

Prevalence and risk factors of suicide in a rural area of Shandong province in mainland China: a case control study*

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Abstract

Objective: Suicide is a major public health problem in China, particularly in rural areas. This study aimed to examine the rate and the risk factors for suicide in a rural area of China. **Methods:** The mortality data of two counties in Shandong Province from January 1st, 2004 to December 31st 2005 were used. Death information was collected via face-to-face interview with informant(s). Psychological autopsy was conducted on 137 completed suicides and 137 matched controls died from other illnesses. Chi-square/Fisher exact and multiple logistic regression were used for bivariate analyses and predictor analyses, respectively. **Results:** The suicide rate was 20.90 per 100,000 persons per year with almost equal rates of males and females. Among those with the age over 40 years old, the suicide rate in males was significantly higher than that in females. The peak of suicide fell in the age group of 70-79 years for males and the age group of ≥ 80 years for females. The most commonly used method for suicide was pesticide ingestion (76.7%). Poor interpersonal relationship ($OR=12.79$), childhood adversities ($OR=7.26$), a history of mental illness ($OR=5.95$), adverse life event(s) within 1 year prior to death ($OR=3.19$), and unstable extravert personality traits ($OR=6.12$) were independent risk factors for suicide. Male gender positively interacted with majority of these risk factors, especially with a history of mental illness ($OR=17.89$). Advanced age positively interacted with all independent risk factors, with a history of mental illness having the largest OR of 1.51 as every 10 year of age advancement. In bivariate analyses, a history of previous suicide attempt ($OR=13.06$), a family history of suicide ($OR=7.08$), and unstable introvert personality trait ($OR=1.83$) were also associated with increased risk for suicide; and stable extravert personality trait ($OR=0.21$) was associated with decreased risk for suicide. **Conclusions:** In this rural population of mainland China, the risk for suicide was almost equal in both males and females with the elderly having the highest risk. The positive interactions of advanced age and male gender with independent risk factors suggest that suicide prevention strategies targeting specific groups with different risk factors are essential.

Key words

Suicide; Risk factor; Rural China; Case-control study; Psychological autopsy

Suicide has long been recognized as a major public health problem worldwide^[1]. The prevalence of suicide worldwide was estimated around 16.7 per 100,000 persons per year and suicide was the 14th-leading cause of death^[1]. In China, suicide rates were estimated from 6.5 per 100,000 persons per year to 27.1 per 100,000 persons per year^[2,3] and suicide was the 5th leading cause of death in 1995~1999. Suicide not only causes loss of productivity, but also causes un-calculable impact on family and society in general^[1].

The impact of suicide has led governments from developed and developing countries, local and international organizations like the World Health Organization (WHO) to support studies on the prevalence of and risk factors

for suicide and suicidal behaviors^[4-24]. Among the risk factors, young and old age, low socioeconomic status, substance use, previous suicide attempt, and adverse life events prior to suicide appeared to be universal in both developed and developing countries^[1,25]. However, some risk factors for suicide appeared to be unique to different countries and different cultures. For example, male has been documented as a risk factor for suicide across all ages in developed countries and some developing countries^[1,25], but in China, a higher suicide rate of women than men has been reported^[3]. In India, the rate for suicide was nearly equal to men and women^[23-24]. Similarly, being unmarried has also been identified as a risk factor for suicide in the majority of previous studies^[1,16-19,26-31]. However, in India, Pakistan, and Iran, majority of suicide victims were married and being married was even a risk factor for suicide, especially in women^[21-23]. History of mental illness has also been reported as a robust risk factor for suicide in developed countries^[1,25], but in China, more than 47% suicide victims did not have a psychiatric diagnosis at the time of death^[4,32-34]. In addition to these national-level differences, people living in the same country also had different risks for suicide because of their differences in religion, ethnicity, or geographic locations^[1,25].

In a landmark study of China, Phillips and colleagues found that the suicide rate of rural residents was 3 times higher than that of urban residents^[3]. Higher rates of suicide in rural areas have also been reported in other developing countries^[25]. In China, more than a half of its population lives in rural areas so that strategies targeting rural residents should be the key elements for suicide prevention. So far, risk factors associated with suicide in China have been investigated at national level in general population⁴ and young rural residents^[6,33-34], and provincial level^[36]. However, none have focused on suicide and its correlates specifically among the rural residents at all ages.

To better understand the prevalence of and the risk factors for suicide in rural residents, we conducted a matched case-control study to identify the characteristics and causes of suicide in rural areas. Since there are many differences between Chinese urban and rural residents in job, income, retirement, health insurance, and housing, specific information on risk factors of suicide in rural residents will be useful for local governments and health professionals to implement proper plan for suicide prevention.

1 Methods

1.1 Subjects The mortality data of rural residents in Hekou District and Lijin County of Shandong Province were obtained from local police stations every 3 months from January 1st 2004 to December 31st 2005. Those who resided in the urban areas of Hekou District and Lijin County were excluded. As previously reported^[4], China doesn't have a standardized reporting system for suicide and other causes of death so that it is very difficult to estimate the prevalence of suicide and risk factors for suicide. However, in mainland China, all deaths have to be reported to a local police station in order to receive the permission for burial ceremony. Collecting death information from local police stations in these two counties would capture all deaths during the studied period.

Since suicide is regarded as "disgraceful" by a lot of families and society overall in China, those who dies from suicide at home might not be reported as suicide. To minimize such underreporting potential, we identified suicide victims through reviewing medical records, interviewing informants, and/or officials in townships or villages where the deceased resided.

1.2 Procedures After receiving mortality data every 3 months, the date of death was first identified. For those who died a minimum of one month earlier, an interview with an informant(s) of the deceased was considered. For those who died within a month, an interview with an informant(s) would be considered in the next round of interview. The actual interview with informant(s) occurred between 2 and 6 months after death.

After a death case was received, a 2-person team of trained researchers visited the deceased family to explain the purpose of the study. An informed consent form approved by the Weifang Medical University Ethic Committee was signed by at least one first-degree relative before any study procedure began. For those without a relative, a consent form was obtained from a caregiver who had the best knowledge of the deceased. After the consent was obtained, the research team would work with informant(s) to fill out First Interview Form. The First Interview

Form included demographics, social background, medical and psychiatric history prior to death, and the cause of death. The cause of death was determined with the definition of the ICD-10. If there was a doubt about accuracy of the reported cause of death, the two interviewers would ask more information about events surrounding the death. The final decision about the cause of death was in accordance with consensus opinion of the two interviewers. Input from local officials was also obtained in difficult cases, especially in those who appeared died from suicide, but death certificate stated from other cause(s). Since all officials at village level are familiar with their residents, their inputs are critical to determine cause of death.

After a suicide victim was identified, a control subject who died from non-suicidal cause(s) during the same study period in the same village or nearby villages was matched to the suicide victim by gender, age, and occupation. The age difference between a suicide and his/her control should not be more than 2 years.

Psychological autopsy on suicide victims and their controls was conducted during a second round interview with their informants by using a Second Interview Form. The psychological autopsy was only completed on those who had minimal 2 informants with one at first level and the other at the second level. The first-level informants were spouse, children, or siblings who lived with the deceased. The second-level informants were close friend(s), neighbor(s) or siblings who did not live with the deceased. A third informant was interviewed if the information collected from the first-two informants was inconsistent or contradictory. If only two informants were available, the information from the one with a closer relationship with the deceased was used for analysis.

The informants were identified based on the information collected in the First Interview Form. After explaining the risk and benefit from the participation of the study, an informed consent form was obtained from the informants who would participate in the psychological autopsy of their deceased relative before the second round interview. The informants were informed that they could withdraw from the study any time during the second round interview.

1.3 Measures Death information including the date, time, and location, and the cause of death or the mode of suicide was obtained during the first-and second-round interviews. Selection of potential risk factors of suicide for the present study was based on the protocol of SUPRE-MISS of the WHO (Suicide Prevention-Multisite Intervention Study on Suicidal Behaviors)(http://www.who.int/mental_health/prevention/suicide/supresuicideprevent/en/) and the results of other studies on suicide.

