Published in final edited form as:
Psychiatry Res. 2010 September 30; 179(2): 217–221. doi:10.1016/j.psychres.2009.12.005.

Access to farming pesticides and risk for suicide in Chinese rural young people

Yuanyuan Kong[a] and **Jie Zhang**[b,*]

[a] Department of Epidemiology and Statistics, School of Public Health, Shandong, University, Jinan, Shandong 250012, China

[b] Department of Sociology, State University of New York College at Buffalo, Buffalo, New York 14222, USA

Abstract

Suicide is a leading cause of death in individuals 15–34 years of age in China. Highly lethal pesticides are a common method used for suicide in Chinese rural areas. This case-control study aimed to test hypotheses concerning the suicide risks associated with pesticide access. Subjects included 370 rural completed suicides aged 15 to 34 years and 370 living controls matched on age, gender, and residence (rural/urban location). Data were collected by a psychological autopsy design with proxy respondents. Pesticide access was a significant risk factor for suicide even after controlling for other known risk factors in social and psychiatric domains, such as education level, living situation, marital status, family annual income, and mental disorder. Increased risk was accounted for by access to insecticide rather than other types of pesticides. Suicide intervention in China should focus on restricting access to pesticides, especially highly toxic insecticide, improving the resuscitation skills of rural primary-care health providers, promoting psychological and social support networks in rural areas, and educating the general public about the suicide risk of having pesticides stored at the households.

Keywords

Suicide; Rural China; Psychological autopsy; Case-control studies; Risk factor; Suicide method; Pesticides

1. Introduction

Suicide is the most common injury death and the fourth most important public health problem in China (Wang et al., 2008). The average death rate for suicide in China was 23 per 100 000 during 1990–2000, accounting for about 287 000 suicide deaths every year (Phillips et al, 2002). The pattern of suicide in China is very different from that reported in western countries: the suicide rate in rural areas is three-fold to five-fold greater than that in urban areas, female suicide rate is slightly higher than male suicide rate, and suicide is the

*Correspondence should be directed to Professor Jie Zhang, Ph.D., Department of Sociology, State University of New York College at Buffalo, 1300 Elmwood Avenue, Buffalo, New York 14222, USA. Phone: 716-878-6425; FAX: 716-878-4009; zhangj@buffalostate.edu.

leading cause of death in individuals 15–34 years of age, accounting for 18.9% of all deaths (Phillips et al., 2002; Zhang et al, 2004; Zhang, 2006).

As a developing and agricultural country, China has large populations in rural areas. The quantity of pesticide use is large, about 1.4 million tons each year (Agriculture Ministry of PRC, 2005). Previous studies have shown that highly lethal pesticides are a common method used for suicide in rural China (Hu et al., 2004; Phillips and Yang, 2004; Yang et al., 2005; Zhang and Xu, 2007). About 166 000 suicides by pesticide ingestion occur each year in China (58% of 287 000 annual suicides), 100 000 of them can receive medical attention but 61% of 166 000 suicides by pesticide ingestion cannot be successfully resuscitated (Yang et al., 2005). WHO's report supported the common view that fatal self harm is usually associated with a mental disorder, but research from China demonstrated that about 35% of people who die by suicide and about 60% of those who attempt suicide do not have a diagnosable mental illness at the time of their suicidal behaviors (Krug et al., 2002; Phillips et al., 2002; Phillips and Yang, 2004; Li et al., 2005). The western models in which suicide is considered the direct result of mental illness and which focus most preventive efforts on the identification and treatment of mental illness might not be applicable to China (Wasserman, 2001; Wang et al., 2008). Therefore, pesticide-related studies and intervention strategies will be an important part of the suicide prevention effort in China.

As part of a case-control psychological autopsy study of suicides aged 15 to 34 years, we collected information concerning pesticide access and types of pesticides stored at the household of suicides and demographically matched controls. The objective was to examine the hypothesis that suicides were more likely to store a pesticide at home than controls. Furthermore, we hypothesized that the risk of suicide might differ across the different functional classes of pesticides stored at home (e.g. those with insecticides stored at home might be at higher risk of suicide compared to those who store other pesticide functional classes such as herbicides.") Finally, we tested whether the suicide risk associated with pesticide access was independent of mental disorder.

