among four seasons in female suicide victims with higher depression scores.

Male suicide victims using pesticide were more likely to commit suicide in summer ($OR = 1.895$) rather than in winter ($OR = 0.262$), while female suicide victims using pesticide were more likely to commit suicide in spring ($OR = 2.225$) rather than in autumn ($OR = 0.486$).

Both male and female suicide victims who ever suffered marital problems were more likely to commit suicide in autumn rather than in spring as the reason mentioned above, but only the OR for female suicide victims (autumn vs. others) were extra high and significant ($OR = 3.29$), which indicated that females were more likely to be affected by marital problems than males. Due to the similar situation in suicide victims who got higher trait anxiety scores (autumn vs.

others, $OR = 2.315$), female suicide victims were also more likely to be affected by trait anxiety.

The OR for Life Events of male suicide victims ($OR = 6.091$) in the spring was extra high (though it was not significant), which indicated that Life Events played a more important role in committing suicide in spring for males. That might partially explain that male suicide victims had an extra high March peak (as was shown in Fig. 1).

Female suicide victims with higher impulsivity scores were more likely to commit suicide in summer ($OR = 2.214$), while there were no significant seasonal preferences for males. It indicated that female suicide victims might be more likely to be affected by impulsivity in hot summer than males.

Roland Mergl and Inga Havers et al. found that seasonality was absent in male suicide attempters and female suicide attempts showed a trough in the spring (Mergl, et al., 2010). In our study, there were similar preferences between male and female suicide victims who got higher suicide intent scores, and male suicide victims with higher suicide intent scores were more likely to commit suicide in spring ($OR = 1.93$) but less likely ($OR = 0.359$) in winter. Having religious beliefs were more likely to protect women from committing suicide in autumn ($OR = 0.349$). From the result we could cautiously infer that seasonal variations of personal and behavioral characteristics might play very important roles in suicide seasonality.

The main shortcoming for this study might be that the sample was relatively small. Most of the data of other researches came from large epidemiological studies, while there were no similar ones in China, and the best way of studying suicide in China was sampling. Some of the instruments still need to be validated for relatives and acquaintances of patients, such as SCID, Ham-D and STAI. Meanwhile, the data from three provinces were combined. Though most of the biases were under control, there might be some confounding factors that misled the results.

We used Psychological Autopsy (PA) method in collecting information of Chinese rural young suicide victims, and this research was able to offer much more information to the seasonality study of suicide. We explored the seasonal variation of suicide with 16 variables and discovered that some social activities and personal characteristics were correlated with suicide seasonality. However, the sample size, with so many variables involved for this particular study, was relatively small, and the small size of sample might lead to bias in our inference. To further explore the relations between seasons and suicide and their correlates, more rigorous and larger data were needed.

Role of funding source

This research was supported by United States National Institute of Mental Health (NIMH): R01 MH068560.

Conflict of interest

The authors had no conflicts of interest to declare in relation to this article.

Acknowledgments

This research was supported by US Public Health Service Grant R01 MH068560. We thank the US National Institute of Mental Health for funding this research, and our research collaborators, interviewers and interviewees in China.

