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TITLE:
Suicide by pesticide poisoning remains a priority for suicide prevention in China: analysis of national mortality trends 2006-2013.

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INTRODUCTION

Suicide remains a major public-health problem for China, despite recent studies showing decreasing trends over the most recent period.(Liu et al., 2015; Zhang et al., 2014) Suicide in China accounts for approximately 20% of all suicides globally (Qin and Mortensen, 2001; Yang et al., 2013) and is the eighth most common cause of years of life lost and second most common external cause of death in China (Yang et al., 2013).

Recent studies of China have shown changes in the epidemiology of suicide in the context of declining national suicide rates (Liu et al., 2015; Zhang et al., 2014), with a higher incidence in males than in females, declines in younger age cohorts, and significant geographic differences (Liu et al., 2015), including differences in area-based markers of socio-economic status such as education level (Liu et al., 2015), unemployment (Li et al., 2012) and the proportion of the population involved in agricultural production (Li et al., 2012). Previously, female suicide rates were higher than male rates in rural areas, and higher suicide rates in young adults aged 20-34 years were also evident (as well as in older age cohorts) (Phillips et al., 2002). However, the most recent trends suggest that male to female ratios in suicide rates are more consistent with Western developed contexts, with higher rates in males than in females. Previous age-specific analyses which showed higher rates in young adults compared to other age groups (Phillips et al., 2002), now show a more conventional age-specific trend in suicide rates, with rising rates with increasing age, and little evidence of elevated suicide rates in young adults (Liu et al., 2015).

Understanding the key methods contributing to national and international suicide rates is also important, as this can inform suicide prevention initiatives and target those methods that are more amenable to prevention (such as suicide by pesticide poisoning (Gunnell and Eddleston,

2003; Gunnell et al., 2007) and suicide by jumping (Pirkis et al., 2013)). Pesticide suicide has previously been shown to be a key priority for suicide prevention in China (Phillips et al., 2002; Zhang et al., 2008), including focussed interventions, of varying success, that have targeted suicide by poisoning by providing 'lock boxes' to agricultural producers in some counties (World Health Organization, 2016). Studies of emerging methods, such as from carbon monoxide poisoning from burning barbecue charcoal reported in other South East Asian contexts (Chang et al., 2014; Chen et al., 2013; Chen et al., 2015), have been limited and, in some cases, restricted to suicides enumerated via newspaper reports (Cheng et al., 2015). Restricting access to means of suicide is a key principle of effective suicide prevention (Gunnell and Frankel, 1994; Mann et al., 2005), with the strongest evidence of population-impact to reduce suicide relating to restriction of access to means, including for barbiturates (Oliver and Hetzel, 1972), carbon monoxide poisoning (following catalytic converters for car exhaust fumes) (Amos et al., 2001; Spittal et al., 2012), and firearms (Miller et al., 2002). Understanding the distribution of suicides in terms of method provides important evidence to inform any potential suicide prevention program or initiative.

Accordingly this study examines recent temporal trends in method-specific suicide among people aged 15 years and older in mainland China between 2006 and 2013 to (i) identify whether changes in patterns of methods used for suicide have contributed to the recent reduction in suicide, and (ii) identify potential socio-demographic determinants of suicide methods.

METHOD

Data sources

Total suicide counts (ICD-10 codes X60-X84, Y10-Y34, Y87.0) from 2006 to 2013 (with corresponding population denominators) were acquired from the national Disease Surveillance Points system (DSPs), a population based death registration system comprising 161 surveillance points (each point corresponds to one county or district) across 31 provinces nationwide (total population coverage of 6% or 73 million). Following preliminary analysis of the proportional distribution of suicide and undetermined deaths that showed a similar distribution by sex and age, suicide methods were categorised as pesticide poisoning (ICD-10 codes X68, X48 and Y18), hanging (X70, Y20, and W75-W76), drowning (X71 and Y21), jumping from a high place (X80 and Y30), and other gases and vapours (including carbon monoxide and motor vehicle exhaust gas) (X67 and Y17). These categories of suicide methods accounted for approximately 90% of all suicide in China. The most common methods were pesticides (approximately 51%) and hanging (approximately 29%), and are the focus of the present study.

Cause of death in the DSPs is attributed by trained coders in hospitals and local Center for Disease Control and Prevention (CDC) staff for all deaths in each surveillance point, and also from household surveys for non-hospital deaths, and data exchange with police stations, the civil affairs department, and maternal and child departments (Liu et al., 2016; Yang et al., 2005; Zhou et al., 2010). Decedents are counted as local residents if they have lived in the county or district for more than six months, otherwise they are coded to their previous county or district of residence. Corresponding population counts cross-classified by 5-year age group and gender for each county or district of DSPs were extracted from the National Bureau of Statistics.

Population catchments for each DSP surveillance point were divided into urban and rural areas, based on the National Bureau of Statistics of China classification for urban areas ('Qu' or districts) and rural areas ('Xian' or county). In total there were 64 urban points and 97 rural points across the DSPs (Supplementary Table 1). This urban-rural classification has been used previously in China (e.g. Yin et al., 2011), and differs slightly from the National Bureau of Statistics standard and uses county as the unit of classification given incomplete address information in the DSP in some instances at the village level. Potential socio-demographic factors associated with suicide were also defined for the county/district level, based on data extracted from the Chinese Census in 2010. These variables were limited to mean years of education as a proxy for area-level socio-economic circumstances (SEC) based on associations shown previously in China (Liu et al., 2015). Given the focus on method specific suicide in the present study, and the likely prominence of pesticide poisoning as a method of suicide (Phillips et al., 2002; Zhang et al., 2008), the proportion employed in agriculture within each county or district was also defined as a proxy measure of exposure to means (Chang et al., 2012). Each of these variables were divided into tertiles representing 'low', 'moderate', and 'high' groups.