1.3.1 Sociodemographic characteristics Name, gender, age, education level, occupation, marital status, household size, average individual income in a family per year, and family responsibility were collected for all participants. The education was classified as illiterate (<3 year education), elementary education (>3 year education but <7 year education), and middle or higher education (≥ 7 year education with middle school graduate certificate). Marital status included single, married/re-married, divorced, or widowed. The sizes of household were 3 groups, ≤ 2 people, 3-5 people, or ≥ 5 people. The annual family income was divided into two groups: $\leq 3,000$ Chinese yuan (RMB) or $>3,000$ Chinese yuan. Family support, responsibility, and living arrangement 3 months prior to death were also collected.

1.3.2 Psychological factors 1) Poor interpersonal relationship included relationship problem with spouse, other family members or colleagues 3 months prior to death; 2) Adverse life event(s) within one year prior to death included: (1) loss of property, family members, relatives, friends, job, education, or other major loss; (2) other potential stressors like dissatisfaction with job or education, financial difficulties, burden of medical disease(s), burden from offspring, or verbally threatened/insults by other; and 3) Childhood (<12 years old) adversities like the death of parent(s), separation/divorce of parents, or abuse/neglect.

1.3.3 Psychiatric Factors The information on psychiatric disorders was based on medical records of the deceased when they were alive. Although non-research Chinese psychiatrists did not often use DSM-IV to diagnose psychiatric disorders, major psychiatric disorders like major depressive disorder, schizophrenia, conversion disorder, bipolar disorder, and anxiety disorders were commonly documented in those who sought psychiatric care prior to death.

1.3.4 Personality traits Since unplanned and “impulsive” suicide was common in China^[37] and proxy (informant)-based personality assessments were reliable^[38-39], variables related to personality traits were also collected in the second-round interview with the Chinese version of E and N domains from the 88-items of Eysenck’s personality questionnaire (EPQ). Using these two domains, we defined four quadrants of personality traits, i.e., stable extraverts, unstable extraverts, stable introverts, and unstable introverts. Some questions of E (extraversion/introversion) and N (neuroticism/stability) domains measuring personal feeling/experience could not be answered by informants so that they were deleted in the final form.

1.3.5 Behavioral factors The behavior and life style factors included alcohol consumption and cigarette smoking. The commonly used illegal drugs in western cultures were not considered because people resided the rural areas like Lijin County and Hekou district rarely heard about these drugs. Alcohol consumption was divided into never, occasionally, and often groups. For those who never drank alcohol was defined as “never”; those who drank less than 3 times a week with any amount were defined as “occasionally”. Those who drank more than 3 times a week with at least 50 ml each time lasting more 6 months were defined as “often”. For those who had previous history of alcohol consumption but abstained for 1 year or more was also considered as “never.” In mainland China, the alcohol concentration of liquor can range from 32% to 63%. For beer, the alcohol concentration can be as low as 3%. It is difficult to use drink(s) to measure quantity of alcohol use. Therefore, we used frequency and volume to define the severity of drinking. Smoking statuses were divided into smoking and non-smoking. Smoking was defined as who smoked \geq half pack (≥ 10 cigarettes) per day for ≥ 6 months. For those who smoke less than half pack per day or < 6 month was considered as non-smoking as well as those who met the criteria for smoking before, but quitted smoking for ≥ 1 year.

1.3.6 Training of Interviewers All interviewers were public health professionals in the Bureau of Public Prevention and Vaccination of Lijing county and Hekou district and their affiliated local stations. The training took place as a group for 2 weeks to go through all questions in both forms, followed by live practice with a 2-person team on informants of the deceased. The inter-rater reliability of personality assessment was 0.85 to 0.92 based on the results of all interviewers after training. A 3-day midterm training was carried out for all interviewers at the end of 2004. The principal investigator oversaw the quality of data collected by each team. If the principal investigator had question or doubt about the accuracy of the data collected by a team, a different team would be sent to re-interview the informants. If a team repeatedly presented inaccuracy data, their participation of the study would be ended.

1.3.7 Statistical Analysis Descriptive analysis was used for the prevalence of suicide and overall death rate, and demographic variables. Standardized death rate during the study period was calculated based on the 2000 Shandong Province census data of the subgroup living in rural areas and at the same age strata. Bivariate analyses between the suicide victims and the controls were performed to provide a comparison with prior studies using this analysis and to screen candidate variables for multiple logistic regression analysis. Chi-square test was used for categorical data. For any cell with a number of < 5 , Fisher’s exact test would be applied. Odds ratio (*OR*) was used for risk estimate with 95% confidence interval (*CI*) to reflect the magnitude of differences. Continuous variables like years of education and family sizes were divided into categories as protocol-defined before *OR* and 95% *CI* confidence interval were estimated. Given the exploratory nature of the study, statistical significance was set at $\alpha = 0.05$, two-tailed without adjustment for multiple comparisons.

A conditional logistic regression among variables was used to study independent predictors for suicide by backward procedure. Adjusted odds ratios and 95% confidence intervals derived from conditional multivariate logistic regression indicates the strength of the association between completed suicide and risk factors. Candidate variables were selected based on the significant level of $P < 0.05$ in bivariate analyses. All variables entered the model were categorical variables. Variables of any adverse life event, mental illness, poor interpersonal relationship, history of previous suicide attempt, family history of suicide, history of childhood adversities, tobacco use, and annual family income were categorized into two groups “yes” (code 1) and “no”(code 0). Educational level, average family size, and alcohol use were ordinal variables (code 1, 2, 3). Personality traits,

living condition, and marital status were categorized into dummy variables (0 0 1, 0 1 0, 1 0 0). The SPSS17.0 software was used for logistic regression analyses.

The interaction of age and gender with independent risk factors in the suicide group was further analyzed with logistic regression. Seven age groups of 10~, 20~, 30~, 40~, 50~, 60~, 70~ were divided. The risk of 10~ group was used as a reference. For gender, female was used for comparison. For personality traits, unstable introvert was used as a comparison group.

2 Results

2.1 Rates of Death and Suicide Of 842,292 subjects investigated during the 2-year period (average 421,146 persons per year), 423,784 were males and 418,508 were females. Of the 5041 deaths from various causes, 176 died from suicide (Figure 1). The overall death rate was 0.60%, which was close to the standardized death rate of 0.54% in people living in rural areas of Shandong Province during the same period. The cumulative suicide incidence rate was 20.90 per 100,000 persons per year. The suicide was the sixth leading cause of death.

