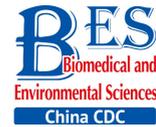


Policy Forum



Acute Pesticide Poisoning in Jiangsu Province, China, from 2006 to 2015*

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This study aimed to investigate the characteristics of pesticide poisoning in Jiangsu Province, China, and to provide a scientific basis for developing effective interventional measures and preventive strategies. From 2006 to 2015, a total of 35,308 cases of pesticide poisoning were reported in Jiangsu Province. Non-occupational poisoning accounted for 73.79% of all poisoning cases. A comparison of the data collected before (2006) and after (2015) this study showed a decrease in non-occupational pesticide poisoning. Pesticide poisoning showed an age central tendency of 30 to 44 years, area central tendency for northern Jiangsu, and seasonal central tendency of occupational pesticide poisoning in autumn. Pesticide poisoning remains a major health concern in China. Government agencies together with scientists should focus their efforts on the prevention of potential threats to vulnerable groups such as the elderly, women, and children.

Pesticide poisoning is increasingly becoming a public health concern worldwide, and greatly affects the safety and health of people^[1-3]. It has also become a hotly debated topic among different global organizations, including the World Health Organization (WHO) and the International Program on Chemical Safety (IPCS)^[4]. Acute organic pesticide poisoning has been recognized as a critical problem in many agricultural communities, especially in developing countries, such as China, India, and Morocco^[5-9].

Chinese rural economic reformation happened in the late 1970s. The control methods used for managing crop pests have changed from centralized control to self-storage of pesticides^[10]. The unavailability of advanced pesticide management

technologies and consumer-safety training resulted in numerous pesticide poisoning cases in as early as the 1980s^[10]. To improve and strengthen the management and supervision of pesticides in rural areas, the Chinese Ministry of Health issued 'Pesticide Poisoning and Health Management Approach (Trial)' in 1988. Additionally, the Chinese Ministry of Health required that all the pesticide poisoning cases be officially reported. In 1990, the Ministry of Health revised the occupational amendments, resulting in the inclusion of reports of occupational categories in rural areas. However, in 2006, the Chinese Disease Control and Prevention (CDC) reporting system started using a unified method known as 'the Occupational Disease Surveillance and Reporting Systems (ODSRS)' for directly reporting pesticide poisoning cases^[12]. Furthermore, the CDC also established four levels of direct network reporting systems for occupational diseases, which included township systems, city systems, provincial systems, and country systems^[13]. The aim of the established disease surveillance systems was to monitor pesticide poisoning reports and manage the Chinese disease control system in a standardized manner.

Until 2016, Jiangsu Province had a recorded usage of an average of 80,000 tons of pesticides annually, and was regarded as being among the top five provinces with high pesticide poisoning incidence rates^[14]. Therefore, we aimed to explore the characteristics of pesticide poisoning in Jiangsu Province, China, and offer a scientific basis for developing effective interventional measures as well as prevention strategies.

Data Source The reporting system database contains data from health institutions, such as

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hospitals, clinics, and healthcare centers, in both urban and rural areas. The pesticide poisoning data were acquired by means of a routine surveillance system by the Jiangsu CDC. The database is an important resource of health policies, and is hence necessary for promoting health and medical research. The use of the database was approved by the Jiangsu CDC. The diagnosis in all the cases (35,308) was made by specialists in different levels of hospitals, per the correlated national diagnostic criteria^[5].

Case Definition The pesticide poisoning report cards contain information, including patient age, sex, and region, as well as diagnostic test results. The aims of the present study were to examine pesticide poisoning data of agriculture and forestry workers who were previously identified as having occupational poisoning (both during employment and domestic use) and those with non-occupational poisoning (including accidental and suicidal) with pesticides. 'Employment' means that hired farmers used pesticides, which lead to poisoning. 'Domestic' means that farmers used pesticides for personal purposes.