Analysis

Age-standardized rates (using the 2010 census population as the standard) were calculated for each suicide method (pesticide poisoning, hanging, drowning, jumping, and other gases and vapours), and also stratified by gender, age group, and urban-rural residence, to investigate trends and differentials in suicide over the study period (2006-2013). A series of multilevel negative binomial regression models (based on counts of suicide stratified by county, gender, age-group and urban-rural residence, and offset by the natural logarithm of the population) were also specified to investigate associations between socio-demographic factors and method-specific suicide. These models were restricted to suicide by pesticides and hanging, as these

methods were the two most common methods of suicide. Multilevel models were employed given the hierarchical structure of the DSPs data (samples of individuals within counties). Models investigated the association between each suicide method and mean years of education and the proportion of the population employed in agriculture, adjusted for sex, age (in 5 year age-groups ≥15 years), and period (details in Supplementary Table 2). The interaction between urban-rural area and (i) tertile of population employed in agriculture and (ii) tertile of mean years of education were investigated to assess whether relative differences between lowest and highest tertiles differed by urban and rural areas, with the interaction term assessed in a Type III test of heterogeneity for fixed effects. Model estimates were exponentiated and expressed as rate ratios (RR) with 95% confidence intervals (CI). Analyses were conducted using PROC GLIMMIX in SAS 9.3.

RESULTS

The most common method of suicide in China over the study period (2006-2013) for both males and females was pesticide poisoning (declining from 9.0 per 100,000 to 4.9 per 100,000 in males and from 8.5 per 100,000 to 4.2 per 100,000 in women), followed by hanging (5.2 to 3.3 per 100,000 in men and 3.2 to 1.9 per 100,000 in women) (Figure 1).

Suicide rates for pesticide poisoning and for hanging increased exponentially with age for both males and females in those aged over ≥45 years, with the highest rates in those aged ≥65 years (Figure 2). Suicide rates declined for all suicide methods, with the sharpest decline evident for suicide by pesticide poisoning (Figure 1). The exception was for suicide by jumping, which increased slightly in males peaking at 1.3 per 100,000 in 2011, and remained at approximately 1.2 per 100,000 to 2013.

As a proportion of all suicides, pesticide poisoning declined from 55% to 49% over the study period, while hanging increased from 27% to 31%, jumping increased from 5% to 11%, and drowning did not change substantially (5% across the study period). Suicide by gases or vapours had rates ranging from 0.05 to 0.2 per 100,000 across both sexes, and did not change substantially as a proportion of total suicides over the period (ranging from 0.6-1%).

Suicide by pesticide poisoning was approximately 3-times higher in rural than in urban areas for both males and females, with rates declining in both urban and rural areas (Table 1). Rates declined more rapidly over the period in urban areas for males and females (43% and 63% decline respectively) than in rural areas (40% and 42% decline). Similarly, suicide by hanging was higher in rural areas for both males and females and also declined over the study period

(Table 1), although more rapidly in urban areas for males and females (38% and 48%) than in rural areas (31% and 32%). The relative difference between urban and rural areas was smaller than for suicide by pesticide poisoning, with suicide rates by hanging approximately 2-times higher in rural than in urban areas.

The proportion of the population employed in agriculture was strongly associated with suicide by pesticide poisoning, with an increasing gradient of suicide risk from the lowest to the highest tertile of agricultural population (RR of high to low % agriculture = 2.98, 95%CI 1.82-4.90, P<0.001) (Table 2). An increasing gradient in suicide risk was also evident from the highest to the lowest tertile of mean education in years (RR of low to high education level = 2.31, 95%CI 1.39-3.85, P=0.0012). Relative differences between lowest and highest tertiles were larger for urban than rural areas (Table 2), for both the proportion employed in agriculture (P for interaction = 0.0017, not shown) and mean education in years (P for interaction = 0.0074, not shown). Urban-rural differences in suicide by pesticide poisoning were attenuated by approximately 60% following adjustment for the proportion employed in agriculture (not shown).

Similar patterns were evident for suicide by hanging (Table 2), with increasing gradients across tertiles of agricultural population (from low to high) and mean education level (from high to low), however, differences were less marked than for suicide by pesticide poisoning.

DISCUSSION

This study investigated trends and differentials in method-specific suicide in China for the period 2006-2013, and found that suicide by pesticide poisoning and suicide by hanging remain the most common methods of suicide (accounting for approximately 80% of all suicides). Suicide rates declined for almost all suicide methods, consistent with recent studies of total suicide in China (Liu et al., 2015; Zhang et al., 2014), with the sharpest decline evident for suicide by pesticide poisoning. As a proportion of all suicides, pesticide poisoning declined from 55% to 49% over the study period, while hanging increased from 27% to 31%. The exception was for suicide by jumping with rates that increased slightly in males over the time period, its contribution to overall suicide rates increased from 5% to 11% of total suicides between 2006 and 2013.

Despite the emergence of suicide by gases or vapours in other South East Asian contexts such as South Korea and Taiwan,(Chang et al., 2014; Chen et al., 2013; Chen et al., 2015) this method had a very low incidence in China (<1 per 100,000) and accounted for less than 1% of total suicides, and trends did not change over the study period. Suicide by pesticide poisoning was substantially higher in rural than in urban areas, and declined more slowly in rural than in urban areas. Suicide by pesticide poisoning was also strongly associated with the proportion of the population employed in agriculture (a proxy measure of access to means), and less strongly associated with socio-economic status as measured by mean education level, but in both instances relative differences were larger in urban than in rural areas. Similar urban-rural differences in suicide by hanging were evident over the study period, however differences were smaller.