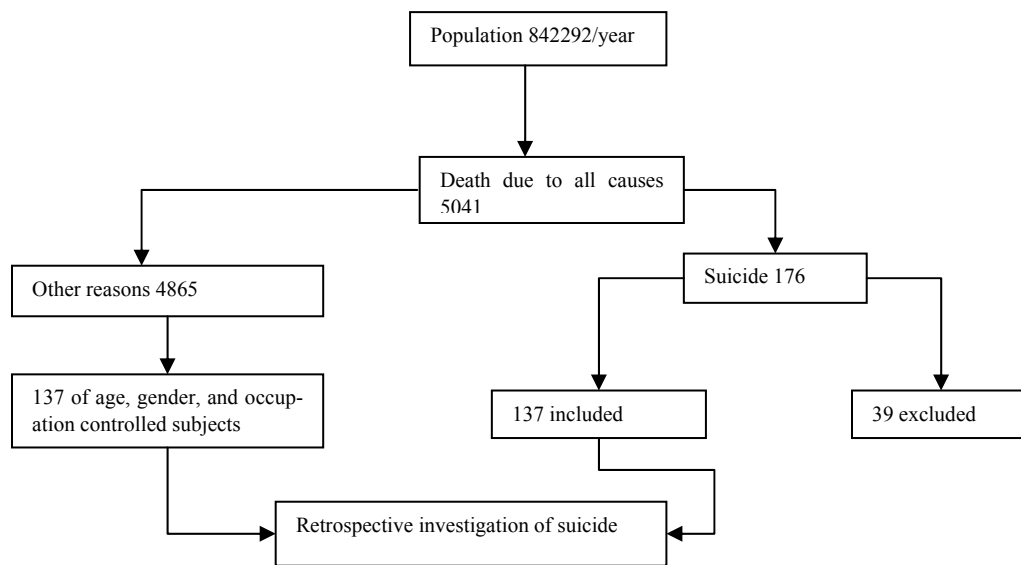


Figure 1 Case control study of the risk factors related to death of suicide

2.2 Characteristics of Suicide Victims Of the 176 suicide deaths, 93 were males and 83 were females, with their annual suicide rate of 21.95 and 19.83 per 100,000 persons, respectively. Male to female ratio was 1.12. The standardized death ratio of male to female in the same period was 1.11. There were no significant differences between male and female in overall suicide rates and the suicide rates from 20 to 39 years old group. However, from the age of 40 years old onward, the suicide rates of male were significantly higher than those of female with an overall *OR* of 1.47 (95% *CI* 1.02 - 2.11). The age of suicide victims ranged from 10 to 87 years old (mean \pm *SD* = 55.61 \pm 17.36). The peak of suicide fell in the age group of 70~79 years for males with a rate of 109.58 per 100,000 persons per year and the age group of \geq 80 years for females with a rate of 137.15 per 100,000 persons per year. Overall, the suicide rate increased with age increases ($P=0.00$, Table 1).

Table 1 Suicide Rates of Male vs. Female in Different Age Strata of Rural Residents in Lijin County and Hekou District of Mainland China from Year of 2004 to Year of 2005

Age	Male			Female			Total		
	Observed(N)	Suicide(N)	Rate*	Observed(N)	Suicide(N)	Rate*	Observed(N)	Suicide(N)	Rate*
0~	48124	0	—	44805	0	—	92929	0	—
10~	65696	4	6.09	61885	3	4.85	127581	7	5.49
20~	44785	3	6.70	45688	7	15.32	90473	10	11.05
30~	91580	11	12.01	91283	16	17.53	182863	27	14.77
40~	58970	18	30.52	57508	9	15.65	116478	27	23.18
50~	61710	21	34.03	60312	16	26.53	122022	37	30.32
60~	31176	14	44.91	31302	9	28.75	62478	23	36.81
70~	17339	19	109.58	19892	15	75.41	37231	34	91.32
80~	4404	3	68.12	5833	8	137.15	10237	11	107.45
total	423784	93	21.95	418508	83	19.83	842292	176	20.90

Notes: *Per 100,000 persons

In terms of occupation, there were 124 farmers, 6 factory workers, 2 truck drivers, 2 students, 1 school teacher, 1 businessman, and 1 health professional. Eighty-seven (49.43%) were illiterate, which was higher than that (16.42%) of the general population in China (http://www.stats.gov.cn/tjgb/rkpcgb/qgrkpcgb/t20060316_402310923.htm) ($P=0.00$).

The methods of suicides were ingestion of pesticide ($n=135$), hanging ($n=25$), drowning ($n=10$), jumping from building 3, cutting ($n=2$), and overdose on sedatives ($n=1$). Of 176 cases, 103 had medical illnesses; and 45 had psychiatric disorders.

2.3 Comparison between suicide victims and controls Of the 176 suicide victims, 137 were compared with matched controls (Figure 1) and the rest ($n=39$) were excluded because no level I informant(s) was available. Among those who were excluded, 22 were males and 17 were females with age from 10 years old to over 80 years old. There was no significant difference in age, age distribution, gender, medical illness, psychiatric disorders, and other sociodemographics between those were excluded and those were included in the analysis.

The causes of death for the matched controls were malignant tumor ($n=52$), cardiovascular and cerebrovascular diseases ($n=34$), respiratory diseases ($n=19$), traffic accident ($n=14$), other medical illnesses ($n=18$). Of the 83 suicide victims who had concomitant diseases, 38 had a mental illness; 13 had a cardiovascular and cerebrovascular disease(s); 10 had a respiratory disease(s); 5 had tumor/cancer; and 17 had other illnesses.

The informants for suicide victims and controls were similar. Among the level I informants, spouses were 32% versus 26%, parents 7% versus 12%, and offspring 61% versus 62% for suicide victims and controls, respectively. As shown in Table 2, two groups were fairly matched with no significant differences between the two groups in age, gender, educational level, and occupation.

Table 2 Distribution of Age, Gender, Educational Level, and Occupation of Suicide Victims and Their Controls

	Case		Control	
	N	%	N	%
Total	137	100	137	100
Age (Years)				
10~	5	3.65	4	2.92
20~	4	2.92	5	3.65
30~	19	13.87	18	13.14
40~	23	16.79	24	17.52
50~	26	18.98	27	19.71
60~	19	13.87	18	13.14

(续表 2)

70~	34	24.82	34	24.82
80~	7	5.11	7	5.11
Gender				
Male	71	51.82	71	51.82
Female	66	48.18	66	48.18
Educational Level				
Illiterate (<3 year)	67	48.91	58	42.34
Elementary (3-7 years)	38	27.24	34	24.82
Middle or higher (≥7 years)	32	23.36	45	32.85
Occupation				
Farmer	124	90.51	124	90.51
Non-Farmer	13	9.49	13	9.49

As shown in Table 3, among all variables, a history of major depressive disorder was significantly associated increased risk for suicide with the largest *OR* of 14.34 (95% *CI* 3.41 to 126.87), followed by a previous history of suicide attempt(s) with an *OR* of 13.06 (95% *CI* 1.73 to 272.67), any interpersonal relationship problem with an *OR* of 10.86 (95% 5.93 to 20.04), a history of any mental illness with an *OR* of 10.13 (95% *CI* 3.76 to 33.94), a family history of suicide attempts with an *OR* of 7.08 (95% *CI* 1.55 to 65.46), any childhood adversities with an *OR* of 4.56 (95% *CI* 1.84 to 12.82), unstable extravert of personality trait with an *OR* of 3.23 (95% *CI* 1.69 to 6.24), and any adverse/negative life events within 1 year prior to death with an *OR* of 2.38 (95% *CI* 1.40 to 4.03). Among the specified adverse life events, dissatisfaction with job or education had the largest *OR* of 7.08 (1.55 to 65.46), followed by the loss of relative or friend with an *OR* of 5.31 (95% *CI* 1.10 to 50.56), and financial difficulty with an *OR* of 1.95 (95% *CI* 1.08 to 3.55). In addition, unstable introvert personality trait was also significantly associated increased risk for suicide with an *OR* of 1.83 (95% *CI* 1.04 to 3.21) as well as family size of > 5 people with an *OR* of 2.36 (95% *CI* 1.13 to 4.98). Significantly more people in the suicide victims (n=29) had two or more adverse life events than the controls (n=2) (*P* = 0.00).

In contrast, stable extravert of personality trait was significantly associated with decreased risk for suicide with an *OR* of 0.21 (95% *CI* 0.12 to 0.37) as well as family size of 3-5 people with an *OR* of 0.60 (95% *CI* 0.36 to 0.98). There was no significantly difference between the suicide victims and the controls in level of education, living conditions, annual family income, marital statuses, alcohol use, and tobacco use (Table 3).