Data Analysis Data obtained from the pesticide poisoning report cards in Jiangsu Province between 2006 and 2015 were organized and analyzed using EXCEL. SAS 9.4 was used to analyze epidemiological data. Further, qualitative data were evaluated using Pearson's χ^2 contingency tables. A correlation analysis was performed to determine the association between continuous and qualitative data; P values < 0.05 represented statistical significance.

Ethics The present study considered the use of secondary data analysis. The patients' private, pesticide-associated information was encrypted by the Jiangsu Provincial Center for Disease Control and Prevention (CDC). With regard to ethical requirements, the study conformed to the Declaration of Helsinki and was nominated to be exempted from the institutional ethics review by the Research Ethics Board of Jiangsu Provincial CDC.

Non-occupational Pesticide Poisoning Accounts for most of the Poisoning Cases and Deaths Between the years 2006 and 2015, a total of 35,308 cases of pesticide poisoning were identified in Jiangsu Province. Of these cases, individuals died in 1,909 cases; the fatality rate was 5.4%. The number of occupational pesticide poisoning cases was 9,255, whereas the number of deaths due to occupational poisoning was 43, with a fatality rate of 0.46%. During the same period, the number of

non-occupational pesticide poisoning cases was recorded to be 26,053, and death was reported in 1,866 of these cases. Consequently, the non-occupational pesticide poisoning fatality rate was significantly higher ($P < 0.05$) than the occupational pesticide poisoning fatality rate.

Figure 1 shows poisoning cases and deaths one year. The figure show a general trend of a decrease in the number of poisoning cases and deaths, specifically suicide cases.

In the occupational pesticide poisoning group, a total of 527 cases related to employment and seven deaths were reported. The fatality rate was 1.33%. The estimated number of pesticide poisonings due to domestic use was 8,728. Among them, 36 deaths were reported. The number of suicide cases associated with drinking pesticides was 22,043, accounting for 62.43% of all the reported cases. Of all the reported suicide cases, death occurred in 1,783. Approximately 4,010 accidental pesticide poisoning cases were reported, and death occurred in 83 of these cases; the fatality rate was 2.07%. The suicide mortality rate (2.27 per million people) was significantly higher than the accidental mortality rate (0.11 per million populations) ($P < 0.05$).

Age Groups with Acute Pesticide Poisoning Cases A large proportion of acute pesticide poisoning cases (29.02%) was identifiable in the age range of 30-44 years. Occupational pesticide poisoning was reported

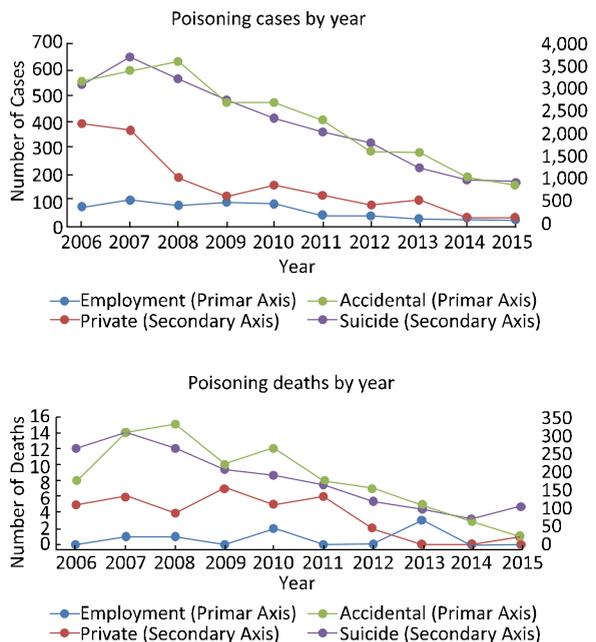


Figure 1. Distribution of cases and deaths due to pesticide poisoning by year.

in individuals within the age range of 45-59 years, which accounted for 41.99% of cases. Among all non-occupational pesticide poisoning cases, the reported cases were mainly in the age range of 30-44 years, accounting for 29.80% of all the reported cases. In the non-occupational poisoning group, subjects aged above 60 years accounted for higher case-fatality rates. Unfortunately, there is a trend toward increasing case-fatality rates with an increase in age for all non-occupational poisonings (that is, both accidental poisonings and suicide attempts) ($P < 0.05$) as shown in Figure 2.