References

- Abdel-Khalek, A.M., Al-Damaty, A.G., 2003. The Kuwait University Anxiety Scale: results for 9031 Saudi students. *Psychol Rep* 93 (1), 203–212.
- Ajdacic-Gross, V., Wang, J., Bopp, M., Eich, D., Rössler, W., Gutzwiller, F., 2003. Are seasonalities in suicide dependent on suicide methods? A reappraisal [Article] *Social Science & Medicine* 57 (7), 1173–1181.
- Bando, D. H., Scrivani, H., Morettin, P. A., & Chei Tung, T. (2009). Seasonality of suicide in the city of Sao Paulo, Brazil, 1979–2003. [Article] *Sazonalidade do suicídio na cidade de São Paulo, Brasil, 1979–2003*, 31 (2), 101–105.
- Barraclough, B.M., White, S.J., 1978. Monthly variation of suicidal, accidental and undetermined poisoning deaths. *British Journal of Psychiatry*. 132 (3), 279–282.
- Beck, A.T., Schuyler, D., Herman, I., 1974. Development of suicidal intent scales. In: Beck, A.T., Resnik, H.L.P., Lettieri, D.J. (Eds.), *The Prediction of Suicide*. Charles Press, Bowie, MD, pp. 45–56.
- Benedito-Silva, A.A., Pires, M.L.N., Calil, H.M., 2007. Seasonal variation of suicide in Brazil [Article] *Chronobiology International: The Journal of Biological & Medical Rhythm Research* 24 (4), 727–737.
- Björkstén, K.S., Bjerregaard, P., Kripke, D.F., 2005. Suicides in the midnight sun—a study of seasonality in suicides in West Greenland [Article] *Psychiatry Research* 133 (2/3), 205–213.
- Björkstén, K.S., Kripke, D.F., Bjerregaard, P., 2009. Accentuation of suicides but not homicides with rising latitudes of Greenland in the sunny months [Article] *BMC Psychiatry* 9 (20), 1–10.
- Brådvik, L., Berglund, M., 2002. Seasonal distribution of suicide in alcoholism [Article] *Acta Psychiatrica Scandinavica* 106 (4), 299–302.
- Bollen, K.A., 1983. Temporal variations in mortality: a comparison of US suicides and motor vehicle fatalities, 1972–1976. *Demography*, 20 (1), 45–59.
- Chew, K.S.Y., McCleary, R., 1995. The spring peak in suicides: a cross-national analysis. *Social Science & Medicine* 40 (2), 223–230.
- Christodoulou, C., Papadopoulos, I.N., Douzenis, A., Kanakaris, N., Leukidis, C., Gournellis, R., et al., 2009. Seasonality of violent suicides in the Athens greater area [Article] *Suicide & Life-Threatening Behavior* 39 (3), 321–331.
- Dickman, S.J., 1990. Functional and dysfunctional impulsivity: personality and cognitive correlates. *Journal of Personality and Social Psychology* 58 (1), 95–102.
- Dixon, P., McDonald, A., Scheitlin, K., Stapleton, J., Allen, J., Carter, W., et al., 2007. Effects of temperature variation on suicide in five U.S. counties, 1991–2001 [Article] *International Journal of Biometeorology* 51 (5), 395–403.
- Dublin, L., 1963. *Suicide: A Sociological and Statistical Study*. Ronald Press, New York.
- Durkheim, E., 1951. *Suicide: A Study in Sociology*. Free Press, New York. (Original work published in 1897).
- Gabennesch, H., 1988. When promises fail: a theory of temporal fluctuations in suicide. *Social Forces* 67 (1), 129–145.
- Hakko, H., Räsänen, P., Tiihonen, J., 1998. Seasonal variation in suicide occurrence in Finland. *Acta Psychiatrica Scandinavica* 98 (2), 92–97.
- Hamilton, M., 1960. A rating scale for depression. *Journal of Neurology, Neurosurgery, and Psychiatry* 23 (1), 56–62.
- Haukka, J., Suominen, K., Partonen, T., Lonnqvist, J., 2008. Determinants and outcomes of serious attempted suicide: a nationwide study in Finland, 1996–2003. *Am. J. Epidemiol.* 167 (10), 1155–1163.
- Iga, M., Yamamoto, J., Noguchi, T., et al., 1978. Suicide in Japan. *Social Science & Medicine. Part A: Medical Psychology & Medical Sociology*. 12, 507–516.
- Kalediene, R., Starkuviene, S., Petrauskienė, J., 2006. Seasonal patterns of suicides over the period of socio-economic transition in Lithuania [Article] *BMC Public Health* 6 (1), 40–48.
- Kim, C.D., Lesage, A.D., Seguin, M., Chawky, N., Vanier, C., Lipp, O., et al., 2004. Seasonal differences in psychopathology of male suicide completers. *Comprehensive Psychiatry* 45 (5), 333–339.
- Kraemer, H.C., Measelle, J.R., Ablow, J.C., Essex, M.J., Boyce, W.T., Kupfer, D.J., 2003. A new approach to integrating data from multiple informants in psychiatric assessment and research: mixing and matching contexts and perspectives. *American Journal of Psychiatry* 160 (9), 1566–1577.
- Lahti, A., Räsänen, P., Karvonen, K., Särkioja, T., Meyer-Rochow, V.B., Hakko, H., 2006. Autumn peak in shooting suicides of children and adolescents from Northern Finland [Article] *Neuropsychobiology* 54 (2), 140–146.
- Lester, D., 1979. Temporal Variation in Suicide and Homicide. *Am. J. Epidemiol.* 109 (5), 517–520.
- Lin, H.-C., Chen, C.-S., Xirasagar, S., Lee, H.-C., 2008. Seasonality and climatic associations with violent and nonviolent suicide: a population-based study [Article] *Neuropsychobiology* 57 (1/2), 32–37.
- MacMahon, K., 1983. Short-term temporal cycles in the frequency of Suicide, United States, 1972–1978. *Am. J. Epidemiol.* 117 (6), 744–750.