As shown in previous studies, the suicide rate in China has continued to decrease continuously from 2006 to 2013 (in both males and females, and urban and rural areas). Suicide rates by pesticide poisoning declined most rapidly over this period, with incidence rates decreasing by 50%. Previous studies have also noted the prominence of suicide by pesticide poisoning in China (Phillips et al., 2002; Zhang et al., 2008), associated more with impulsive behaviour rather than ongoing mental disorder (Zhang and Li, 2011, 2013; Zhang et al., 2013). Suicide by pesticide poisoning has been the focus of targeted 'lock-box' interventions on agricultural properties, designed to restrict access to means (World Health Organization, 2016). However it is unlikely that these interventions have contributed to declines in suicide by pesticides, given that they have been used in only a limited number of areas and declines in pesticide poisoning have occurred in the context of declines in most other methods of suicide, and also contemporaneously with increases in urbanisation (population migration from rural to urban areas). The lock-box intervention has had varying success in the Chinese context (World Health Organization, 2016) and there have been no other studies that assess the effectiveness of safe pesticide storage devices (Konradsen et al., 2007). An evaluation is currently ongoing in Sri Lanka,(Pearson et al., 2011) and related interventions in India have also considered the feasibility of community storage facilities of pesticides (Vijayakumar et al., 2013).

Additionally, there have been a number of revisions to national regulations on the safe use of pesticides, since their initial inception in 1982, leading to the lower toxicity of some pesticides.(Ministry of Agriculture, 1999, 2007; Ministry of Agriculture and Ministry of Health, 1982; State Council of the PRC, 1997) There was has also been the development of agricultural extension guidelines in 1999 for agricultural technology promotion units at provincial and local levels to promote the safe use of pesticides to prevent pesticide poisoning (Ministry of Agriculture, 1999).

Declines in suicide by pesticide poisoning are also likely to reflect a declining population employed in agricultural production, associated with rapid economic development and urbanisation in recent decades. Access to pesticides in agricultural communities is an important determinant of suicide (Kong and Zhang, 2010) and changes in the number of people employed in agriculture and the quantity of pesticides used in production are likely to be important factors associated with this access. It appears that this socio-economic development in combination with regulatory changes in pesticide use, and possibly the role of targeted suicide prevention in some areas, may explain the faster decline in suicide by pesticide poisoning than for other suicide methods. Additionally, there have been improvements in health and emergency services that would have coincided with this socio-economic development, including in rural areas, that may also have contributed to declines in suicide over time.

A number of methodological limitations need to be taken into account in the interpretation of findings from this study. First, mortality counts were extracted from the DSPs and involve cause of death information being coded from a range of sources, which may be a source of misclassification bias. The DSPs is a nationally representative sample registration system and cases of death are enumerated through hospitals, household surveys, police stations, and maternal and child health departments, with attribution of cause made by trained coders in hospitals and by local CDC staff. It is also important to note that the DSP system used in the current analysis represents 6% of the population (unlike the current iteration of the DSP which covers 26% of the population (Liu et al., 2016)), and it is likely that the diversity of the population (particularly for some minority populations) may not be captured.

Strategies are in-place to monitor data quality, and previous assessment of the extent of misclassification of suicide within DSPs (for the period 1995-2000) suggested that approximately 2% of suicides should be redistributed to other external causes, whereas 5% of 'other' external causes, 49% of 'unknown' external causes, and 15% of deaths attributed to psychiatric disorders should be re-distributed to suicide (Wang et al., 2003). In the present study, given this misclassification and also similarities in the sex- and age-distribution of cases, 'undetermined' cases of death were combined with suicide cases. Despite these inclusions, the rates in present study are likely to under-estimate suicide in China, and it is also not clear the extent to which misclassification differs across DSPs points over the study period, limiting definitive inter-regional comparisons.

Secondly, this is an ecological study of a time series of suicide rates, and risk factor adjustment was limited to population-level point estimates derived from a single census year (2010). The strength of the associations between risk factors and suicide by pesticide poisoning and suicide by hanging needs to be interpreted cautiously, and may be affected by residual confounding. For example, the proportion of the population involved in agriculture in a DSP is an ecological variable, and is not a measure of individual exposure to an agricultural pesticides. Similarly, socio-economic circumstances in the present study related to the proportion of the county population with a given level of education, not the educational status of the individuals residing in the county. Other factors that may influence the incidence of pesticide suicide and which were could not be examined at the population-level in our analyses include availability and quantity of pesticides.

In conclusion, suicide by pesticide poisoning and suicide by hanging remain the leading methods of suicide in China for the period 2006-2013, with all methods trending downward

with the exception of suicide by jumping in males. The recent emergence of suicide by gases and vapours in other South East Asian contexts is not reflected in China, with these methods associated with very low incidence and representing less than 1% of total suicides. Improvements in social and economic circumstances appear to be partially reflected in downward trends in suicide by hanging and suicide by pesticide poisoning. Regulatory changes to the safe use of pesticides and targeted prevention initiatives aiming to restrict access also may have contributed to declines in suicide by pesticide poisoning. The variations in suicide methods, and the predominance of suicide by pesticide poisoning, illustrates the importance of understanding factors associated with access to means to inform locally-specific suicide prevention activities, and how these factors interact with wider social and psychiatric determinants of suicide across different regions in China.

