Original Article



# Childhood pesticide poisoning trend analysis of 13 years in Jiangsu, China

**Boshen Wang[1,2], Xiuting Li[3], Lei Han[1], Han Shen[1], Juan Zhang[2], Dawei Sun[1,2], Dengfeng Gao[1,2], Bing Zhu[4], Baoli Zhu[1,2]**

[1]Department of Prevention and Control for Occupational Disease, Jiangsu Provincial Center for Disease Prevention and Control, Nanjing 210000, China; [2]Key Laboratory of Environmental Medicine Engineering of Ministry of Education, School of Public Health, Southeast University, Nanjing 210009, China; [3]Nanjing Prevention and Treatment Center for Occupational Diseases, Nanjing 210042, China; [4]Mazhuang Health Center, Taizhou 225300, China

*Contributions:* (I) Conception and design: B Zhu, B Wang; (II) Administrative support: B Zhu; (III) Provision of study materials or patients: B Zhu, X Li; (IV) Collection and assembly of data: B Wang, X Li, L Han; (V) Data analysis and interpretation: B Wang, X Li, L Han; (VI) Manuscript writing: All authors; (VII) Final approval of manuscript: All authors.

*Correspondence to:* Bing Zhu. Mazhuang Health Center, Taizhou 225300, China. Email: 13961082857@163.com; Baoli Zhu. Institute of Occupational Disease Prevention, Jiangsu Provincial Center for Disease Prevention and Control, No. 172 Jiangsu Road, Nanjing 210000, China. Email: zhbl5888@sina.com.

**Background:** Childhood pesticide poisoning could be regarded as a critical communal health problem in different countries. The purpose of this research was to assess the occurrence probability of childhood pesticide poisoning in Jiangsu province and depict the relevant prevalent pathology features.

**Methods:** From 2006 to 2017, a total of 1,373 cases of pesticide poisoning among children were reported in Jiangsu Province. The related materials and data were made in Excel Table and carefully analyzed by SAS relevant tool.

**Results:** About 1,373 kids whose ages are 0–14 years were found in the pesticide poisoning examples who were reflected in Jiangsu Province in the research phase. The rate of occurrence from pesticide poisoning was 1.1 per 100,000 children every year. Organophosphorus and carbamate insecticides were seen as the reason of many poisons (504 out of 1,373). And most pesticide poisoning occurred in season summer [439] and autumn [433].

**Conclusions:** Pesticide poisoning is prevailing among kids in Jiangsu Province; thus, effective measures are very necessary for the reduction of the examples of childhood pesticide poisoning.

**Keywords:** Pesticide poisoning; children; epidemiological trend

Received: 18 December 2018; Accepted: 28 December 2018; Published: 30 December 2018.
doi: 10.21037/jphe.2018.12.04
**View this article at:** http://dx.doi.org/10.21037/jphe.2018.12.04

## Introduction

Pesticide poisoning has been previously noted as a serious problem in China (1-3) and in other developing (4,5) and developed countries (6), both for children and adults. Researches from various regions in El Salvador and Nicaragua have showed a whole occurrence rate of 37 per 10,000 for acute pesticide poisoning (APP) in the whole population (7) and 17.6 per 10,000 career-related APP in Thailand. In Belize. It has been found that there are 16 pesticide poisoning per 100,000 inhabitants per year, with 4,132 poisoning occurring each year (8).

It is worth noting that most of the researches on pesticide poisoning are conducted among adults (9-11). However, pesticides could be regarded as the main causes of poisoning in children especially in those underdeveloped regions and countries (12). The relevant organizations have reported

 

that around 31% of the main causes of the serious disease among children are related to the environmental elements, and that pesticides are the major contributors (13). From 2003 to 2007, pesticide poisoning in level three children's Hospital in South Africa (14) accounted for 10.8% of all child poisoning cases, and between 1989 and 1995 (15), French children emergency room poisoning accounted for 3.3% and 3.9% in a similar unit in Turkey in 2009 (16). These indirect risks of childhood pesticide are documented in various studies worldwide. Studies in the United State confirm that children of agricultural families are at risk of being related to farm pesticides even if they do not do farm work (17) and the kids who are living with their parents in the farms, or adjacent to pesticide treatment farmland, are more exposed than other kids living in the same place (18). Kids have higher metabolic rates and their bodies have poor detoxification skills. However, children absorb more pesticides while their bodies are still developing, so they are least able to defend their bodies. Therefore, data on the extent of risk in children from pesticide exposure are needed to make preventive interventions to protect children from harmful effects of chemicals (13).