Table 3 Bivariate Analyses of Risk factors Associated with Suicide Between Suicide Victims and Controls

Variable	Case group		control group		χ^2	<i>P</i>	<i>OR</i> (95% <i>CI</i>)
	N	%	N	%			
Adverse life events within 1 year prior to death							
Any adverse life event	96	70.07	68	49.64	11.91	0.00	2.38(1.40-4.03)
Financial difficulty	43	31.39	26	18.98	5.58	0.02	1.95(1.08-3.55)
Burden of medical disease(s)	20	14.60	31	22.63	2.92	0.09	0.58(0.30-1.13)
Burden from offspring	13	9.49	7	5.11	1.94	0.16	1.95(0.70-5.60)
Loss of relative or friend	10	7.30	2	1.46	5.58	0.02*	5.31(1.10-50.56)
Loss of property	4	2.92	1	0.73	1.83	0.18*	4.09(0.40-202.88)
Dissatisfaction to job or education	13	9.49	2	1.46	8.53	0.00*	7.08(1.55-65.46)
Verbally threatened by other	13	9.49	0	0.00	13.65	0.00*	—
Other adverse events	19	13.87	2	1.46	13.61	0.00*	10.02(2.33-89.89)
History of mental illness							
Any mental illness	38	27.74	5	3.65	29.93	0.00	10.13(3.76-33.94)
Schizophrenia	12	8.76	2	1.46	7.53	0.01*	6.48(1.39-60.41)

(续表 3)

Major depressive disorder	24	17.52	2	1.46	20.57	0.00*	14.34(3.41-126.87)
Other psychiatric disorder	2	1.46	1	0.73	0.34	0.56*	2.01(0.10-119.73)
Poor interpersonal relationship							
Any interpersonal problem	97	70.80	25	18.25	76.60	0.00	10.86(5.93-20.04)
Problem with spouse	48	35.04	18	13.14	17.96	0.00	3.57(1.87-6.86)
Problem with other family member	40	29.20	7	5.07	27.97	0.00	7.66(3.12-19.63)
Problem with colleagues	9	6.57	0	0.00	9.31	0.00*	—
History of previous suicide attempt	12	8.76	1	0.73	9.77	0.00*	13.06(1.73-272.67)
Low level of education (< 7 year)	105	76.64	92	67.15	3.05	0.08	1.60(0.91-2.84)
Family history of suicide	13	9.49	2	1.5	8.53	0.00*	7.08(1.55-65.46)
Childhood adversities							
Any childhood adversities	27	19.71	7	5.11	13.38	0.00	4.56(1.84-12.82)
Death of a parent	11	8.03	4	2.92	3.46	0.06*	2.90(0.83-2.90)
Neglect	7	5.11	1	0.73	4.64	0.03*	7.32(0.92-332.42)
Physical abuse	6	4.38	1	0.73	3.67	0.06*	6.23(0.74-288.58)
Separation/divorce of parents	3	0.73	0	0.73	3.03	0.08*	—
Personality Traits							
Unstable extravert	45	32.85	18	13.14	15.03	0.00	3.23(1.69-6.24)
Unstable introvert	49	35.77	32	23.36	5.07	0.02	1.83(1.04-3.21)
Stable extravert	34	24.82	83	60.58	35.81	0.00	0.21(0.12-0.37)
Stable introvert	9	6.57	4	2.92	2.02	0.16*	2.34(0.63-10.62)
Living condition 3 months prior to death							
Lived alone	68	49.64	61	44.53	0.72	0.40	1.23(0.74-2.03)
Living with spouse	18	13.14	24	17.52	1.01	0.31	0.71(0.35-1.45)
Living with offspring	39	28.47	46	33.58	0.84	0.36	0.79(0.46-1.36)
Living with parent	9	6.57	5	3.65	1.20	0.27	1.86(0.54-7.23)
Living with others	3	2.19	1	0.73	1.01	0.31*	3.04(0.24-161.00)
Average Annual income / family member							
Low family income ≤ 3000 RMB	47	34.31	52	37.96	0.40	0.53	0.85(0.51-1.44)
High family income > 3000 RMB	90	65.69	85	62.04	0.40	0.53	1.17(0.69- .98)
Family size							
≤ 2 people	40	29.20	38	27.74	0.07	0.79	1.07(0.61-1.88)
3 – 5 people	68	49.64	85	62.04	4.28	0.04	0.60(0.36-1.00)
> 5 people	29	21.17	14	10.22	6.21	0.01	2.36(1.13-4.98)
Alcohol use							
“Never”	85	62.04	90	65.69	0.40	0.53	0.85(0.51-1.44)
“Occasionally”	15	10.95	22	16.06	1.53	0.22	0.64(0.90-3.07)
“Often”	37	27.01	25	18.25	3.00	0.08	1.66(0.90- 3.07)
Tobacco Use							
Smoking	95	69.34	97	70.80	0.07	0.79	0.93(0.54-1.62)
Non-smoking	42	30.66	40	29.20	0.07	0.79	0.07(0.62-1.86)
Marital Status							
Married	77	56.20	88	64.23	1.84	0.17	0.71(0.43-1.20)
Single	17	12.41	9	6.57	2.72	0.10	2.01(0.81-5.11)
Divorced	5	3.65	1	0.73	2.73	0.10*	5.15(0.58-245.41)
Widowed	38	27.74	39	28.47	0.02	0.89	0.96(0.55-1.69)

Notes: Abbreviations: *CI*, confidence interval; *N*, number; *OR*, odds ratio; *P*, *P*value; *Fisher exact test

2.4 Independent risk factors for suicide After stepwise backward procedure with all candidate variables of *P* value < 0.05 from bivariate analyses (Table 3), poor interpersonal relationship, any childhood adversity, a history of

mental illness, any adverse life events within 1 year, and unstable extravert of personality traits were remained in the model as independent risk factors for suicide. A history of previous suicide attempt and a family history of suicide had trended significance for predicting suicide with an *OR* of 7.98 (95% *CI* 0.79 to 80.67, *P*=0.08) and 4.25 (95% *CI* 0.72 to 25.00, *P*=0.11), respectively. Stable extravert personality trait did not significantly predict a decreased risk for suicide with an *OR* of 0.24 (95% *CI* 0.28 to 1.37, *P*=0.24).

Table 4 Independent Risk factors Associated with Suicide in Multivariate Logistic Regression Analysis

Variables	<i>OR</i> (95% <i>CI</i>)	<i>P</i>
Poor interpersonal relationship	12.79 (6.25 - 26.21)	0.00
Childhood adversities	7.26 (2.14 - 24.68)	0.00
History of mental illness	5.95 (1.61 - 21.97)	0.01
Adverse life events within 1 year prior to death	3.19 (1.58 - 6.46)	0.00
Unstable extravert of Personality Trait	6.12 (1.37 - 27.27)	0.02

Notes: Abbreviations: *CI*, confidence interval; *OR*, odds ratio; *P*, *P* value

2.5 Interactions of age and gender with independent risk factors As shown in Table 5, advanced age had significant interactions with all independent risk factors with a history of mental illness having the largest *OR* of 1.51 (95% *CI* 1.26 to 1.82). Advanced age also positively interacted to the previous history of suicide attempt and family history of suicide for increased risk of suicide with an *OR* of 1.78 (95% *CI* 1.05 to 3.03, *P*=0.03) and 1.36 (95% *CI* 1.05 to 1.75, *P*=0.02) although these two variables were not independent risk factors during logistic regression analysis. On the other hand, advanced age positively interacted with stable extravert personality trait for decreased risk of suicide with an *OR* of 0.87 (95% *CI* 0.80 to 0.94, *P*=0.00).

Male gender had positive interactions with the majority of independent risk factors for increased risk of suicide (Table 5) with a history of mental illness having the largest *OR* of 17.98 (95% *CI* 2.35 to 137.62). In contrast, male gender did not have significant interaction with previous history of suicide attempt, family history of suicide, or adverse life events. Male with stable extravert personality trait also had significantly reduced suicide risk compared to those with unstable introvert with an *OR* of 0.41 (95% *CI* 0.22 to 0.77, *P*=0.00).