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Figure 1: Age-standardised rates of suicide by method, China 2006-2013

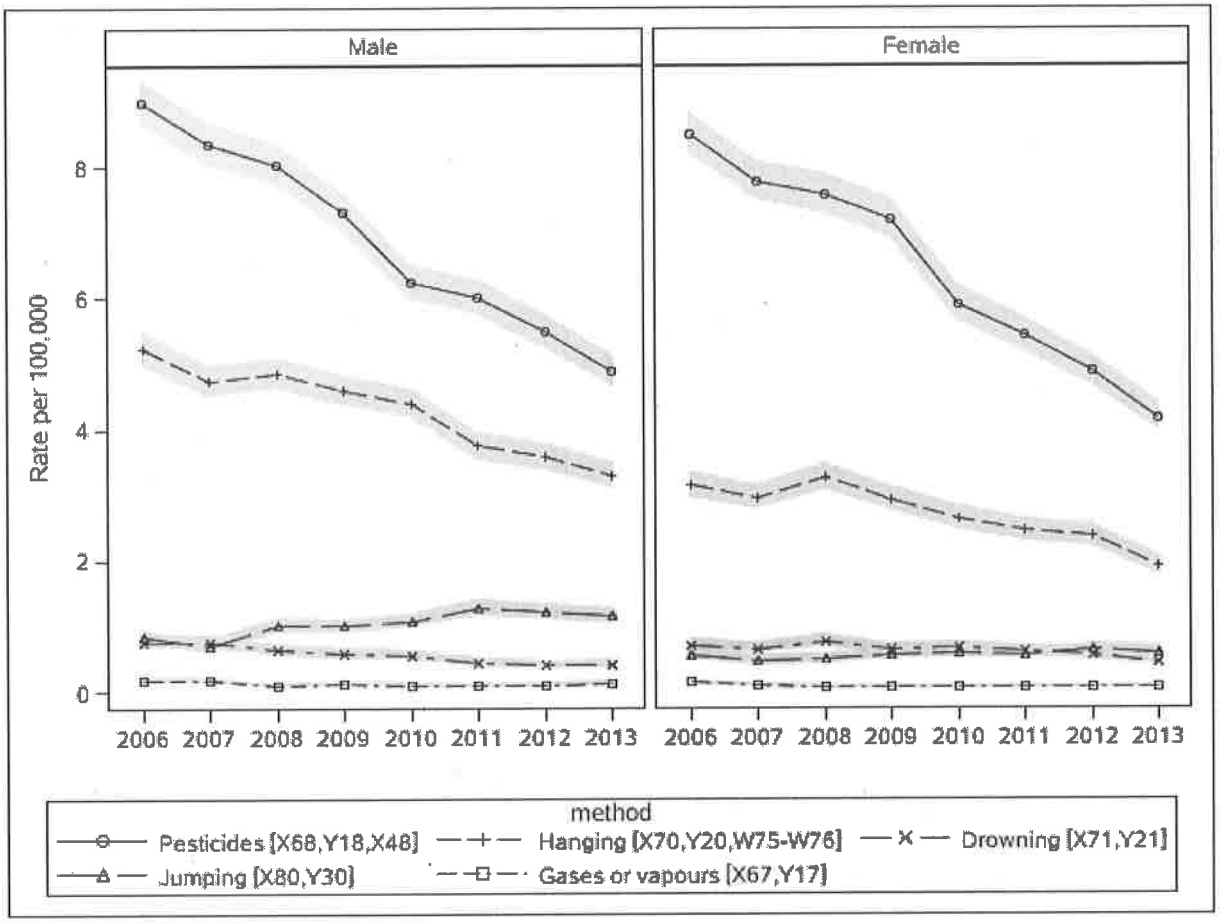

Figure 2: Age-specific rates of suicide by method, China 2006-2013

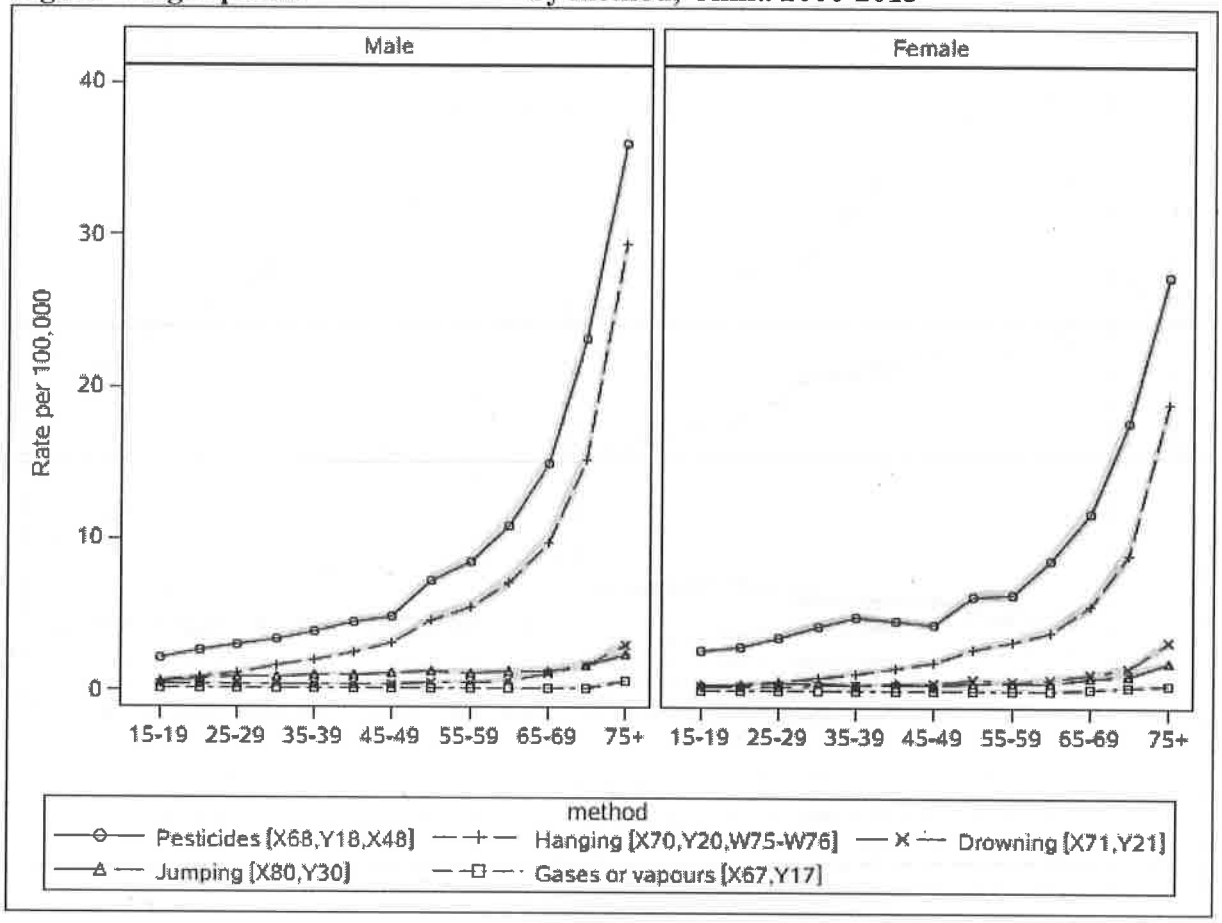

Table 1: Pesticide and hanging suicide rates* (and cases) by urban-rural residence, 2006-2013.

		2006	2007	2008	2009	2010	2011	2012	2013	Total
Pesticides										
Males										
Urban	Rate	3.7	3.5	3.4	3.3	2.6	2.4	2.4	2.1	2.8
	Cases	*356*	*425*	*442*	*417*	*377*	*317*	*360*	*409*	*3,103*
Rural	Rate	12.4	11.9	11.4	10.0	8.9	8.5	7.9	7.5	9.6
	Cases	*1,849*	*1,962*	*2,079*	*1,870*	*1,712*	*1,670*	*1,571*	*1,551*	*14,264*
Females										
Urban	Rate	4.3	3.0	3.1	3.3	2.4	2.3	2.0	1.6	2.6
	Cases	*415*	*364*	*409*	*414*	*338*	*300*	*304*	*317*	*2,861*
Rural	Rate	11.3	11.3	10.8	9.9	8.6	7.6	7.1	6.6	9.0
	Cases	*1,688*	*1,854*	*1,958*	*1,822*	*1,611*	*1,465*	*1,387*	*1,339*	*1,3125*
Hanging										
Males										
Urban	Rate	3.2	2.9	2.7	2.7	2.9	2.4	2.4	2.0	2.6
	Cases	*303*	*348*	*354*	*342*	*420*	*312*	*363*	*393*	*2,836*
Rural	Rate	6.5	6.1	6.4	5.9	5.5	4.7	4.5	4.5	5.4
	Cases	*960*	*992*	*1,160*	*1,092*	*1,053*	*929*	*904*	*946*	*8,035*
Females										
Urban	Rate	2.1	1.8	2.0	1.9	1.8	1.4	1.5	1.1	1.7
	Cases	*196*	*214*	*263*	*233*	*261*	*192*	*231*	*225*	*1,814*
Rural	Rate	3.8	3.8	4.2	3.7	3.2	3.1	3.0	2.6	3.4
	Cases	*559*	*615*	*743*	*670*	*612*	*612*	*596*	*541*	*4,949*

*Direct age-standardised rate per 100,000