In this research, we used data on pesticide poisoning cases registered with the Occupational Disease Surveillance and Reporting Systems (ODSRS) in Jiangsu Province, China, to describe the whole epidemiological features of childhood pesticide poisoning. The research was an important part of the overall studies in this field and it also provided important information on pesticide poisoning among kids, which cannot be neglected. As far as we know, it is the first effective and great work of childhood pesticide poisoning in this province, China.

## Methods

### *Materials sources*

Pesticide poisoning materials and data from 2006 to 2017 were gotten from ODSRS at the Jiangsu Provincial Center for Disease Control and Prevention (CDC). The kid pesticide poisoning approving was requested by Jiangsu CDC and reported by the doctor of the medical institution of the reporting team. In the poisoning records found through the ICD-10 code (T36.0–T65.9), we found all pesticide poisoning records from January 1, 2006 to December 31, 2017, which listed a disease diagnostic code for at least one pesticide toxicity effect (ICD-10 code, T60.0–T60.9), which is suitable for the first or other diagnostic areas for kids aged 0–14 years.

### *Data analysis*

The occurrence of pesticide poisoning was calculated for every 100,000 child populations. Detailed statistics on the socio-demographic variables of pesticide poisoning were showed. SAS 9.4 was used to analyze all the data.

## Results

### *Trend of pesticide poisoning among children in 13 years*

Between the years 2006 and 2017, a total of 37,964 cases of pesticide poisoning were identified in Jiangsu Province. Totally, 1,373 child pesticide poisoning cases were identified, including 802 male cases and 571 female cases. The *Figure 1* showed a general trend of a decrease in the number of total pesticide poisoning cases and pesticide poisoning of children, specifically total pesticide poisoning cases. The proportion of children with pesticide poisoning per 100,000 child population showed a decreasing trend, but the proportion of children with pesticide poisoning in the total pesticide poisoning cases showed an increasing tendency (*Figure 2*).

### *Distribution of pesticide poisoning cases by age*

Male consisted of the greatest number of childhood cases with pesticide poisoning, and the quantity of childhood examples of pesticide poisoning cases in various age teams was also mainly male. The whole proportion of boys' and girls' examples during the research period was 1.31:1 per cent. The number of pesticides poisoning in different age groups, whether male or female, was mainly concentrated in the age of 0 to 5, which accounted for 67.70% and 62.98% of the total number of childhood pesticide poisoning cases, respectively (*Figure 3*).

The number of children with pesticide poisoning is mainly concentrated in 0–5 years old (920 for 65.74%). Pesticide poisoning before the age of 7 was mainly the accidental exposured to pesticides. At the age of 7, oral intake of pesticides to commit suicide began to appear, and it increased significantly after the age of 10. The number of cases of suicides at the age of 11 has exceeded the number of cases of accidental exposured to pesticides (*Figure 4*).

### *Pesticide poisoning among kids was ordinary in the period of the farming season*

Seasonal variation was found in the number of child

 