Higher Poisoning Rates among Female Patients
 There were 14,850 male and 20,458 female patients. The number of female patients in the non-occupational pesticide poisoning group was 15,930 (estimated to be 40.98 per million people). Among them, 1,053 died. Thus, the suicide rate for non-occupational pesticide poisoning in female patients (approximately 20.73 per million people) was found to be significantly higher than that in the male patients (approximately 13.18 per million people) ($P < 0.05$). Figure 3 illustrates this observation.

Higher Number of Poisoning Cases in Northern Jiangsu
 From a geographical perspective, the proportion of occupational pesticide poisoning cases in northern Jiangsu areas (including Xuzhou, Suqian, Huaian, Yancheng, and Lianyungang), middle Jiangsu areas (including Yangzhou, Taizhou, and Nantong), and southern Jiangsu areas (including Nanjing, Zhenjiang, Changzhou, Wuxi, and Suzhou) was reported to be 61.53%, 25.58%, and

12.88%, respectively. Among these cities, Nantong City (1,872, approximately 25.30 per million people), Yancheng City (1,803, approximately 25.04 per million people), and Xuzhou City (1,397, approximately 16.44 per million people) were the top three in terms of pesticide poisoning rates. Non-occupational pesticide poisoning was largely observed in the northern Jiangsu area, accounting for approximately 58.04% of all pesticide poisoning cases. Xuzhou City (6,426, approximately 75.60 per million people), Huaian City (3,017, approximately 52.93 per million people), and Nantong City (2,963, approximately 40.04 per million people) were the top three cities in terms of prevalence of non-occupational pesticide poisoning. Xuzhou City, particularly, had higher suicidal poisoning and accidental poisoning rates (24.66% and 25.60%, respectively) than those reported in all other areas with non-occupational pesticide poisoning cases. Figure 4 illustrates this observation.

Season-related Acute Pesticide Poisoning
 Occupational pesticide poisoning is associated with seasons. It occurs mainly in the autumn ($P < 0.05$). The probability of its incidence in each season was estimated as follows: 1.92% in spring (January 0.55%, February 0.54%, and March 0.83%), 7.95% in summer (April 1.45%, May 2.85%, and June 3.65%), 85.89% in autumn (July 20.76%, August 54.01%, and September 11.12%), and 4.24% in winter (October 2.60%, November 1.15%, and December 0.49%). Figure 5 summarizes the monthly pesticide poisoning cases and the monthly pesticide poisoning-related deaths.

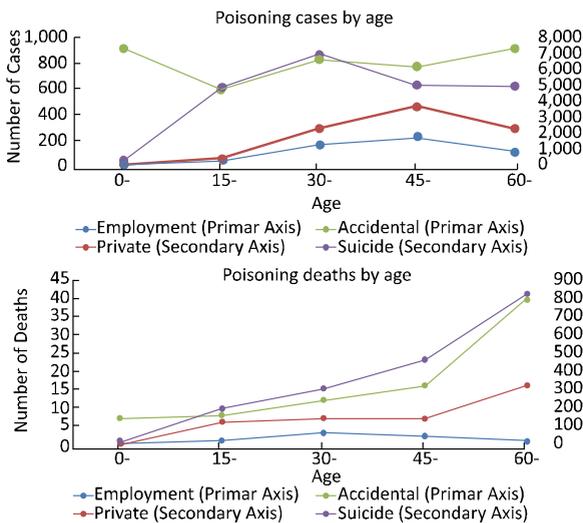


Figure 2. Distribution of pesticide poisoning cases and deaths by age.