2. Methods

2.1. Subjects

Three provinces in China were chosen for this study. Liaoning is an industrial province located in Northeast China, Hunan an agricultural province in the Central South China, and Shandong a province with economic prosperity in both industry and agriculture that is located on the east coast of China mid-way between Liaoning and Hunan. Sixteen rural counties were randomly selected from the three provinces (6 from Liaoning, 5 from Hunan, and 5 from Shandong). In each of the 16 counties, suicides aged 15–34 were consecutively recruited from October 2005 through June 2008. Similar numbers of community living controls were recruited in the same counties at about the same time periods.

For our study, all village doctors in the research areas were briefly trained on judging and reporting suicide. The information of suicidal deaths gathered at the county CDCs were then forwarded on a monthly basis to the provincial CDC. For those suicidal deaths that were not recognized by any health agency, our mortality registry system allowed the village treasurers, who collect fees for each burial or cremation and are aware of all the deaths in the village, to notify the *Xiang* (township) health agency or the county CDC. Whenever necessary, an investigation with the village board and villagers was conducted by the research team to make sure no suicide cases were missed, or erroneously reported.

The community living control group was a random sample stratified by age range and county. For each suicide, we utilized the 2005 census database of the county where the

deceased lived to randomly select a living control in the same age range (± 3 years). The control sample did not exclude individuals who had been diagnosed with mental disorders or previous suicide attempts.

After successful interviews with the informants of the suicides, a total of 392 suicide cases and 416 living controls were entered for study. Among these subjects, we matched 370 pairs controlling for age, gender, and residence (rural/urban location) for this study.

2.2. Procedures

2.2.1. Measures—Measures regarding to this study include sociodemographic information, the presence of specific psychiatric symptoms, and a series of questions concerning the storage of pesticides at home. Informants were asked if, at the time of death (for suicides) or interview (for controls), there was a pesticide kept at home. In those subjects who stored one or more pesticides in the home, the informant was asked the types of the pesticides. The Chinese version of the Structured Clinical Interview for the Diagnostic and Statistical Manual of Mental Disorders (SCID-I-P)(First et al., 2002) was used to generate current diagnoses for both suicides and living controls. Diagnoses were made by the psychiatrists on each team in consensus meeting at which all responses from each informant were presented by the interviewers. Four categories of diagnoses of DSM-IV axis I mental disorders were obtained: mood disorder, schizophrenia and other psychotic disorder, alcohol and substance use disorder, and anxiety disorder and other axis I disorder. Multiple diagnoses were made if appropriate.

2.2.2 Training of interviewers—All interviewers were mental health professionals or public health professionals and were intensively trained for two weeks on psychological autopsy methods and instruments including SCID by US and domestic experts before the research. Another one-week mid-term training of all investigators from the three research sites was carried out in January, 2007.

2.2.3. Interviewing procedures—Informants were first approached by the local health agency or the village administration by a personal visit. Upon their agreement on the written informed consent, the interview was conducted between two and six months after suicide incident. Interviews with informants regarding living controls were scheduled as soon as the control targets and their informants were identified. Each informant was interviewed separately by one trained interviewer in a private place of a hospital/clinic or the informant's home, and the controls were not present when the control informants were interviewed. Mandarin or local dialect if necessary was used in the interviews. The average time for each interview was 2.5 hours.

Inter-rater reliability was ensured by limiting the principal data gathering role to the 24 trained clinical interviewers and by regular comparison of duplicate ratings of the interviewers. The same interviewers participated in data collection for both case and control samples, promoting inter-rater reliability across the study.

This study was approved by Institutional Review Boards of those universities where the researchers were affiliated with. The research nature of the interview and the background of the research project were explicitly explained and informed consent that details the rights of the interviewee was read and signed by both parties prior to each face-to-face interview. If distress was present during the interview and the participant wished to stop, the interview would be discontinued, and then another informant was chosen as a replacement.

2.2.4. Selecting information sources—For each suicide and each control, we interviewed two informants. We used the information provided by 740 suicide informants

and 740 control informants for this study. To obtain parallel data as from the suicide cases, we also used proxy information from the controls. However, the type of informants rather than the number of informants used in psychological autopsy studies was an extremely important and complex consideration (Younger et al., 1990). Informants were included by the following four guidelines: (1) Suicide informants were recommended by the village head and the village doctor, while control group informants were recommended by the controls themselves. Then, informants were selected by the research team based on familiarity with the subject's life and circumstances, availability for and willingness to consent to in -person interviews. (2) Informants had to be 18 years of age or older. Characteristics of the informants for both suicides and controls were noted in a standardized fashion (i.e., most recent contact, frequency of contacts in the last month and last year, number of years informant has known the target, relationships, and the informant's impression of their familiarity with target persons). (3) For both suicides and controls, 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) If marital infidelity and family oppression were possible causes of suicide, we tried to avoid recruiting informants associated with family disputes because interview these people could result in biased reports.