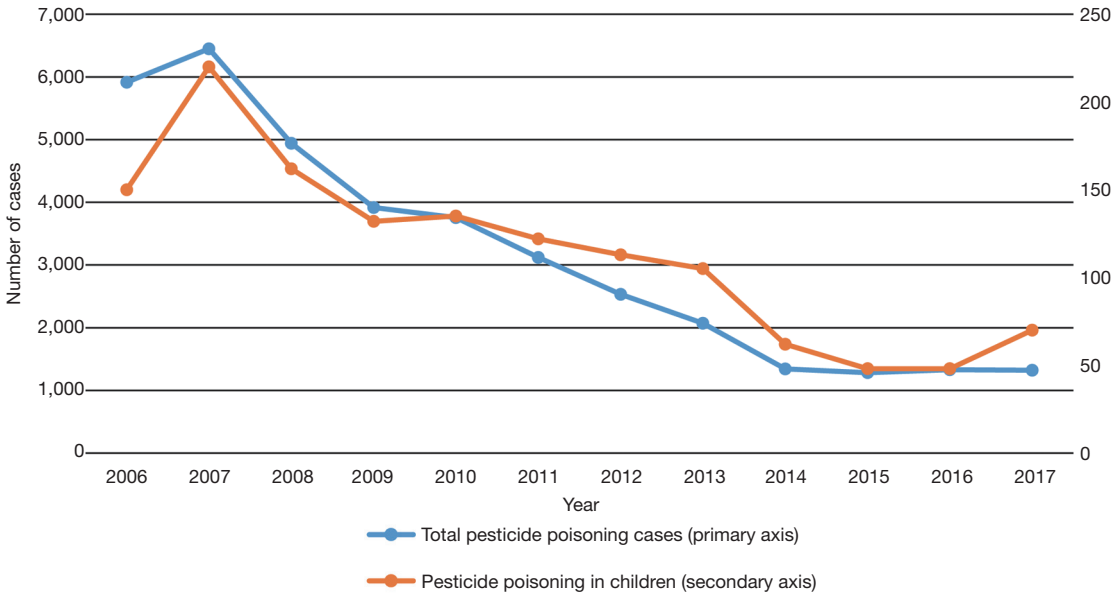


**Figure 1** Annual reported cases of pesticide poisoning in Jiangsu Province, 2006–2017.

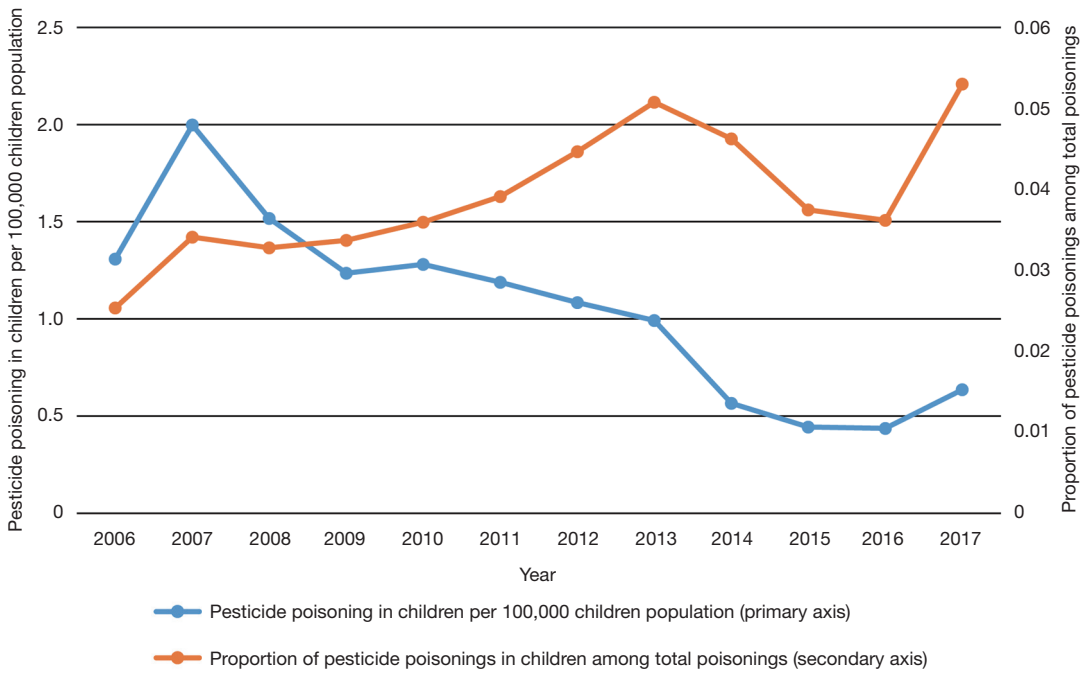


**Figure 2** The proportion of children with pesticide poisoning per 100,000 child population and the proportion of children with pesticide poisoning in the total pesticide poisoning cases.