- Maes, M., Cosyns, P., 1993. Seasonality in violent suicide but not in nonviolent suicide or homicide [Article] *American Journal of Psychiatry* 150 (9), 1380.
- Massey, J.T., 1967. Suicide in the United States, 1950–1964. *Vital Health Stat* 20 8 (5), 1–34.
- Meares, R., Mendelsohn, F.A., Milgrom-Friedman, J., 1981. A sex difference in the seasonal variation of suicide rate: a single cycle for men, two cycles for women. *The British Journal of Psychiatry*, 138, 321–325.
- Mergl, R., Havers, I., Althaus, D., Rihmer, Z., Schmidtke, A., Lehfeld, H., et al., 2010. Seasonality of suicide attempts: association with gender. *European Archives of Psychiatry and Clinical Neuroscience* 260 (5), 393–400.
- Morken, G., Lilleeng, S., Linaker, O.M., 2002. Seasonal variation in suicides and in admissions to hospital for mania and depression [Article] *J. Affect. Disord.* 69 (1–3), 39.
- Oravec, R., Sisti, D., Rocchi, M.B.L., Preti, A., 2007. Changes in the seasonality of suicides over time in Slovenia, 1971 to 2002. Amplitude is only positively related to suicide rates among females [Article] *J. Affect. Disord.* 104 (1–3), 211–215.
- Pendse, B.P.G., Öjehagen, A., Engström, G., Träskman-Bendz, L., 2003. Social characteristics of seasonal affective disorder patients: comparison with suicide attempters with non-seasonal major depression and other mood disorder patients [Article] *European Psychiatry* 18 (1), 36.
- Posternak, M.A., Zimmerman, M., 2002. Lack of association between seasonality and psychopathology in psychiatric outpatients [Article] *Psychiatry Research* 112 (3), 187.
- Postolache, T.T., Mortensen, P.B., Tonelli, L.H., Jiao, X., Frangakis, C., Soriano, J. J., et al., 2010. Seasonal spring peaks of suicide in victims with and without prior history of hospitalization for mood disorders [Article] *J. Affect. Disord.* 121 (1/2), 88–93.
- Preti, A., 1997. The influence of seasonal change on suicidal behaviour in Italy. *J. Affect. Disord.* 44 (2–3), 123–130.
- Räsänen, P., Hakko, H., Jokelainen, J., Tiihonen, J., 2002. Seasonal variation in specific methods of suicide: a national register study of 20 234 Finnish people [Article] *J. Affect. Disord.* 71 (1–3), 51.
- Reutfors, J., Ösby, U., Ekblom, A., Nordström, P., Jokinen, J., Papadopoulos, F.C., 2009. Seasonality of suicide in Sweden: relationship with psychiatric disorder [Article] *J. Affect. Disord.* 119 (1–3), 59–65.
- Rocchi, M.B.L., Sisti, D., Cascio, M.T., Preti, A., 2007. Seasonality and suicide in Italy: amplitude is positively related to suicide rates [Article] *J. Affect. Disord.* 100 (1–3), 129–136.
- Rogot, E., Fabsitz, R., Feinleib, M., 1976. Daily Variation in USA Mortality. *Am. J. Epidemiol.* 103 (2), 198–211.
- Sher, L., Oquendo, M.A., Galfalvy, H.C., Zalsman, G., Cooper, T.B., Mann, J.J., 2005. Higher cortisol levels in spring and fall in patients with major depression [Article] *Progress in Neuro-Psychopharmacology & Biological Psychiatry* 29 (4), 529–534.
- Spielberger, C.D., Gorsuch, R.L., Lushene, R.E., 1983. *Manual for the State-Trait Anxiety Inventory (Form Y)*. Consulting Psychologists Press, Inc., Palo Alto, CA.
- Weaver, A.C., Munro, D., 2009. Country living, country dying: rural suicides in New Zealand, 1900–1950 [Article] *Journal of Social History* 42 (4), 933–961.
- Yip, P.S.F., Yang, K.C.T., Qin, P., 2006. Seasonality of suicides with and without psychiatric illness in Denmark [Article] *J. Affect. Disord.* 96 (1/2), 117–121.
- Younger, S.C., Clark, D.C., Oehmig-Lindroth, R., Stein, R.J., 1990. Availability of knowledgeable informants for a psychological autopsy study of suicides committed by elderly people. *J. Am. Geriatr. Soc.* 38, 1169–1175.
- Zhang, J., Norvilitis, J.M., 2002. Measuring Chinese psychological well-being with western developed instruments. *J. Pers. Assess.* 79 (3), 492–511.
- Zhang, J., Wiczorek, W.F., Jiang, C., Zhou, L., Jia, S., Sun, Y., et al., 2002. Studying suicide with psychological autopsy: social and cultural feasibilities of the methodology in China. *Suicide Life-Threat. Behav.* 32 (4), 370–379.
- Zhang, J., Conwell, Y., Wiczorek, W.F., Jiang, C., Jia, S., Zhou, L., 2003. Studying Chinese suicide with proxy-based data: reliability and validity of the methodology and instruments in China. *J. Nerv. Ment. Dis.* 191 (7), 450–457.
- Zonda, T., Bozsonyi, K., Veres, E., 2005. Seasonal fluctuation of suicide in Hungary between 1970–2000 [Article] *Arch. Suicide Res.* 9 (1), 77–85.