2.2.5. Integrating the information from different sources—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 (i.e. age, gender, education, marital status, family annual income, living situation), we basically relied on the answers by the informant who had the best access to the information. To determine pesticide availability and a diagnosis with the SCID, we selected a positive response (the agreement level of the two informants was acceptable: $\text{kappa}_{[\text{pesticide availability}]} = 0.5$; $\text{kappa}_{[\text{SCID diagnosis}]} = 0.7$), because sensitivity is the principal concern in proxy-based research of suicidal behavior. These guidelines were applied in integrating responses of both cases and controls.

2.3. Statistical Analysis

Descriptive analyses, paired *t*-test, and McNemar's test, conditional logistic regression models were carried out for comparison of suicide group and control group. Odds ratios (OR) and 95% confidence intervals (95%CI) derived from conditional logistic regression models indicated associations between suicide and pesticide access in the whole sample, then stratified by age (15–23 years and 24–34 years) and gender. After controlling education, living situation, marital status, and family annual income, a conditional logistic regression model was used to determine whether the risk for suicide associated with pesticide access was accounted for by mental disorder. To test interactions between pesticide access and age or gender, adjusted odds ratios (AOR) were calculated in each age and gender subgroup after controlling education, living situation, marital status, family annual income, and SCID, then Woolf test was used to exam for homogeneity of the AORs within different age groups and gender groups respectively.

The cases and controls were dichotomized as low (0–6), and high (≥7) education level. The family annual income was measured with Chinese Renminbi (RMB); each US dollar was approximately equivalent to 7.00RMB during the period of research. Marital status was categorized into "single," "married," and "separated, divorced, or widowed." All analyses were two-tailed, with statistical significance determined by $p < 0.05$.

3. Results

Table 1 lists the sociodemographic characteristics of suicide and control informants. Compared to control group, suicide group had significant more male and elder informants. However, there was no significant difference between these two groups in education level, family status in village, and the mean number of information sources.

Table 2 presents the sociodemographic characteristics of suicides and controls. A total of 370 pairs suicides and controls matched for gender, age, and residence were obtained from this study. The proportion of men to women was 1.1:1 (196/174), and the ethnicity of majority was Hanzu (92.4%). The averageage of suicides and controls was 26.60 (SD=6.33) and 25.85 (SD=6.12)respectively. Education ranged from 0 to 16 years for the suicides and 2 to 18 years for the controls. Suicides had statistically significant lower education level and family annual income. A significantly greater proportion of suicides than controls were non-marital status (181 [49.0%] vs. 131 [35.4%]), lived alone (9.2% vs. 3.8%), stored pesticides at home (76.1% vs. 63.3%), and suffered mental illness (47.0% vs. 3.0%).

Among all suicides, 245 (66.2%) died by ingestion of a pesticide, and the other methods of suicide included hanging 38(10.3%), ingestion of other poisons 24(6.5%), drowning 20 (5.4%), or others 43 (11.6%). Other methods included: jumping 7, drug overdose 12, wrist cutting 1, carbon monoxide poisoning 1, suffocation 2, electrocution 1, railway 1, other 18.

Table 3 shows the frequency distribution of pesticide stored at households of suicides and controls. Of 337 suicides, 170 (50.4%) had a pesticide in the home; 76 (22.6%) had more than two pesticides in the home. Of 319 controls, 121 (37.9%) had a pesticide in the home; 62 (19.4%) had more than two pesticides in the home. Of the 246 suicides with one or more pesticides at home, 181 (73.6%) died by pesticide ingestion. There was a significant difference between the suicides and controls in the mean number of pesticides.