pesticide poisoning cases. *Figure 5* shows the distribution of the cases by month and season in male and female groups. According to the distribution of poisoning cases in different months, child pesticide poisoning was most common in May with 155 cases and least in January with 54 cases (*Figure 5*). From the perspective of the seasons, more cases were reported in farming season: summer (439 for 32.0%) and fall (433 for 31.6%) (*Figure 6*). The same

 

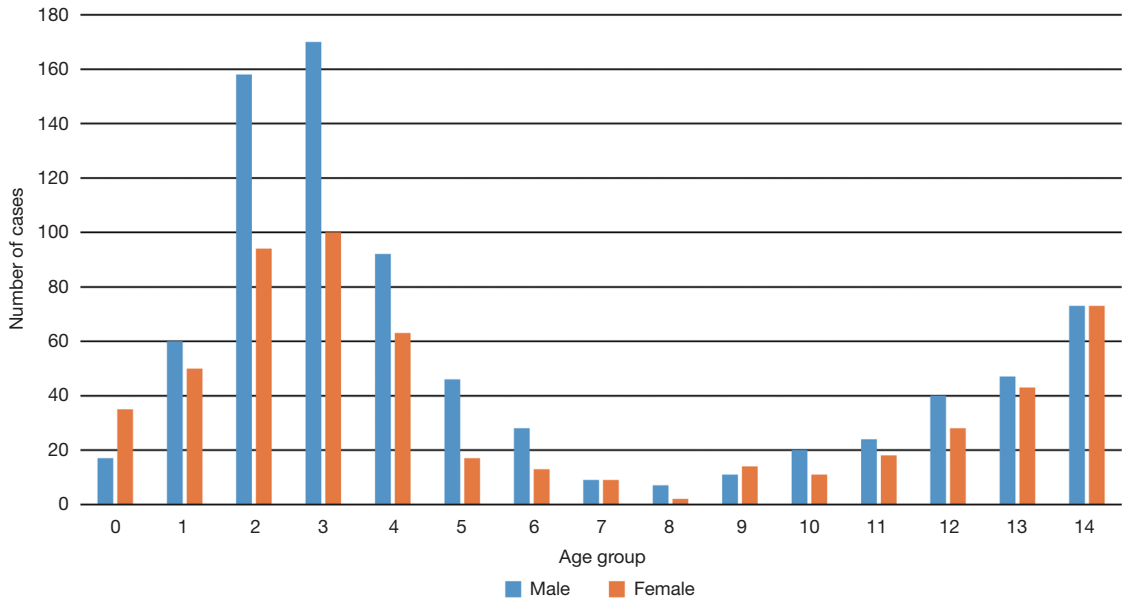


**Figure 3** Distribution of pesticide poisoning cases by gender.

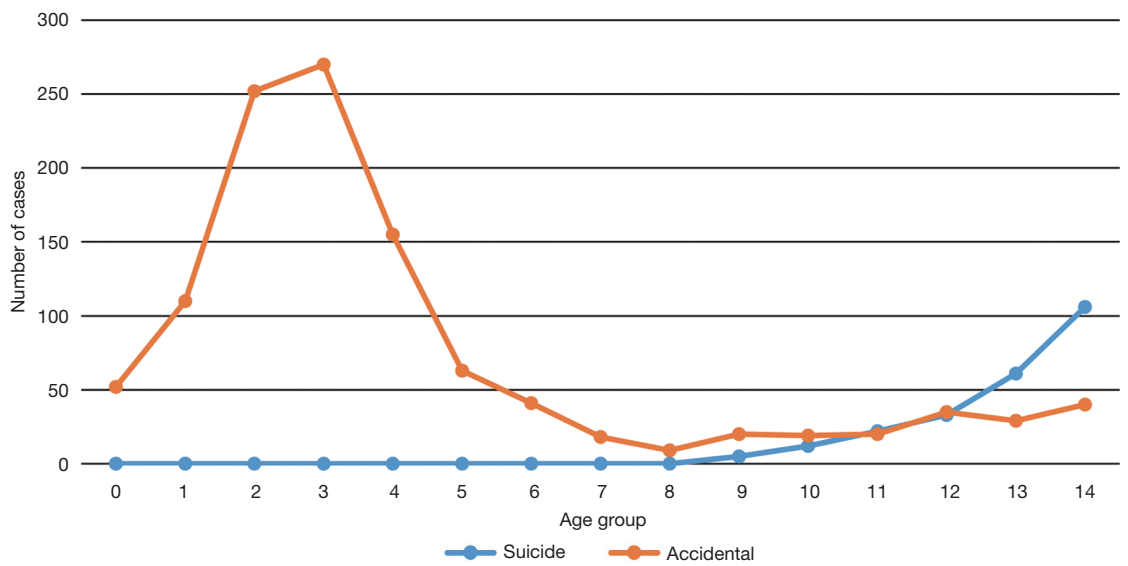


**Figure 4** Distribution of pesticide poisoning cases by age.

distribution pattern of monthly and seasonal poisoning cases was found in both male and female groups. Cases involving boys outnumbered those involving girls all seasons (*Figure 6*). There are seasonal changes in the number of pesticide poisoning cases in children. *Figure 5* shows the monthly and seasonal distribution of cases in the male and female groups. According to the distribution of poisoning cases in different months, pesticide poisoning was most common in children in May, in 155 cases and at least 54 cases in January (*Figure 5*). Seasonally, more cases are reported during the agricultural season: summer (439 per 32%) and autumn (433 per 31.6%) (*Figure 6*). The same distribution patterns for monthly and seasonal poisoning cases were found in both male and female groups. The number of cases involving boys exceeds all season-related cases involving girls (*Figure 6*).

 