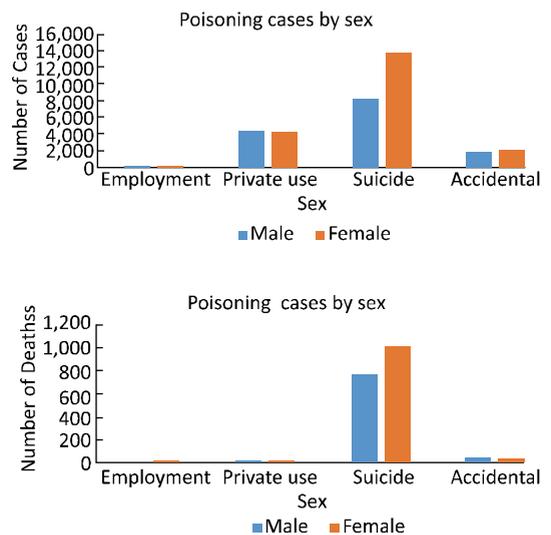


Figure 3. Distribution of pesticide poisoning cases and deaths by sex.

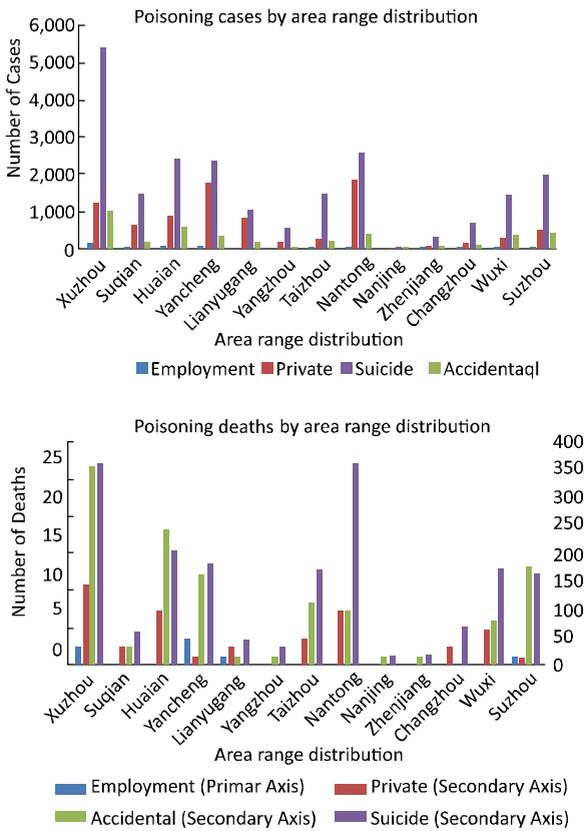


Figure 4. Distribution of pesticide poisoning cases and deaths by area.

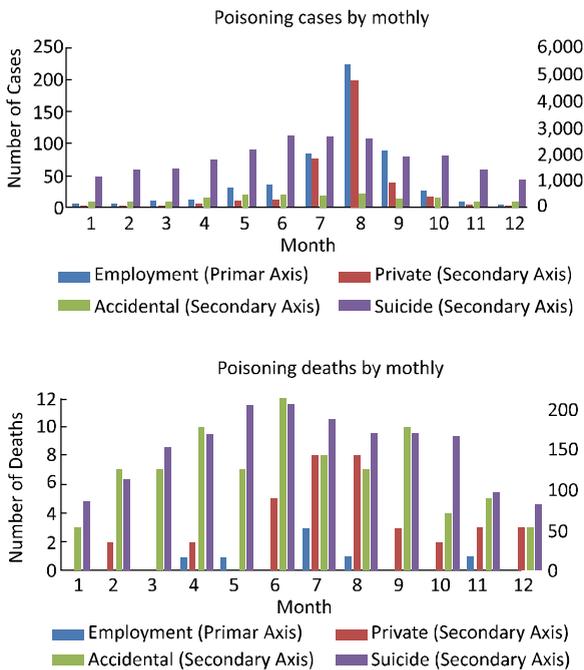


Figure 5. Distribution of pesticide poisoning cases and deaths by month.