The total number of pesticides was 582, and 328 was for suicides and 254 was for controls. There were mainly four types of farming pesticides: herbicide, insecticide, bactericide and rodenticide. Insecticide (370 [63.6%]) was the most popular pesticide stored in our sample, followed by herbicide (114 [19.6%]). Pesticides with higher proportion among insecticide were Dimethoate, Methamidophos, Dichlorvos, Parathion, Trichlorfon, Cartap, Omethoate. Among herbicide the higher proportion of pesticides were Acetochlor, Paraquat, Butachlor. Only 2 of these pesticides were low toxicity (Acetochlor, Butachlor), the others were medium or high toxicity (Table 4).

Table 5 lists the compared results of pesticide access for suicides and controls and the effect of the type of pesticide on suicide. Information on pesticide access was from 113 matched pairs of suicides and controls aged 15–23 years, and 227 matched pairs aged 24–34 years. Suicides had significantly more pesticide availability, with an unadjusted OR of 2.09 (CI: 1.53 –2.85). When tested separately, insecticide generated increased risk for suicide (OR=1.95; CI: 1.45–2.64). The presences of herbicide, combination of bactericide and rodenticide, and other pesticides at home had no significant difference between suicides and controls in either age or gender category. The effect of the type of pesticide on suicide was examined using the presence of each type of pesticide as an independent variable in a conditional logistic regression model controlling for education, living situation, marital status, and family annual income. Insecticide was significantly associated with suicide (χ^2=9.33, *P*=0.002).

Mental Disorder

Mental disorder is a strong predictor of suicide. Of 174 suicides with mental disorder, 84 (48.3%) were diagnosed as depression, 38 (21.8%) as schizophrenia, 20 (11.5%) as mood disorder, and 12 (6.9%) as alcohol use disorder. A conditional logistic regression model was used to test whether the effect of pesticide access on suicide was associated with mental disorder. After controlled Axis I disorder, education, living situation, marital status, and family annual income, pesticide access remained a significant independent predictor of suicide (χ^2=10.19, P=0.001), with an adjusted OR of 2.08 (CI: 1.33–3.26).

Age Effect

The presence of a pesticide at home increased risk for suicide in both age-groups (OR=1.52, CI: 0.88–2.64 and OR=2.52, CI: 1.66–3.82 for 15–23 years group and 24–34 years group respectively[results appeared in Table 5]). Having an insecticide at home associated with significantly higher risk for suicide among subjects aged 24–34 (OR=2.26, CI: 1.52–3.36 [results appeared in Table 5]). After controlling education, living situation, marital status, family annual income, and SCID, the AORs for suicide associated with the presence of a pesticide at home were 1.26 (CI: 0.63–2.51; χ^2=0.43, P=0.510) for 15–23 years group and 3.28 (CI: 1.62–6.64; χ^2=10.91, P=0.001) for 24–34 years group respectively. Examination of the interaction between age-group and pesticide access indicated that the risk related with pesticide exposure was significantly higher for 24–34 years age-group than 15–23 years age-group (χ^2=8.59, P=0.003).

Gender Effect

About 66.8% male and 66.1% female suicides had access to one or more pesticides. The corresponding proportions for controls were 52.0% and 46.6% respectively. Risk for suicide both in men and women were significantly enhanced by the presence of any pesticide (OR=1.85, CI: 1.22–2.81 for men; OR=2.42, CI: 1.50–3.89 for women[results appeared in Table 5]) and insecticide at home (OR=1.81, CI: 1.21–2.71 for men; OR=2.14, CI: 1.37–3.36 for women [results appeared in Table 5]). AORs for suicide associated with the presence of a pesticide at home were the same in both men and women (AOR=1.99; CI: 1.00–3.95, χ^2=3.84, P=0.050 for men and CI: 1.04–3.78, χ^2=4.37, P=0.037 for women), showing that there was no interaction of pesticide availability and gender.

4. Discussion

In this sample of Chinese rural young suicides, pesticide ingestion accounted for 66.2% of all deaths aged 15 –34 years, slightly higher than that reported in an earlier study which found 62% of a nationally representative sample of 519 suicides died by pesticide ingestion (Phillips et al., 2002). About 73.6% of suicides used pesticides stored in the home; most of these pesticides are insecticides with medium or high toxicity. A number of studies in other countries have found a strong relationship between method availability and the method chosen to commit suicide (Cantor and Baume, 1998). Method availability may also change the threshold at which negative life events precipitate suicidal behavior (Yang et al., 2005). This could be a further evidence of the relationship of the common use of pesticide for suicide in Chinese rural areas and the higher suicide rates in rural China.