Table 2: Predictors of suicide by pesticide poisoning and hanging in China, 2006-2013*

	Urban			Rural			Total		
	n	RR (95%CI)	P value	n	RR (95%CI)	P value	n	RR (95%CI)	P value
Pesticides									
%Employed in agriculture (a)									
Low	513	1.00		16,271	1.00		16,784	1.00	
Middle	3,369	3.88 (2.00-7.55)	<0.001	9,497	1.33 (0.73-2.43)	0.3532	12,866	2.82 (1.82-4.37)	<0.001
High	2,082	6.03 (1.22-29.83)	0.0277	1,622	1.49 (0.83-2.69)	0.1842	3,703	2.98 (1.82-4.90)	<0.001
Mean education in years (b)									
High	947	1.00		12,310	1.00		13,257	1.00	
Middle	2,265	2.02 (0.98-4.15)	0.0553	14,474	1.13 (0.59-2.15)	0.7213	16,739	1.91 (1.19-3.05)	0.0072
Low	2,752	2.65 (0.69-10.16)	0.1556	606	1.31 (0.69-2.49)	0.4043	3,357	2.31 (1.39-3.85)	0.0012
Hanging									
%Employed in agriculture (a)									
Low	178	1.00		6,562	1.00		6,740	1.00	
Middle	2,126	2.18 (1.40-3.38)	0.0005	4,944	1.12 (0.62-2.05)	0.7041	7,070	1.73 (1.22-2.47)	0.0022
High	2,347	1.97 (0.68-5.71)	0.2115	1,478	1.01 (0.56-1.82)	0.9771	3,825	1.49 (1.00-2.22)	0.0527
Mean education in years (b)									
High	499	1.00		6,416	1.00		6,915	1.00	
Middle	1,270	1.27 (0.78-2.05)	0.3326	6,328	1.93 (1.00-3.71)	0.0493	7,598	1.59 (1.08-2.23)	0.0176
Low	2,881	1.94 (0.80-4.70)	0.1441	241	2.13 (1.11-4.06)	0.0223	3,122	1.90 (1.26-2.86)	0.0024

*Adjusted for sex, age-group, urban-rural residence, period, and each of the variables in the table.
a Tertiles were Low: 0-29%; Middle: 29-65%; High: >65%
b Tertiles were 'Low': 0-8.5 years; 'Middle' 8.5-9.3 years; High: >9.3 years