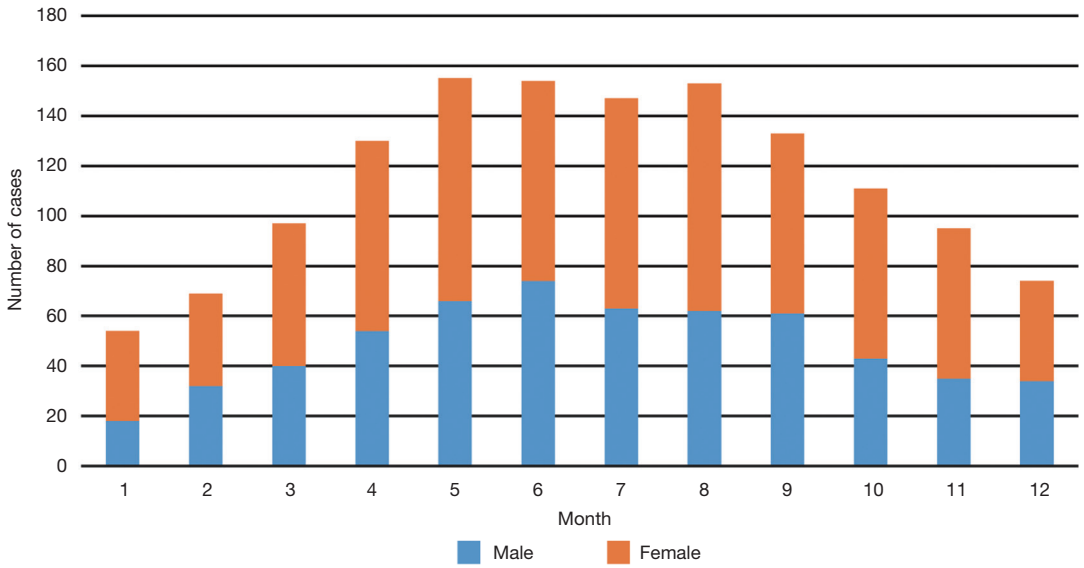


**Figure 5** Distribution of pesticide poisoning cases by month.

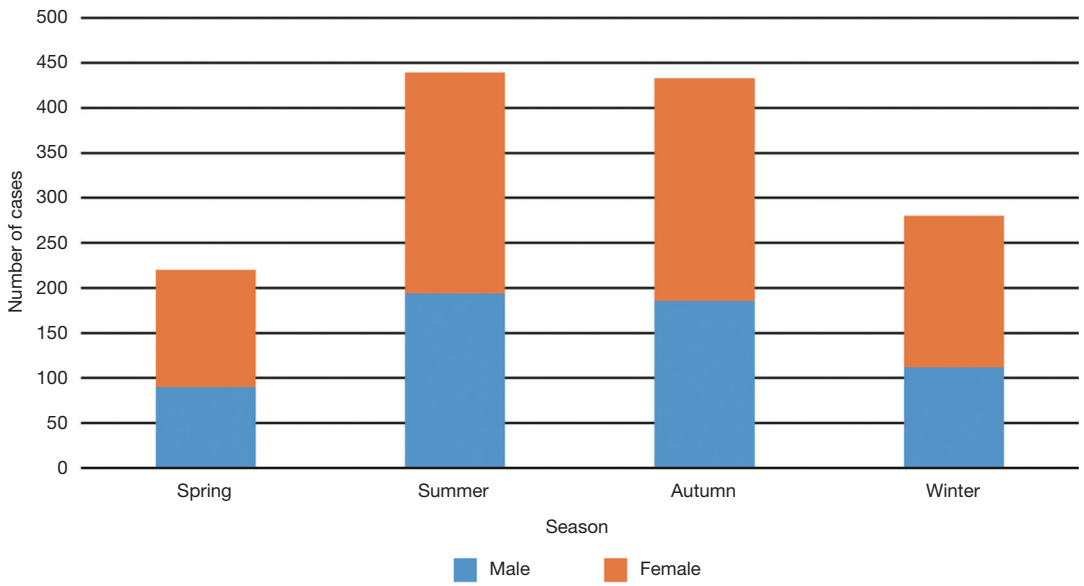


**Figure 6** Distribution of pesticide poisoning cases by seasons.

***Organophosphate and carbamate insecticides was the most common type in child pesticide poisoning organophosphorus and carbamate insecticides are the most common types of pesticide poisoning in children***

Poisoning by organophosphate and carbamate insecticides was most common: there were 504 cases, which accounted for 36.73% of all cases (*Figure* 7). Overall, insecticides were the main agent responsible for child pesticide poisoning (830 for 60.50%). Organophosphorus and carbamate insecticide poisoning is most common: there are 504 cases, accounting for 36.73% of all cases (*Figure* 7). In general, insecticides are a major contributor to pesticide poisoning in children (830%, 60.50%).

The main cause of pesticide poisoning in children was

 