This study revealed that pesticides were significantly more likely to be found in the homes of suicide victims than in the homes of matched controls. The risk for suicide associated with pesticide access was applicable to both men and women, but higher for suicide in individuals aged 24–34 years than those aged 15 –23 years. Furthermore, insecticide rather than other types of pesticides caused the difference between suicides and controls. It is

important to note that pesticide access was a significant risk factor for suicide even after controlling for other known risk factors in social and psychiatric domains.

Our findings indicate that restriction of access to pesticides, especially insecticides with high toxicity, maybe an effective preventive intervention for reducing rate of suicide in rural China. There is no evidence that the complete removal of pesticides from home would result in a dramatic decline in suicide attempts. However, such removal may reduce suicide mortality since less lethal suicide attempts might be pursued. The World Health Organization's recent World Report on Violence and Health recommends that suicide prevention strategies focus on the identification and treatment of people with mental disorders (Krug et al., 2002). However, previous studies reported that many individuals who commit suicide in rural China, with little intention to die, make an impulsive suicide attempt following an acute interpersonal conflict die because they have the highly lethal method (pesticide ingestion), and local health services are unable to effectively manage serious pesticide poisoning (Conner et al., 2005; Yang et al., 2005; Conner et al., 2007; Wang et al., 2008). Therefore, this increases the fatality rate of suicidal behavior in Chinese rural areas, and the proportion of female individuals among suicides because more women than men engage in low-intent suicidal behavior. In a study of 326 people who had carried out serious but non-fatal acts of self-harm, 35% reported that they first considered harming themselves 10 minutes or less before making the attempt (Li et al., 2002). The suicide prevention strategies focus on mental disorders may not be the most effective approach for rural China. Pesticide-related preventive strategies are the most likely to rapidly reduce the overall suicide rate because over 60% fatal suicides die by pesticide ingestion.

Self harm, in particular self poisoning, is used to gain attention, express distress, or get revenge, and it is not just for ending life (Hawton, 2007; Maracek, 1998). Traditionally, suicide is a powerful way for persons in lower status in China (particularly women) to proclaim their innocence or to protest unfair treatment (Pearson et al., 2002). Besides, it is easily get access to pesticides in rural China. These characteristics of pesticide-ingestion suicides in China suggest that suicide intervention may take the following preventive strategies into consideration—i.e., inspection and administration in the use and sale of pesticides by government (Agriculture Ministry and agricultural administrative departments of local governments take responsibility of supervision and management in the use and sale of pesticides. This intervention requires political participation.);reduction of access to pesticides with lockboxes; requiring the licensing of pesticide applicators; restricting sale of toxic pesticides to licensed applicators only; banning of highly toxic pesticides, inclusion of vomit inducing substances with pesticides (Eddleston et al., 2006); reducing the use of pesticides through integrated pest management or non -pesticide management (Eddleston et al., 2002; Eddleston et al., 2006; Vijayakumar and Babu, 2009); improving accessibility to necessary drugs and equipment for rural primary -care health providers (Yang et al., 2005; Eddleston et al., 2006);promotion of psychological and social support in rural areas (Eddleston and Phillips, 2004;Zhang et al., 2008); educating the general public and their healthcare providers about the suicide risk associated with the presence of pesticides in the households (WHO, 2006).

Limitations of the study include the limited age range of the sample, that focused on methods of suicide for individuals aged 15 to 34 years, and therefore we are not able to have the information on how suicide by older victims in China was affected by pesticides. Another limitation is most of background characteristics of suicide and control informants were comparable expect gender and age. The differences might lead to information bias. Besides, since interviews were conducted months after the suicide, it is unknown if the pesticides accessible at the interview was the same as that at the time of suicide. This may also cause recall bias. However, it is unlikely to dramatically change our general conclusion.

Acknowledgments

This research was supported by a grant of US NIMH: R01MH068560. We thank our research collaborators in Liaoning, Hunan, and Shandong of China. We also thank all interviewees for their unique contribution to the study.

References

Agriculture Ministry of PRC. 2005 China Agriculture Development Report. Beijing: Agriculture Press; 2005.