Table 5 Interactions of age and gender with Independent risk factors for suicide

Independent risk factors	Advanced age		Male gender	
	<i>OR</i> (95% <i>CI</i>)	<i>P</i>	<i>OR</i> (95% <i>CI</i>)	<i>P</i>
Poor interpersonal relationship	1.36 (1.25 - 1.48)	0.00	5.99 (3.01 - 11.90)	0.00
Childhood adversities	1.21 (1.06 - 1.39)	0.00	12.26 (1.56 - 96.37)	0.02
History of mental illness	1.51 (1.26 - 1.82)	0.00	17.98 (2.35 - 137.62)	0.01
Adverse life events in 1 year prior to	1.13 (1.05 - 1.22)	0.00	1.46 (0.85 - 2.51)	0.17
Unstable extravert of Personality Trait	1.14 (1.01 - 1.28)	0.03	3.11 (1.10 - 8.80)	0.03

Notes: Age groups were 10~, 20~, 30~, 40~, 50~, 60~, 70~, 80~; Abbreviations: *CI*, confidence interval; *OR*, odds ratio; *P*, *P* value

3 Discussion

In this case-controlled study of a rural area in mainland China, we found that the overall suicide rate was 20.9 per 100,000 persons per year with almost equal rates among males and females. The risk for suicide increased with the age increases. Majority of suicide victims had < 7 year education. The most common mean of suicide was the ingestion of pesticides. Poor interpersonal relationship, childhood adversities, a history of mental illness, any adverse life events within a year prior to death, and unstable extravert personality traits were independent risk factors for suicide. Stable extravert of personality trait and family size of 3-5 people were associated with decreased risk for suicide in the bivariate analysis. Advanced age and male gender had positive interactions with independent risk factors, history of previous suicide attempt, and family history of suicide for increased risk of suicide.

The suicide rate in our study (Table 1) is consistent with previous suicide studies in mixed urban and rural Chinese populations^[2,38,40], but not with studies in urban Chinese residents^[41-42]. The sixth leading cause of the death of suicide in our study is also consistent with the mortality data of the Chinese Ministry of Health^[3]. In contrast, the suicide rate in the United States in 2005 was 10.8 per 100,000 persons and the suicide was 11th leading cause of death^[1]. Meanwhile, the suicide rate worldwide was 16.7 per 100,000 persons per year and was the 14th leading cause of death^[1]. These data suggest that there is an urgent need for Chinese central and logical governments to implement strategies to prevent suicide.

The finding of a slight higher rate of suicide in males than in females is also consistent with other case-controlled studies in China^[4,6,34,42] although other studies in China reported that the rate of suicide in females was much higher than in males^[3,36]. The cause of this “shift” toward a higher rate of suicide in Chinese male than in female remains yet to determine, but one possible reason is that the methodology using to identify suicide victims has become more complicate and thorough^[4,6]. The female dominance among the suicide victims in previous studies could be a reporting bias. This assumption is supported by studies from Hong Kong and Taiwan, in which the ratio of male to female for suicide was more than 2:1 that was similar to Western countries^[1,43]. Therefore, unless China implements a standard death recording system like western countries, the male to female ratio of suicide will remains inclusive. More importantly, the positive interactions between male gender and independent risk factors (Table 5) suggest that clinicians and mental health professionals should pay close attention to these high risk subgroups of people for suicide in order to reduce the death from suicide in China.

In terms of age distribution, we did not observe the “two-peak” distributions (early adulthood and late adulthood) as previously reported in China^[3-4], and in the United States^[1]. As shown in Table 1, the peak of suicide among males was at the 70 -79 age group with a rate of 109.6 per 100,000 persons per year. For females, the peak was at the ≥ 80 year old group with a rate of 137.2 per 100,000 persons per year. The highest rates of suicide among the oldest groups were consistent with the data of the Chinese Ministry of Health^[3], studies in the United State^[1], and a study from Taiwan^[27]. Although previous studies consistently showed that younger age was a robust risk factor for suicide^[1,22,23,31,44], our results (Tables 2&5) and a previous study from China^[3] showed that the most vulnerable group is the elderly, suggesting that the strategy for preventing suicide in China should also be focus on this group.

Poor interpersonal relationship or interpersonal conflict as a risk factor for suicidal behaviors has been reported in different countries^[45-47]. Differential interactions of interpersonal conflict with gender and ethnicity on the risk for suicide were also observed^[48-49]. In a study of the divergence in contributing factors for suicide among men and women in the Kentucky State of the United States, intimate partner problems was a contributing factor for about 29% of all suicide victims^[48]. Among these 29% suicide cases, 87% were men, which is consistent with our finding that male gender positively interacted with poor interpersonal relationship for increased risk for suicide (Table 5). However, in rural young Chinese, interpersonal conflict played a more important role in women than men for increased risk of suicide^[50]. A study from Australia found that Indigenous suicide victims have a higher rate of family conflict before death than non-Indigenous^[49]. There data suggest that the negative impact of interpersonal conflict on the risk of suicide is universal, but may have differential effect on gender and ethnic groups.

The finding of childhood adversities as an independent predictor for suicide is consistent with previous studies^[51,52]. In a study from the World Mental Health (WMH) surveys including 21 countries, childhood adversities were associated with increased risk for suicidal ideation and suicide attempt across the lifespan^[51]. A longitudinal study also found that childhood adversities were associated with an elevated risk for suicide attempts during late adolescence or early adulthood^[52]. Moreover, different adversities may have different impact on the risk for suicide behaviors. In the study of WMH surveys, sexual abuse and physical abuse were the strongest risk factors for both the onset and persistence of suicidal behavior. In our study, sexual abuse was not reported; physical abuse and neglect only had numerical increase in suicide victims than in the controls, 4% versus 1% and 5% versus 1%, respectively (Table 3). In addition, the rates of childhood adversities in our studies were much lower than in other studies^[51-52]. For example, in the study of the WMH surveys, among those attempted suicide,

29% had physical abuse; 19% had neglect, and 16% had death of a parent(s)^[51]. It is unclear if the lower rates in our study were a true finding or a reporting bias.

Childhood adversities appear to be risk factors for suicidal behaviors across countries and cultures although different adversities may occur with different frequencies in different countries or cultures. A recent genome-wide epigenetic study showed that childhood adversity was associated with sustained alterations in the promoters of several genes related to neuronal plasticity in hippocampus in suicide victims who had early-life trauma^[53]. These findings highlight the importance of preventing childhood adversities in order to reduce the risk for suicide and other psychiatric disorders.

The finding of a history of mental illness as an independent risk factor for suicide in our study is consistent with some studies in China^[6,32,34] and Western countries^[7,54-56]. In Western cultures, psychological autopsy studies revealed that 90-95 percent of suicide victims had a diagnosable psychiatric disorder at the time of the suicide^[11], but only about half of suicide victims in China had a history of psychiatric diagnosis at the time of death^[4,6,32,34]. The decline in suicide has been reported in United Kingdom and the United States although the role of the treatment of psychiatric disorders in the decline of suicide remains unclear^[11,57]. However, there have been reports that antidepressant treatments, especially SSRIs and other new-generation non-SSRI antidepressants, could reduce the risk of suicidal behaviors^[58-59].

Unfortunately, there was only less than 10% of patients with mental illness in China ever sought professional health^[60]. Similarly, in other developing countries, patients with psychiatric disorders and suicide thoughts were commonly undiagnosed and untreated^[7,61]. Recent studies from the WHO^[9,10] and China^[5,32,62] have shown that psychiatric disorders played an important role in suicidal behaviors. Clearly, diagnosis and treatment of psychiatric disorders should be a part of any suicide prevention plan.

Among the psychological factors, the association of any adverse life event within 1 year prior to death with increased risk for suicide is consistent with previous studies in China^[4,6] and studies in both developed and developing countries^[7,63-67]. Although the underlying mechanism between adverse life events and suicide remains unclear, according to the stress-diathesis model, adverse life event(s) can trigger a series of genetic, physiological, and psychological changes including the modification of gene expression through DNA methylation^[1,53,68-70]. A longitudinal prospective study showing that depressive mood was a necessary precondition of suicide ideation after adverse events occurred^[71]. It is quiet possible that the increased risk for suicide after adverse life events could be the occurrence of psychiatric disorders.

Meanwhile, adverse life event(s), especially acute life event(s), could trigger impulsive suicide and suicide attempt. In China, about a half of suicide victims did not have a psychiatric diagnosis at the time of death^[4,32-34]. Impulsive suicide and suicide attempts have been reported in rural Chinese residents^[34,37,72-73] and other countries^[74]. Although most impulsive suicide attempts tended to be less lethal and the less impulsive attempts tended to be more lethal^[74], high acute stress score, recent adverse life events, and low quality of life showed to be associated with increased risk for suicide attempt regardless of the level of intent^[5]. It is quite possible that some of suicide victims in China who did not have a history of psychiatric disorder killed themselves because of high lethality of pesticides even if they acted impulsively with low-intent of death^[5,34,37,72-73].