Supplementary Table 1: Disease Surveillance Points (DSP) sites categories as urban or rural residence

DSP code	Province	District/county	Urban-rural category
110101	Beijing	Dongcheng District	Urban
110112	Beijing	Tongzhou District	Urban
120106	Tianjin	Hongqiao District	Urban
120225	Tianjin	Ji County	Rural
130205	Hebei	Kaiping District	Urban
130227	Hebei	Qianxi County	Rural
130302	Hebei	Haigong District	Urban
130427	Hebei	Ci County	Rural
130481	Hebei	Wuan County	Rural
130702	Hebei	Qiaodong District	Urban
130721	Hebei	Xuanhua County	Rural
130826	Hebei	Fengning Man Autonomous County	Rural
140107	Shanxi	Xinhualing District	Urban
140321	Shanxi	Pingding County	Rural
140427	Shanxi	Huguan County	Rural
140602	Shanxi	Sucheng District	Urban
140826	Shanxi	Jiang County	Rural
141124	Shanxi	Lin County	Rural
150103	Inner Mongolia	Huimin District	Urban
150423	Inner Mongolia	Balinyou Qi	Rural
150523	Inner Mongolia	Kailu County	Rural
150802	Inner Mongolia	Linhe District	Urban
152524	Inner Mongolia	Suniteyou Qi	Rural
210113	Liaoning	Shenbeixin District	Urban
210204	Liaoning	Shahekou District	Urban
210311	Liaoning	Qianshan District	Urban
210682	Liaoning	Fengcheng District	Rural
210921	Liaoning	Fuxin Menggu Autonomous County	Rural
211021	Liaoning	Liaoyang County	Rural
220102	Jilin	Nanguan District	Urban
220183	Jilin	Dehui City	Rural
220211	Jilin	Fengman District	Urban
220582	Jilin	Ji'an City	Rural
222405	Jilin	Longjing City	Rural
230103	Heilongjiang	Nangang District	Urban
230208	Heilongjiang	Meilisida Woer District	Urban
230223	Heilongjiang	Yi'an County	Rural
230305	Heilongjiang	Lishu District	Urban
230523	Heilongjiang	Baoqing County	Rural
230606	Heilongjiang	Datong District	Urban
230826	Heilongjiang	Huachuan County	Rural
310103	Shanghai	Luwan District	Urban
310117	Shanghai	Songjiang District	Urban
320111	Jiangsu	Pukou District	Urban
320303	Jiangsu	Yunlong District	Urban
320506	Jiangsu	Wuzhong District	Urban
320582	Jiangsu	Zhangjiagang City	Rural
320831	Jiangsu	Jinhu County	Rural
320921	Jiangsu	Xiangshui County	Rural
330103	Zhejiang	Xiacheng District	Urban
330283	Zhejiang	Fenghua City	Rural
330483	Zhejiang	Tongxiang City	Rural
330523	Zhejiang	An'ji County	Rural
330702	Zhejiang	Wucheng District	Urban

DSP code	Province	District/county	Urban-rural category
331123	Zhejiang	Suichang County	Rural
340504	Aihui	Yushan District	Urban
340803	Aihui	Daguan District	Urban
341181	Aihui	Tianchang City	Rural
341402	Aihui	Chaohu District	Urban
341622	Aihui	Mengcheng County	Rural
341823	Aihui	Jing County	Rural
350402	Fujian	Meilie District	Urban
350521	Fujian	Hui'an County	Rural
350783	Fujian	Jiang'ou City	Rural
350822	Fujian	Yongding County	Rural
350902	Fujian	Jiaocheng District	Urban
360102	Jiangxi	Donghu District	Urban
360423	Jiangxi	Wuning County	Rural
360702	Jiangxi	Zhanggong District	Urban
360727	Jiangxi	Longnan County	Rural
360923	Jiangxi	Shanggao County	Rural
370203	Shandong	Shibei District	Urban
370213	Shandong	Licang County	Urban
370323	Shandong	Yiyuan County	Rural
370403	Shandong	Xuecheng District	Urban
370602	Shandong	Zhifu District	Urban
370684	Shandong	Penglai City	Rural
370785	Shandong	Gaomi City	Rural
371202	Shandong	Laicheng District	Urban
371327	Shandong	Junan County	Rural
410102	Henan	Zhongyuan District	Urban
410306	Henan	Jili District	Urban
410323	Henan	Xin'an County	Rural
410526	Henan	Hua County	Rural
410782	Henan	Huixian City	Rural
411328	Henan	Tanghe City	Rural
411422	Henan	Hui County	Rural
411502	Henan	Shihe District	Urban
420102	Hubei	Jiang'an District	Urban
420202	Hubei	Huangshixiang District	Urban
420503	Hubei	Wujiagang District	Urban
420625	Hubei	Gucheng County	Rural
420923	Hubei	Yunmeng County	Rural
429006	Hubei	Tianmen City	Rural
430103	Hunan	Tianxin District	Urban
430181	Hunan	Liuyang City	Rural
430626	Hunan	Pingjiang County	Rural
430702	Hunan	Wulin District	Urban
431003	Hunan	Suxian District	Urban
431281	Hunan	Hongjiang City	Rural
433123	Hunan	Fenghuang County	Rural
440104	Guangdong	Yuexiu District	Urban
440282	Guangdong	Nanxiong City	Rural
441284	Guangdong	Sihui City	Rural
441424	Guangdong	Wuhua County	Rural
441502	Guangdong	Shangtou City District	Urban
445302	Guangdong	Yuncheng District	Urban
450126	Guangxi	Binyan County	Rural
450205	Guangxi	Liubei District	Urban
450302	Guangxi	Xiufeng District	Urban