Pesticides are used worldwide and are identified among the major causes of occupational, accidental, and intentional poisoning^[15-16]. Unsafe processing, storage, and use of pesticides are the main contributors to acute poisoning^[17-18]. An estimated 3 million cases of pesticide poisoning are reported annually, with approximately 220,000 deaths reported worldwide. On average, 3% of agricultural workers in developing countries are under the threat of an episode of pesticide poisoning every year^[19]. By comparing data collected before (2006) and after (2015) the present study, we found that there was a decrease in non-occupational pesticide poisoning ($P < 0.05$), especially through suicide; this finding was similar to those obtained in the rest of the provinces in China.

This study revealed that hospitals treated more female pesticide poisoning cases than male cases. Females have a higher probability of developing mental health issues than males^[20]. This might be the result of female vulnerability to factors such as stress of juggling multiple roles, fragile emotional state, domestic disputes, and emotional breakdown, in addition to other feminine issues^[21]. The WHO also revealed that approximately 30% of global suicides were the result of pesticide self-poisoning^[22-24]. A majority of these suicides took place in rural agricultural areas in developing countries. Therefore, this may also be related to the increased amount of oral intake of pesticides to commit suicide, time and place of concealment, and lack of prompt emergency services^[25]. In this regard, it would be beneficial to widen the scope of women’s education, replace highly toxic pesticides with less toxic pesticides, and attempt suicide intervention by addressing domestic disputes and other personal issues.

A large number of rural youths tend to work in cities, which results in the presence of an elderly workforce in the rural areas. Consequently, major occupational pesticide poisoning cases in rural areas often affect the elderly. Regarding non-occupational pesticide poisoning, the reported cases mainly fall in the age range of 30-49 years, which accounts for approximately 29.80% of all cases. It has also been argued that life stress, heavy burdens, or depression could also lead to self-poisoning with pesticides. Moreover, in the non-occupational poisoning group, subjects aged over 60 years seemed to have higher case-fatality rates than younger people. Unfortunately, there is a trend of increasing case fatality with increasing age in all non-occupational

poisoning cases (both accidental poisonings and suicide attempts) ($P < 0.05$). For the elderly, there is a higher case-fatality rate. In this regard, effective educational programs regarding pesticide safety could be useful in preventing pesticide poisoning. Previous studies have suggested that pesticide safety education among farmers could raise awareness of pesticide exposure risk and the adverse health consequences associated with acute pesticide poisoning. Improvements in pesticide safety knowledge using different delivery modes may lead to some improvement in protective practices and increase the use of personal protective equipment. The high incidence of childhood accidental pesticide poisoning may also be related to improper storage and packaging of pesticides. However, the bulk of poisoning accidents occurred when chemicals were stored within the reach of children. This should be avoided. Additionally, inappropriately labeled pesticide containers might convey misleading signals to children or other users. Pesticide bottles or containers similar to soft drink bottles or other drinks can be misleading. This should be avoided to reduce cases of accidental consumption^[26].

Occupational pesticide poisoning also has a clear regional and seasonal aggregation. It mostly occurs in the farming seasons, which might be the result of an increase in pests and high temperatures during these months^[5]. Media should be used to raise public awareness of the safe use and storage of pesticides. Occupational pesticide poisoning cases were mainly clustered in northern Jiangsu, which accounted for 61.53% of all cases in Jiangsu Province. The government should strengthen suicide prevention strategies and ensure that interventional education pertaining to suicidal behavior is made available to the people, especially in areas that are majorly affected. The number of reported cases of non-occupational pesticide poisoning in Xuzhou City was the highest in terms of suicidal and accidental poisonings. Therefore, interventional education pertaining to suicidal behavior should be implemented in this city. Xuzhou City is an agricultural production area and is relatively developed. However, there seems to be a problem with pesticide control. Additionally, accidents and suicides were identifiably the highest in this region, reflecting the lack of education about pesticide use and educational programs pertaining to suicidal behavior intervention.

In summary, pesticide poisoning is still a major health concern in China. Government agencies

together with scientists should focus on the prevention of potential threats to vulnerable groups, such as the elderly, women, and children.

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