Unstable extravert personality trait commonly manifests as touchy, restless, excitable, impulsive, and irresponsible. Its association with an increased risk for suicide in our bivariate analysis (Table 3) suggests personality might play a role in averse-life-event-related “impulsive” suicide. Previously, a number of studies showed that the most attributing factors of personality disorders to suicidal behaviors were impulsivity, aggression, and hostility^[37,75-86]. Since about half of suicides in China were unplanned and impulsive, the relationship between personality traits/disorder and suicides is worthy of further exploration with larger sample size studies.

Previous history of suicide attempt as a risk factor of suicide in our study (Table 3) is consistent with previous studies in China^[4,6] and other countries^[14-15]. Its insignificant association with increased risk for suicide as an independent predictor might be due to a relatively small size of our study. A long-term study of Swedish cohort

who attempted suicide found that a high proportion of suicides took place within the first year of follow-up^[15]. Therefore, aftercare for those who attempted suicide with psychiatric conditions is essential to reduce the risk for suicide.

Unstable introvert personality trait is commonly present as quiet, reserved, pessimistic, sober, rigid, anxious, and/or moody. Its association with the increased risk for suicide in our bivariate analysis suggests that people with introvert personality trait who commit suicide may be through different pathways compared to people with unstable extravert personality who are likely through impulsivity. One of such pathways is through the emergence of psychiatric disorders, especially depression and/or anxiety disorder. A study from an outpatient clinic in China found that introvert characteristics were an independent risk factor for personality disorders which was associated with increased risk for mood and anxiety disorders^[87]. It is reasonable to assume that the unstable introverts with mood disorder, especially depression, are more likely to have feeling of hopelessness, lack of enjoyment, and co-occurrence anxiety. High level of hopelessness was strongly related to suicide among Chinese rural young adults^[88]. Meanwhile, the combination of neurotic characteristics with lack of enjoyment, pessimism, hopelessness, and low extravert characteristics was associated with increased risk for suicide in rural China^[89]. These findings suggest that psychological testing for personality traits might be considered as a part of suicidal risk assessment.

The finding that heavy alcohol use was not an independent predictor for suicide in our study is inconsistent with previous reports, in which alcohol use disorder was associated with increased risk for suicide^[90-93]. In a previous study from China, a history of alcohol use disorder was only significantly associated with an increased risk for suicide in male, rural residents, and those with age < 40 years old^[32]. In our study, all suicide victims were rural residents and were matched with age and gender, therefore, alcohol use disorder might lose its discriminative effect on the risk of suicide in our study.

The finding of lower education level as a trended risk for suicide (Table 3) is consistent with the case-control studies in young rural Chinese^[6] and in general Chinese population^[4], and other population-based studies from different countries^[7,10,12-13,94]. However, among the psychiatric patients, a higher level of education (postgraduate education) was associated with increased risk for suicide compared to those with lower education^[95]. In a study of acceptability of suicide among rural residents, urban residents, and college students from China, overall acceptability score of suicide increased with years of education increases^[63]. Therefore, the role of educational level in suicide is worthy of further investigation.

Since stable extraverts commonly with characteristics of outgoing, responsive, easygoing, lively, carefree, and/or leadership, the decreased risk associated with this personality trait for suicide in our bivariate analysis is not unexpected (Table 3). More importantly, the decreased risk for suicide with stable extravert personality trait was observed with advanced age and male gender in the present study, suggesting that a healthy personality may protect against suicide.

Lack of association of married status and living with others with suicide risk in our bivariate analyses (Table 3) is consistent with some Chinese studies^[4,34], but not with the one in young rural Chinese suicide victims^[6]. Married status as a protective factor and a risk factor for suicide has also been reported in other countries. In India, Pakistan, and Iran, being married appeared to a risk factor for suicide, especially for women^[21-23]. However, most studies from Asia, Europe, New Zealand, and the United States have shown that married status had some protective effect against suicide, especially for men^[6,16-19,28-31]. In Denmark, marital status had a comparable protective influence on suicide risk in both sexes^[20]. These data suggest that marital status has different effects on suicide in different countries which is more likely related to their cultures, especially the quality of marriages.

3.1 Limitation Since this study was focus on two rural counties of Shandong province, the data from this study may not be generable to the other rural population of China and other parts of the world. Meanwhile, changes in rural areas of China in last decade are rapid, but unequal. It is unclear how our data will be applied to the current rural residents. The sample size was relatively small. Therefore, difference in some variables between suicide victims and controls might not be detected. In addition, the history of mental illness was determined with medical

records. The prevalence of mental illness might be underestimated. Psychological autopsy is a valid method, but its inherent limitation and disadvantage like bias by informants could not be avoided^[96].

3.2 Conclusion The suicide rate in this rural population was 20.9 per 100,000 persons per year with almost equal rates in both males and females. The elderly had the highest risk for suicide. The most common method for suicide was ingestion of pesticides. Poor interpersonal relationship, childhood adversities, history of mental illness, adverse life event(s) within 1 years prior to death, previous history of suicide attempt, and unstable extravert personality traits were independently associated with increased risk for suicide with positive interactions with male gender and advanced age. Strategies targeting these factors, especially in male and elderly, should be taken into consideration for suicide prevention. Large sample studies are warranted to assess the other factors including marital status, alcohol use disorder, and personality disorders in suicide.

Conflict of Interest

Dr. Gao has received grant support from AstraZeneca, NARSAD, and Cleveland Foundation. Dr. Gao has not been on any speaker bureau in last 2 years. Other authors have no conflict of interest to disclose.

[References]

- [1] Nock MK, Borges G, Bromet EJ, et al. Suicide and suicidal behavior. *Epidemiol Rev*,2008,30:133-154.
- [2] Cao W, Wu T, An T, et al. Study on the mortality of injury in Chinese population in urban and rural areas from 1990 to 1997. *Chin J Epidemiol*,2000,21:327-329.
- [3] Phillips MR, Li X, Zhang Y. Suicide rates in China, 1995-99. *Lancet*,2002,359:835-840.
- [4] Phillips MR, Yang G, Zhang Y, et al. Risk factors for suicide in China: a national case-control psychological autopsy study. *Lancet*,2002,360:1728-1736.
- [5] Conner KR, Phillips MR, Meldrum SC. Predictors of low-intent and high-intent suicide attempts in rural China. *Am J Public Health*,2007,97:1842-1846.
- [6] Zhang J, Xiao S, Zhou L. Mental disorders and suicide among young rural Chinese: a case-control psychological autopsy study. *Am J Psychiatry*,2010,167:773-781.
- [7] Almasi K, Belso N, Kapur N, et al. Risk factors for suicide in Hungary: a case-control study. *BMC Psychiatry*,2009,9:45.
- [8] Borges G, Nock MK, Medina-Mora ME, et al. Psychiatric disorders, comorbidity, and suicidality in Mexico. *J Affect Disord*,2010,124:98-107.
- [9] Nock MK, Hwang I, Sampson N, et al. Cross-national analysis of the associations among mental disorders and suicidal behavior: findings from the WHO World Mental Health Surveys. *PLoS Med*,2009,6:e1000123.
- [10] Borges G, Nock MK, Haro Abad JM, et al. Twelve-month prevalence of and risk factors for suicide attempts in the World Health Organization World Mental Health Surveys. *J Clin Psychiatry*,2010,71:1617-1628.
- [11] Kessler RC, Berglund P, Borges G, et al. Trends in suicide ideation, plans, gestures, and attempts in the United States, 1990-1992 to 2001-2003. *JAMA*,2005,293:2487-2495.
- [12] Jeon HJ, Lee JY, Lee YM, et al. Lifetime prevalence and correlates of suicidal ideation, plan, and single and multiple attempts in a Korean nationwide study. *J Nerv Ment Dis*,2010,198:643-646.
- [13] Andersson L, Allebeck P, Gustafsson JE, et al. Association of IQ scores and school achievement with suicide in a 40-year follow-up of a Swedish cohort. *Acta Psychiatr Scand*,2008,118:99-105.
- [14] Runeson B, Tidemalm D, Dahlin M, et al. Method of attempted suicide as predictor of subsequent successful suicide: national long term cohort study. *BMJ*,2010,341:c3222.
- [15] Tidemalm D, Långström N, Lichtenstein P, et al. Risk of suicide after suicide attempt according to coexisting psychiatric disorder: Swedish cohort study with long term follow-up. *BMJ*,2008,337:a2205.
- [16] Petrović B, Kocić B, Nikić D, et al. The influence of marital status on epidemiological characteristics of suicides in the southeastern part of Serbia. *Cent Eur J Public Health*,2009,17:41-46.
- [17] Poudel-Tandukar K, Nanri A, Mizoue T, et al. Social support and suicide in Japanese men and women - the Japan Public Health Center (JPHC)-based prospective study. *J Psychiatr Res*,2011,45:1545-1550.
- [18] Masocco M, Pompili M, Vanacore N, et al. Completed suicide and marital status according to the Italian region of origin. *Psychiatr Q*,2010,81:57-71.
- [19] Corcoran P, Nagar A. Suicide and marital status in Northern Ireland. *Soc Psychiatry Psychiatr Epidemiol*,2010,45:795-800.
- [20] Andrés AR, Collings S, Qin P. Sex-specific impact of socio-economic factors on suicide risk: a population-based case-control