Cantor CH, Baume PJM. Access to methods of suicide: what impact? Australian and New Zealand Journal of Psychiatry. 1998; 32:8–14. [PubMed: 9565178]

Conner KR, Phillips MR, Meldrum S, Knox KL, Zhang Y, Yang G. Low-planned suicides in China. Psychological Medicine. 2005; 35:1197–1204. [PubMed: 16116945]

Conner KR, Phillips MR, Meldrum SC. Predictors of low-intent and high-intent suicide attempts in rural China. American Journal of Public Health. 2007; 97:1842–1846. [PubMed: 17395838]

Eddleston M, Buckley NA, Gunnell D, Dawson AH, Konradsen F. Identification of strategies to prevent deaths from pesticide self-poisoning using a Haddon matrix. Injury Prevention. 2006; 12:333–337. [PubMed: 17018677]

Eddleston M, Karalliedde L, Buckley N, Fernando R, Hutchinson G, Isbister G, Konradsen F, Murray D, Piola JC, Senanayake N, Sheriff R, Singh S, Siwach SB, Smit L. Pesticide poisoning in the developing world—a minimum pesticiides list. Lancet. 2002; 360:1163–1167. [PubMed: 12387969]

Eddleston M, Phillips MR. Self poisoning with pesticides. British Medical Journal. 2004; 328:42–44. [PubMed: 14703547]

First, MB.; Spitzer, RL.; Gibbon, M.; Williams, JBW. Structured Clinical Interview for DSM-IV-TR Axis I Disorders, Research Version, Patient Edition. New York: Biometrics Research, New York State Psychiatric Institute; 2002. (SCID-I/P)

Hawton K. Psychiatric assessment and management of deliberate self-poisoning patients. Medicine. 2007; 35:565–569.

Hu ZY, Zhang SD, Chen SY, Wang SW. Survey of epidemic character of suicide by taking poison. Journal of Environmental and Occupational Medicine. 2004; 21:243–244.

Kraemer HC, Measelle JR, Ablow JC, Essex MJ, Boyce WT, Kupfer DJ. A new approach to integrating data from multiple informants in psychiatric assessment and research: Mixing and matching contexts and perspectives. American Journal of Psychiatry. 2003; 160:1566–1577. [PubMed: 12944328]

Krug, EG.; Dahlberg, LL.; Mercy, JA.; Zwi, AB.; Lozano, R. World report on violence and health. Geneva: World Health Organization; 2002.

Li XY, Phillips MR, Ji HY, Xu YC, Bian QT. The characteristics of serious suicide attempters living in villages. Chinese Journal of Nervous and Mental disorders. 2005; 31:272–277.

Li XY, Xu YC, Wang YP, Yang RS, Zhang C, Ji HY, Bian QT, Ma ZW, He FS, Phillips MR. Characteristics of serious suicide attempts treated in general hospitals. Chinese Journal of Mental Health. 2002; 16:681–684.

Maracek J. Culture, gender, and suicidal behavior in Sri Lanka. Suicide and Life-Threatening Behavior. 1998; 28:69–81. [PubMed: 9560168]

Pearson V, Phillips MR, He FS, Ji HY. Attempted suicide among young rural women in the People's Republic of China: possibilities for prevention. Suicide and Life-Threatening Behavior. 2002; 32:359–369. [PubMed: 12501961]

Phillips MR, Li X, Zhang Y. Suicide rates in China, 1995–99. The Lancet. 2002; 359:835–840.

Phillips MR, Yang G. Suicide and attempted suicide in China, 1990–2002. Morbidity and Mortality Weekly Report. 2004; 53:481–484. [PubMed: 15190245]

Phillips MR, Yang G, Zhang Y, Wang L, Ji H, Zhou M. Risk factors for suicide in China: a national case-control psychological autopsy study. The Lancet. 2002; 360:1728–1736.

Vijayakumar L, Babu RS. Does 'no pesticide' reduce suicides? International Journal of Social Psychiatry. 2009; 55:401–406. [PubMed: 19617276]

Wang SY, Li Y, Chi G, Xiao SY, Ozanne-Smith J, Stevenson M, Phillips MR. Injury-related fatalities in China: an under-recognised public-health problem. The Lancet. 2008; 372:1765–1773.

Wasserman, D. A stress-vulnerability model and the development of the suicidal process. In: Wasserman, D., editor. Suicide: An Unnecessary Death. London: Martin Dunitz; 2001.

WHO. Safer access to pesticide: community interventions. Geneva: World Health Organization; 2006.

Yang GH, Phillips MR, Zhou MG, Wang LJ, Zhang YP, Xu D. Understanding the unique characteristics of suicide in China: national psychological autopsy study. Biomedical Environment Science. 2005; 18:379–389.