DSP code	Province	District/county	Urban-rural category
450521	Guangxi	Hepu County	Rural
451027	Guangxi	Lingyun County	Rural
451225	Guangxi	Luocheng Mulao Autonomous County	Rural
460108	Hainan	Meilang District	Urban
469021	Hainan	Anding County	Rural
500101	Chongqing	Wanzhou District	Urban
500225	Chongqing	Dazu District	Rural
510105	Sichuan	Qingyang District	Urban
510182	Sichuan	Pengzhou City	Rural
510411	Sichuan	Renhe District	Urban
511025	Sichuan	Zizhong County	Rural
511325	Sichuan	Xichong County	Rural
511823	Sichuan	Hanyuan County	Rural
513321	Sichuan	Kangding County	Rural
513434	Sichuan	Yuexi County	Rural
520302	Guizhou	Honghuagang District	Urban
520328	Guizhou	Meitang County	Rural
522223	Guizhou	Yuping Dong Autonomous County	Rural
522623	Guizhou	Shibing County	Rural
522726	Guizhou	Dushan County	Rural
530402	Yunnan	Hongta District	Urban
530423	Yunnan	Tonghai County	Rural
532627	Yunnan	Guangnan County	Rural
532823	Yunnan	Mengla County	Rural
532923	Yunnan	Xiangyun County	Rural
533325	Yunnan	Lanping Baizupumi Autonomous County	Rural
540102	Tibet	Chengguan District	Urban
540127	Tibet	Mozhugongka County	Rural
542221	Tibet	Naidong County	Rural
542323	Tibet	Jiangzi County	Rural
542623	Tibet	Milin County	Rural
610202	Shannxi	Wangyi County	Urban
610326	Shannxi	Mei County	Rural
610582	Shannxi	Huayin City	Rural
610629	Shannxi	Luochuan County	Rural
610921	Shannxi	Hanyin County	Rural
620423	Gansu	Jiangtai County	Rural
620503	Gansu	Maiji District	Urban
620702	Gansu	Zhangye City	Rural
620982	Gansu	Dunhuang City	Rural
623021	Gansu	Lintan County	Rural
630103	Qinghai	Chengzhong District	Urban
632121	Qinghai	Ping'an County	Rural
632221	Qinghai	Menyuan Hui Autonomous County	Rural
640104	Ningxia	Xingqing District	Urban
640502	Ningxia	Zhongwei County	Rural
650102	Xinjiang	Tianshan District	Urban
652925	Xinjiang	Xinhe County	Rural
653125	Xinjiang	Shache County	Rural
653221	Xinjiang	Hetian County	Rural
654025	Xinjiang	Xinyuan County	Rural

Supplementary Table 2a: Predictors of suicide by pesticide poisoning in China, 2006-2013

	Urban		Rural		Total	
	RR (95%CI)	P value	RR (95%CI)	P value	RR (95%CI)	P value
Sex						
Female	1.00		1.00		1.00	
Male	1.09 (1.03-1.17)	0.005	1.12 (1.08-1.16)	0.000	1.11 (1.08-1.15)	<0.001
Age-group						
15-19	0.07 (0.06-0.09)	<0.001	0.10 (0.09-0.11)	<0.001	0.09 (0.08-0.10)	<0.001
20-24	0.09 (0.08-0.11)	<0.001	0.13 (0.12-0.14)	<0.001	0.12 (0.12-0.13)	<0.001
25-29	0.13 (0.11-0.15)	<0.001	0.15 (0.13-0.16)	<0.001	0.14 (0.13-0.15)	<0.001
30-34	0.16 (0.13-0.18)	<0.001	0.16 (0.14-0.17)	<0.001	0.16 (0.15-0.17)	<0.001
35-39	0.17 (0.15-0.20)	<0.001	0.18 (0.16-0.19)	<0.001	0.17 (0.16-0.19)	<0.001
40-44	0.18 (0.15-0.20)	<0.001	0.19 (0.17-0.20)	<0.001	0.18 (0.17-0.20)	<0.001
45-49	0.17 (0.15-0.20)	<0.001	0.19 (0.18-0.21)	<0.001	0.19 (0.17-0.20)	<0.001
50-54	0.27 (0.24-0.31)	<0.001	0.27 (0.25-0.29)	<0.001	0.27 (0.25-0.28)	<0.001
55-59	0.29 (0.25-0.33)	<0.001	0.28 (0.26-0.30)	<0.001	0.28 (0.27-0.30)	<0.001
60-64	0.34 (0.30-0.39)	<0.001	0.34 (0.31-0.36)	<0.001	0.34 (0.32-0.36)	<0.001
65-69	0.45 (0.39-0.52)	<0.001	0.44 (0.41-0.47)	<0.001	0.44 (0.41-0.47)	<0.001
70-74	0.66 (0.57-0.75)	<0.001	0.63 (0.59-0.68)	<0.001	0.64 (0.60-0.68)	<0.001
75+	1.00		1.00		1.00	
Period						
2006	2.11 (1.86-2.40)	<0.001	1.76 (1.64-1.89)	<0.001	1.83 (1.72-1.95)	<0.001
2007	1.76 (1.55-2.00)	<0.001	1.65 (1.54-1.77)	<0.001	1.67 (1.57-1.78)	<0.001
2008	1.46 (1.30-1.66)	<0.001	1.59 (1.48-1.70)	<0.001	1.56 (1.47-1.65)	<0.001
2009	1.36 (1.20-1.54)	<0.001	1.45 (1.35-1.55)	<0.001	1.43 (1.35-1.52)	<0.001
2010	1.13 (1.00-1.29)	0.053	1.24 (1.16-1.33)	<0.001	1.22 (1.15-1.30)	<0.001
2011	1.04 (0.91-1.19)	0.528	1.14 (1.07-1.23)	<0.001	1.12 (1.06-1.19)	<0.001
2012	1.01 (0.89-1.15)	0.868	1.09 (1.02-1.17)	0.015	1.07 (1.01-1.14)	0.024
2013	1.00		1.00		1.00	
%Employed in agriculture (a)						
Low	1.00		1.00		1.00	
Middle	3.88 (2.00-7.55)	<0.001	1.33 (0.73-2.43)	0.353	2.82 (1.82-4.37)	<0.001
High	6.03 (1.22-29.83)	0.028	1.49 (0.83-2.69)	0.184	2.98 (1.82-4.90)	<0.001
Mean education in years (b)						
High	1.00		1.00		1.00	
Middle	2.02 (0.98-4.15)	0.055	1.13 (0.59-2.15)	0.721	1.91 (1.19-3.05)	0.007
Low	2.65 (0.69-10.16)	0.156	1.31 (0.69-2.49)	0.404	2.31 (1.39-3.85)	0.001
Urban-rural residence						
Urban					1.00	
Rural					1.27 (0.81-2.00)	0.303