- study in Denmark. *Eur J Public Health*,2010,20:265-270.
- [21] Khan MM, Mahmud S, Karim MS, et al. Case-control study of suicide in Karachi, Pakistan. *Br J Psychiatry*,2008,193:402-405.
- [22] Lari AR, Joghataei MT, Adli YR, et al. Epidemiology of suicide by burns in the province of Isfahan, Iran. *J Burn Care Res*,2007, 28:307-311.
- [23] Mohanty S, Sahu G, Mohanty MK, et al. Suicide in India: a four year retrospective study. *J Forensic Leg Med*,2007,14:185-189.
- [24] Mayer P, Ziaian T. Suicide, gender, and age variations in India. Are women in Indian society protected from suicide? *Crisis*,2002, 23:98-103.
- [25] Vijayakumar L, John S, Pirkis J, et al. Suicide in developing countries (2): risk factors. *Crisis*,2005,26:112-119.
- [26] Yeh JY, Xirasagar S, Liu TC, et al. Does marital status predict the odds of suicidal death in Taiwan? A seven-year population-based study. *Suicide Life Threat Behav*,2008,38:302-310.
- [27] Liu HL. Epidemiologic characteristics and trends of fatal suicides among the elderly in Taiwan. *Suicide Life Threat Behav*,2009,39:103-113.
- [28] Blakely TA, Collings SC, Atkinson J. Unemployment and suicide. Evidence for a causal association? *J Epidemiol Community Health* 2003,57:594-600.
- [29] Masocco M, Pompili M, Vichi M, Vanacore N, Lester D, Tatarelli R. Suicide and marital status in Italy. *Psychiatr Q*,2008, 79:275-85
- [30] Griffiths C, Ladva G, Brock A, et al. Trends in suicide by marital status in England and Wales, 1982-2005. *Health Stat Q*,2008, 37:8-14.
- [31] Luoma JB, Pearson JL. Suicide and marital status in the United States, 1991-1996: is widowhood a risk factor? *Am J Public Health*,2002,92:1518-1522.
- [32] Tong Y, Phillips MR. Cohort-specific risk of suicide for different mental disorders in China. *Br J Psychiatry*,2010,196:467-473.
- [33] Zhang J, Li N, Tu XM, et al. Risk factors for rural young suicide in China: a case-control study. *J Affect Disord*,2011, 129:244-251.
- [34] Li XY, Phillips MR, Zhang YP, et al. Risk factors for suicide in China's youth: a case-control study. *Psychol Med*,2008, 38:397-406.
- [35] Zhang J, Wieczorek W, Conwell Y, et al. Characteristics of young rural Chinese suicides: a psychological autopsy study. *Psychol Med*,2010,40:581-589.
- [36] Zhang J, Zhang Y, Weng Z. Characteristics of suicide mortality in different populations of Shandong Province: a comparison of three epidemiologic study methods. *J Clin Rehab Tissue Engineering Res* ,2007, 11:10543-10546.
- [37] Conner KR, Phillips MR, Meldrum S, et al. Low-planned suicides in China. *Psychol Med*,2005,35:1197-1204.
- [38] Zhang J, Conwell Y, Wieczorek WF, et al. Studying Chinese suicide with proxy-based data: reliability and validity of the methodology and instruments in China. *J Nerv Ment Dis*,2003,191:450-357.
- [39] Holst G, Rennemark M, Hallberg IR. Self and next of kin's assessment of personality and sense of coherence in elderly people: implication for dementia care. *Dementia*,2012,11:19-30.
- [40] Li N, Yang X, Yan T, et al., Analysis on the suicide mortality of urban and rural residents in Liaoning Province during 1999 to 2003. *Chin J Prev Contr Chron Non-commun Dis*,2008, 16:382-383.
- [41] Qi Z, Jia C, Zhang J. Epidemiological characteristics of completed suicide in Zhouching City from 2004 to 2007. *Practical Preventive Medicine*,2008, 15:1784-1783.
- [42] Dong G, Pan G, Dong Q, et al. Analysis of suicide in seven urban areas of Liaoning Province from 1988 to 2000. *Chin J Epidemiol*,2005,26:1004-1005.
- [43] Pan YJ, Liao SC, Lee MB. Suicide by charcoal burning in Taiwan, 1995-2006. *J Affect Disord*,2010,120:254-257.
- [44] Al Ansari A, Ali MK. Psychiatric and socioenvironmental characteristics of Bahraini suicide cases. *East Mediterr Health J*,2009, 15:1235-1241.
- [45] Nazarzadeh M, Bidel Z, Ayubi E, et al. Determination of the social related factors of suicide in Iran: a systematic review and meta-analysis. *BMC Public Health*,2013,13:4.
- [46] Dieserud G, Gerhardsen RM, Van den Weghe H, et al. Adolescent suicide attempts in Bærum, Norway, 1984-2006. *Crisis*,2010, 31:255-264.
- [47] Jeon HJ, Lee JY, Lee YM, et al. Unplanned versus planned suicide attempters, precipitants, methods, and an association with mental disorders in a Korea-based community sample. *J Affect Disord*,2010,127:274-280.
- [48] Walsh S, Clayton R, Liu L, et al. Divergence in contributing factors for suicide among men and women in Kentucky: recommendations to raise public awareness. *Public Health Rep*,2009,124:861-867.
- [49] Kuipers P, Appleton J, Pridmore S. Thematic analysis of key factors associated with Indigenous and non-Indigenous suicide in the Northern Territory, Australia. *Rural Remote Health*,2012,12:2235