Younger SC, Clark DC, Oehmig-Lindroth R, Stein RJ. Availability of knowledgeable informants for a psychological autopsy study of suicides committed by elderly people. Journal of the American Geriatrics Society. 1990; 38:1169–1175. [PubMed: 2246452]

Zhang, J. Suicide in China. In: Lader, M., editor. Psychiatry Highlights 2005–06. Health Press; London: 2006. p. 44-50.

Zhang J, Conwell Y, Zhou L, Jiang C. Culture, risk factors and suicide in rural China: a psychological autopsy case control study. Acta Psychiatrica Scandinavica. 2004; 110:430–437. [PubMed: 15521827]

Zhang J, Xu HL. The effects of religion, superstition, and perceived gender inequality on the degree of suicide intent: a study of serious attempters in China. Omega: Journal of Death and Dying. 2007; 55:185–197.

Zhang X, Li HS, Zhu QH, Zhou J, Zhang S, Zhang L, Sun CY. Trends in suicide by poisoning in China 2000–2006: age, gender, method, and geography. Biomedical and Environmental Sciences. 2008; 21:253–256. [PubMed: 18714825]

Table 1

Comparison of sociodemographic characteristics of informants for suicides and controls

Sociodemographic Characteristics	Suicide Informants (*n*=740)	Control Informants (*n*=740)	χ^2/t	*P*
Gender, *n* (%)				
Male	417 (56.4%)	315 (42.6%)	28.12	<0.01
Female	323 (43.6%)	425 (57.4%)		
Age, years, mean (SD)	45.30 (12.88)	35.03 (12.66)	15.44	<0.01
Years formal education, mean (SD)	7.78 (8.29)	8.33 (3.01)	−1.69	0.091
Family status in village				
Very good, or good	146 (19.7%)	139 (18.8%)	0.21	0.644
Not good	594 (80.35)	601 (81.2%)		
Information sources, *n* (%)				
Parent	159 (21.5%)	131 (17.7%)		
Parent in law	40 (5.4%)	22 (3.0%)		
Sibling	53 (7.2%)	45 (6.1%)		
Spouse	47 (6.4%)	131 (17.7%)		
Child	0 (0.0%)	1 (0.1%)		
Other relative	115 (15.5%)	46 (6.2%)		
Friend/neighbor	290 (39.2%)	328 (44.3%)		
Unknown	36 (4.9%)	36 (4.9%)		
Total number of information sources mean (SD)	4.86 (2.53)	5.00 (2.41)	−1.10	0.270

Note: SD=standard deviation.

Differences tested with two-tailed *t*-test.

Table 2

Comparison of sociodemographic characteristics of suicides and controls

Sociodemographic Characteristics	Suicides (*n*=370)	Controls (*n*=370)	χ^2/t	*P*
Gender, *n* (%)				
Male	196 (53.0%)	196 (53.0%)	0.00	1.000
Female	174 (47.0%)	174 (47.0%)		
Age, years, mean (SD)	26.60 (6.33)	25.85 (6.12)	1.62	0.105
15–23 years	120 (32.4%)	136 (36.8%)		
24–34 years	250 (67.6%)	234 (63.2%)		
Years formal education, *n* (%)				
≥ 7 years	228 (62.1%)	323 (87.8%)	64.40	<0.001
0–6 years	139 (37.9%)	45 (12.2%)		
Marital status, *n* (%)				
Single	156 (42.2%)	127 (34.3%)		
Married	189 (51.1%)	239 (64.6%)	24.02	<0.001
Separated, divorced, or widowed	25 (6.8%)	4 (1.1%)		
Family annual income, RMB, 10,000 mean (SD)	1.44 (2.38)	2.07 (1.94)	−3.79	<0.001
Lived alone, *n* (%)	34 (9.2%)	14 (3.8%)	8.91	0.003
Pesticides stored at home, *n* (%)	246 (66.5%)	183 (49.5%)	22.01	<0.001
Mental disorder, *n* (%)	174 (47.0%)	11 (3.0%)	191.50	<0.001

Note: SD=standard deviation.

Differences tested with two-tailed *t*-test.