a Tertiles were Low: 0-29%; Middle: 29-65%; High: >65%
b Tertiles were 'Low': 0-8.5 years; 'Middle' 8.5-9.3 years; High: >9.3 years

Supplementary Table 2b: Predictors of suicide by hanging in China, 2006-2013

	Urban		Rural		Total	
	RR (95%CI)	P value	RR (95%CI)	P value	RR (95%CI)	P value
Sex						
Female	1.00		1.00		1.00	
Male	1.82 (1.74-1.90)	<0.001	1.67 (1.56-1.79)	<0.001	1.77 (1.71-1.84)	<0.001
Age-group						
15-19	0.02 (0.02-0.02)	<0.001	0.02 (0.01-0.03)	<0.001	0.02 (0.02-0.02)	<0.001
20-24	0.03 (0.02-0.03)	<0.001	0.04 (0.03-0.05)	<0.001	0.03 (0.03-0.03)	<0.001
25-29	0.04 (0.03-0.04)	<0.001	0.05 (0.04-0.06)	<0.001	0.04 (0.03-0.04)	<0.001
30-34	0.05 (0.05-0.06)	<0.001	0.06 (0.05-0.07)	<0.001	0.06 (0.05-0.06)	<0.001
35-39	0.07 (0.06-0.08)	<0.001	0.07 (0.06-0.08)	<0.001	0.07 (0.06-0.08)	<0.001
40-44	0.08 (0.08-0.09)	<0.001	0.10 (0.09-0.12)	<0.001	0.09 (0.08-0.10)	<0.001
45-49	0.10 (0.09-0.11)	<0.001	0.14 (0.12-0.16)	<0.001	0.11 (0.10-0.12)	<0.001
50-54	0.15 (0.13-0.16)	<0.001	0.21 (0.19-0.24)	<0.001	0.17 (0.15-0.18)	<0.001
55-59	0.18 (0.17-0.20)	<0.001	0.21 (0.19-0.24)	<0.001	0.19 (0.18-0.20)	<0.001
60-64	0.22 (0.20-0.24)	<0.001	0.24 (0.21-0.28)	<0.001	0.23 (0.21-0.24)	<0.001
65-69	0.30 (0.28-0.33)	<0.001	0.37 (0.32-0.42)	<0.001	0.32 (0.30-0.34)	<0.001
70-74	0.50 (0.46-0.54)	<0.001	0.48 (0.42-0.55)	<0.001	0.49 (0.46-0.53)	<0.001
75+	1.00		1.00		1.00	
Period						
2006	1.45 (1.33-1.59)	<0.001	1.67 (1.45-1.93)	<0.001	1.51 (1.40-1.63)	<0.001
2007	1.41 (1.29-1.54)	<0.001	1.61 (1.40-1.84)	<0.001	1.47 (1.36-1.58)	<0.001
2008	1.49 (1.37-1.62)	<0.001	1.41 (1.23-1.61)	<0.001	1.47 (1.37-1.57)	<0.001
2009	1.33 (1.22-1.45)	<0.001	1.34 (1.17-1.54)	<0.001	1.34 (1.24-1.44)	<0.001
2010	1.24 (1.14-1.36)	<0.001	1.46 (1.29-1.67)	<0.001	1.31 (1.22-1.40)	<0.001
2011	1.11 (1.01-1.21)	0.023	1.11 (0.97-1.28)	0.134	1.11 (1.03-1.20)	0.005
2012	1.07 (0.98-1.16)	0.152	1.22 (1.07-1.39)	0.004	1.11 (1.03-1.20)	0.005
2013	1.00		1.00		1.00	
%Employed in agriculture (a)						
Low	1.00		1.00		1.00	
Middle	1.12 (0.62-2.05)	0.704	2.18 (1.40-3.38)	0.001	1.73 (1.22-2.47)	0.002
High	1.01 (0.56-1.82)	0.977	1.97 (0.68-5.71)	0.212	1.49 (1.00-2.22)	0.053
Mean education in years (b)						
High	1.00		1.00		1.00	
Middle	1.93 (1.00-3.71)	0.049	1.27 (0.78-2.05)	0.333	1.59 (1.08-2.33)	0.018
Low	2.13 (1.11-4.06)	0.022	1.94 (0.80-4.70)	0.144	1.90 (1.26-2.86)	0.002
Urban-rural residence						
Urban					1.00	
Rural					1.03 (0.71-1.48)	0.888

a Tertiles were Low: 0-29%; Middle: 29-65%; High: >65%
b Tertiles were 'Low': 0-8.5 years; 'Middle' 8.5-9.3 years; High: >9.3 years