- [50] Zhang J, Ma Z. Patterns of life events preceding the suicide in rural young Chinese: a case control study. *J Affect Disord*,2012, 140:161-167.
- [51] Bruffaerts R, Demyttenaere K, Borges G, et al. Childhood adversities as risk factors for onset and persistence of suicidal behaviour. *Br J Psychiatry*,2010,197:20-27.
- [52] Johnson JG, Cohen P, Gould MS, Kasen S, Brown J, Brook JS. Childhood adversities, interpersonal difficulties, and risk for suicide attempts during late adolescence and early adulthood. *Arch Gen Psychiatry* 2002, 59:741-749.
- [53] Labonté B, Suderman M, Maussion G, et al. Genome-wide epigenetic regulation by early-life trauma. *Arch Gen Psychiatry* 2012, 69:722-731.
- [54] Fleischmann A, Bertolote JM, Belfer M, et al. Completed suicide and psychiatric diagnoses in young people: a critical examination of the evidence. *Am J Orthopsychiatry*,2005,75:676-683.
- [55] Schneider B, Wetterling T, Sargk D, et al. Axis I disorders and personality disorders as risk factors for suicide. *Eur Arch Psychiatry Clin Neurosci*,2006,256:17-27.
- [56] Ilgen MA, Bohnert AS, Ignacio RV, et al. Psychiatric diagnoses and risk of suicide in veterans. *Arch Gen Psychiatry*,2010, 67:1152-1158.
- [57] Biddle L, Brock A, Brookes ST, et al. Suicide rates in young men in England and Wales in the 21st century: time trend study. *BMJ*,2008,336:539-542.
- [58] Gibbons RD, Brown CH, Hur K, et al. Relationship between antidepressants and suicide attempts: an analysis of the Veterans Health Administration data sets. *Am J Psychiatry*,2007,164:1044-1049.
- [59] Gibbons RD, Hur K, Bhaumik DK. The relationship between antidepressant medication use and rate of suicide. *Arch Gen Psychiatry*,2005,62:165-172.
- [60] Phillips MR, Zhang J, Shi Q, et al. Prevalence, treatment, and associated disability of mental disorders in four provinces in China during 2001-05: an epidemiological survey. *Lancet*,2009,373:2041-2053.
- [61] Bruffaerts R, Demyttenaere K, Hwang I, et al. Treatment of suicidal people around the world. *Br J Psychiatry*,2011,199:64-70.
- [62] Lee S, Fung SC, Tsang A, et al. Lifetime prevalence of suicide ideation, plan, and attempt in metropolitan China. *Acta Psychiatr Scand*,2007,116:429-437.
- [63] Li X, Phillips MR. The acceptability of suicide among rural residents, urban residents, and college students from three locations in China: a cross-sectional survey. *Crisis*,2010,31:183-193.
- [64] Foster T. Adverse life events proximal to adult suicide: a synthesis of findings from psychological autopsy studies. *Arch Suicide Res*,2011,15:1-15.
- [65] Pompili M, Innamorati M, Szanto K, et al. Life events as precipitants of suicide attempts among first-time suicide attempters, repeaters, and non-attempters. *Psychiatry Res*,2011,186:300-305.
- [66] Palacio C, García J, Diago J, et al. Identification of suicide risk factors in Medellín, Colombia: a case-control study of psychological autopsy in a developing country. *Arch Suicide Res*,2007,11:297-308.
- [67] Cavanagh JT, Owens DG, Johnstone EC. Life events in suicide and undetermined death in south-east Scotland: a case-control study using the method of psychological autopsy. *Soc Psychiatry Psychiatr Epidemiol*,1999,34:645-650.
- [68] Currier D, Mann JJ. Stress, genes and the biology of suicidal behavior. *Psychiatr Clin North Am*,2008,31:247-269.
- [69] Wasserman D, Geijer T, Sokolowski M, et al. Nature and nurture in suicidal behavior, the role of genetics: some novel findings concerning personality traits and neural conduction. *Physiol Behav*,2007,92:245-249.
- [70] Booij L, Wang D, Lévesque ML, et al. Looking beyond the DNA sequence: the relevance of DNA methylation processes for the stress-diathesis model of depression. *Philos Trans R Soc Lond B Biol Sci*,2013,368:20120251.
- [71] Hintikka J, Koivumaa-Honkanen H, Lehto SM, et al. Are factors associated with suicidal ideation true risk factors? A 3-year prospective follow-up study in a general population. *Soc Psychiatry Psychiatr Epidemiol*,2009,44:29-33.
- [72] Cui W. Women and suicide in rural China. *Bull World Health Organ*,2009,87:888-889.
- [73] Eddleston M, Phillips MR. Self poisoning with pesticides. *BMJ*,2004,328:42-44.
- [74] Baca-García E, Diaz-Sastre C, Basurte E, et al. A prospective study of the paradoxical relationship between impulsivity and lethality of suicide attempts. *J Clin Psychiatry*,2001,62:560-564.
- [75] McGirr A, Renaud J, Bureau A, et al. Impulsive-aggressive behaviours and completed suicide across the life cycle: a predisposition for younger age of suicide. *Psychol Med*,2008,38:407-417.
- [76] McGirr A, Paris J, Lesage A, et al. Risk factors for suicide completion in borderline personality disorder: a case-control study of cluster B comorbidity and impulsive aggression. *J Clin Psychiatry*,2007,68:721-929.
- [77] McGirr A, Alda M, Séguin M, et al. Familial aggregation of suicide explained by cluster B traits: a three-group family study of suicide controlling for major depressive disorder. *Am J Psychiatry*,2009,166:1124-1134.
- [78] Koller G, Preuss UW, Bottlender M, et al. Impulsivity and aggression as predictors of suicide attempts in alcoholics. *Eur Arch*

- Psychiatry Clin Neurosci,2002,252:155-160.
- [79] Maloney E, Degenhardt L, Darke S, et al. Impulsivity and borderline personality as risk factors for suicide attempts among opioid-dependent individuals. *Psychiatry Res*,2009,169:16-21.
- [80] Chioqueta AP, Stiles TC. Assessing suicide risk in cluster C personality disorders. *Crisis*,2004,25:128-133.
- [81] Brent DA, Johnson BA, Perper J, et al. Personality disorder, personality traits, impulsive violence, and completed suicide in adolescents. *J Am Acad Child Adolesc Psychiatry*,1994,33:1080-1086.
- [82] Dervic K, Grunebaum MF, Burke AK, et al. Cluster C personality disorders in major depressive episodes: the relationship between hostility and suicidal behavior. *Arch Suicide Res*,2007,11:83-90.
- [83] Diaconu G, Turecki G. Obsessive-compulsive personality disorder and suicidal behavior: evidence for a positive association in a sample of depressed patients. *J Clin Psychiatry*,2009,70:1551-1556.
- [84] Schneider B, Schnabel A, Wetterling T, et al. How do personality disorders modify suicide risk? *J Pers Disord*,2008, 22:233-245.
- [85] Zouk H, Tousignant M, Seguin M, et al. Characterization of impulsivity in suicide completers: clinical, behavioral and psychosocial dimensions. *J Affect Disord*,2006,92:195-204.
- [86] Gvion Y, Apter A. Aggression, impulsivity, and suicide behavior: a review of the literature. *Arch Suicide Res*,2011,15:93-112.
- [87] Zhang TH, Xiao ZP, Wang LL, et al. A cross-sectional survey on personality disorder in mental disorder outpatients in Shanghai. *Zhonghua Liu Xing Bing Xue Za Zhi*,2010, 31:933-937.
- [88] Zhang J, Li N, Tu XM, et al. Risk factors for rural young suicide in China: a case-control study. *J Affect Disord*,2011, 129:244-251.
- [89] Fang L, Heisel MJ, Duberstein PR, et al. Combined effects of neuroticism and extraversion: findings from a matched case control study of suicide in rural China. *J Nerv Ment Dis*,2012,200:598-602.
- [90] Pirkola SP, Isometsä ET, Heikkinen ME, et al. Suicides of alcohol misusers and non-misusers in a nationwide population. *Alcohol Alcohol*,2000,35:70-75.
- [91] Brady J. The association between alcohol misuse and suicidal behaviour. *Alcohol Alcohol*,2006,41:473-478.
- [92] Flensburg-Madsen T, Knop J, Mortensen EL, et al. Alcohol use disorders increase the risk of completed suicide--irrespective of other psychiatric disorders. A longitudinal cohort study. *Psychiatry Res*,2009,167:123-130.
- [93] Schneider B. Substance use disorders and risk for completed suicide. *Arch Suicide Res*,2009,13:303-316.
- [94] Wiktorsson S, Runeson B, Skoog I, et al. Attempted suicide in the elderly: characteristics of suicide attempters 70 years and older and a general population comparison group. *Am J Geriatr Psychiatry*,2010,18:57-67.
- [95] Agerbo E. High income, employment, postgraduate education, and marriage: a suicidal cocktail among psychiatric patients. *Arch Gen Psychiatry*,2007,64:1377-1384.
- [96] Pouliot L, De Leo D. Critical issues in psychological autopsy studies. *Suicide Life Theat Behav*,2006,36:491-510.