Table 3

Frequency distribution of pesticide stored at the household of suicides and controls

Frequency Distribution of Pesticide	Suicides (*n*=337)	Controls (*n*=316)	*t*	*P*
Mean (SD)	0.97 (0.74)	0.80 (0.82)	2.91	0.004
0	91 (27.0%)	136 (42.6%)		
1	170 (50.4%)	121 (37.9%)		
2	70 (20.8%)	53 (16.6%)		
3	6 (1.8%)	9 (2.8%)		

Note: Difference tested with two-tailed *t*-test.

Table 4

Chemical common name, CAS number, WHO pesticides classification and number of major pesticides among insecticide and herbicide

Chemical common name	CAS number	WHO classification	Number among suicides	Number among controls
Insecticide (*n*=370)				
Dimethoate	60-51-5	II	76	67
Methamidophos	10265-92-6	Ib	75	42
Dichlorvos	62-73-7	Ib	59	42
Parathion	56-38-2	Ia	19	15
Trichlorfon	52-68-6	II	11	21
Cartap	15263-53-3	II	14	16
Omethoate	1113-02-6	Ib	18	7
Herbicide (*n*=114)				
Acetochlor	34256-82-1	III	11	13
Paraquat	1910-42-5	II	12	1
Butachlor	23184-66-9	U	5	5

Note: Ia: Extremely hazardous; Ib: Highly hazardous; II: Moderately hazardous; III: Slightly hazardous; U: Unlikely to pose an acute hazard in normal use (WHO recommended classification of pesticides by hazard).

Psychiatry Res. Author manuscript; available in PMC 2011 September 30.

Table 5

Comparison of pesticide access for suicides and controls and the effect of the type of pesticide on suicide

	Suicides *n* (%)	Controls *n* (%)	Pairs in analysis, n	Odds Ratio (OR)	95% Confidence Interval (CI)	Chi-Square *p*	Odds Ratio* (OR)	95% Confidence Interval* (CI)	Chi-Square* *p**
≥ One pesticide at home	246 (66.5)	183 (49.5)	370	2.09	1.53–2.85	χ^2=21.20 *P*=<0.001	1.95	1.33–2.85	χ^2=11.61 *P*=0.001
15–23 years	70 (61.9)	59 (52.2)	113	1.52	0.88–2.64	χ^2=2.25 *P*=0.134			
24–34 years	157 (69.2)	110 (48.5)	227	2.52	1.66–3.82	χ^2=18.89 *P*=<0.001			
Men	131 (66.8)	102 (52.0)	196	1.85	1.22–2.81	χ^2=8.40 *P*=0.004			
Women	115 (66.1)	81 (46.6)	174	2.42	1.50–3.89	χ^2=13.22 *P*=<0.001			
Insecticide at home	216 (58.4)	154 (41.6)	370	1.95	1.45–2.64	χ^2=19.29 *P*=<0.001	1.92	1.26–2.91	χ^2=9.33 *P*=0.002
15–23 years	60 (53.1)	49 (43.4)	113	1.44	0.86–2.40	χ^2=1.96 *P*=0.161			
24–34 years	138 (60.8)	94 (41.4)	227	2.26	1.52–3.36	χ^2=16.08 *P*=<0.001			
Men	113 (57.7)	83 (42.3)	196	1.81	1.21–2.71	χ^2=8.40 *P*=0.004			
Women	103 (59.2)	71 (40.8)	174	2.14	1.37–3.36	χ^2=11.09 *P*=0.001			
Herbicide at home	56 (15.1)	58 (15.7)	370	0.95	0.61–1.49	χ^2=0.05 *P*=0.819	0.78	0.41–1.49	χ^2=0.56 *P*=0.456
Bactericide and Rodenticide at home	9 (2.4)	7 (1.9)	370	1.00	0.32–3.10	χ^2=0.00 *P*=1.000	0.99	0.22–4.41	χ^2=0.00 *P*=0.987
Other pesticides[a] at home	44 (11.9)	34 (9.2)	370	1.33	0.79–2.26	χ^2=1.14 *P*=0.287	1.16	0.61–2.20	χ^2=0.20 *P*=0.653

Note: we combined Bactericide and Rodenticide because of their small numbers.

[a]Other pesticides included: seed coating agent, acid, inorganic compounds, mixture or uncertain farming chemicals which cannot be sorted into any of the four types of pesticides.

Matched analyses controlled for age, gender, and residence.

*Education level, living situation, marital status, and family annual income were also adjusted for in this multivariable analysis. All analyses had 1 *df*, expect marital status had 2 *df*.