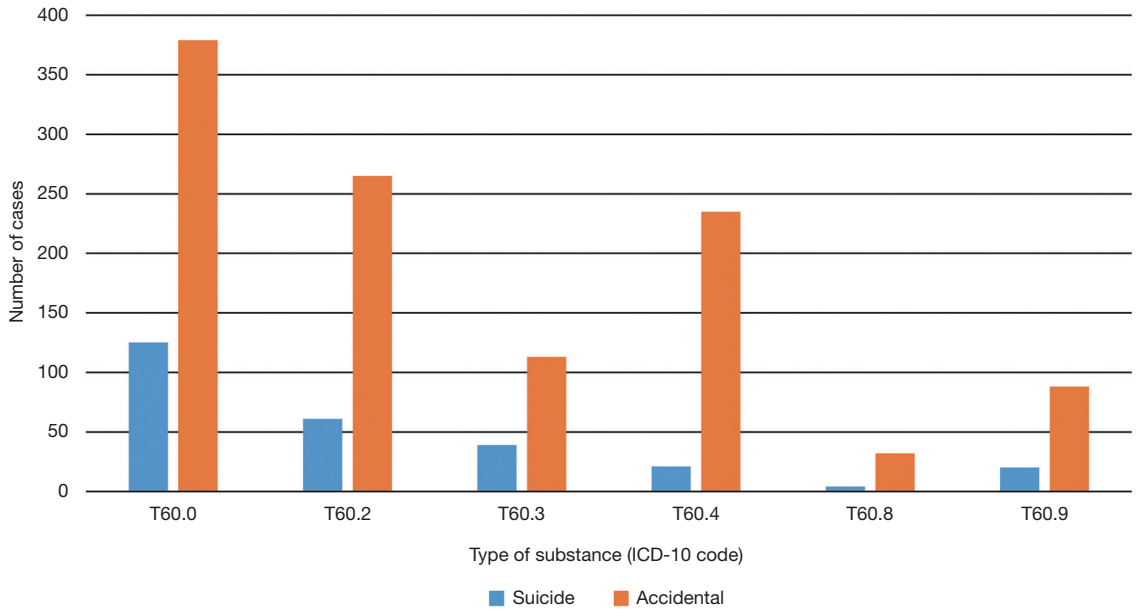


**Figure 7** Distribution of pesticide poisoning by substance involved among children.

accidental exposured to pesticides. Among different kinds of pesticides, the number of mistaking pesticide was greater than the number of oral intake of pesticides to commit suicide (1,103 *vs.* 270).

## Discussion

Epidemiological features of pesticide poisoning among kids were in line with reports from China and many other related countries (19-21). The results of this research show that pesticide poisoning among kids was an ordinary clinical issue, with 1.1 examples per 100,000 children in Jiangsu Province in 2006–2017. Our estimates were lower than the estimates for the United States (22) and Taiwan (23), but there are restrictive factors to direct comparisons because of various materials and data sources and research cycles. According to national monitoring data in the United States, the occurrence rate of pesticide-related diseases in 1998–2002 was 7.4 cases per million children (22). In Taiwan, using national Health insurance data from 1999 to 2008, the hospitalization rate in the 0–4 age group was 1.34 per 100,000 people and 100,000 persons per 0.17 people in the 5–14-year-old population.

Pesticide poisoning among kids was common in the farming season. The degree of pesticide poisoning among adults in agricultural season in Jiangsu Province was higher (3). Researches in different countries have shown that the occurrence of pesticide poisoning was associated with pesticide supply due to seasonal agricultural activities (14,20). Pesticide poisoning rates were highest at the age of 0–5 and peaked in summer. Pesticide poisoning was most frequently detected in the 0–5 age group, and it was consistent with relevant researches among kids (24,25). This may be due to their inherent curiosity and the high "hand-to-mouth" activity out of strange and its ability to find knowledge (26). This is an indisputable fact that kids usually are curious about their environments and often do not know the dangers that were coming. Children in this age group may be able to obtain pesticides, but they do not develop a sense of cognitive hazard. When pesticides were not kept safely, the likelihood of accidental poisoning increases (27,28). If the useful prevention strategies are used, most pesticide poisoning among kids can be prevented. It was so important to provide a great surrounding for kids. It needs better management of pesticides, including the labeling of pesticide containers with poison warning labels and the placement of pesticides in safe storage immediately after use. In a lot of developed cities and countries, child anti-drug packaging has been used to package drugs, household chemicals and pesticides, which has become one of the greatest preventive solutions against unintentional poisoning among small kids (22). In China, kid protective caps are not extensively utilized in pesticide packaging, which makes it easier for children to access pesticides.

 

Therefore, it is demanded that pesticide production and storage should be carried out in China to prevent children from packaging and sealing.

The number of examples among kids aged 6–10 has declined obviously, in part because they are increasingly aware of pesticide risks and spend less time in unsafe home surroundings. However, the number of examples of poisoning revived in the 11-14 age team. Other relevant researches also showed that the number of examples decreased with age, but then increased to a second peak (28) during puberty. This may be related to intentional poisoning with a goal of achieving self-harm. It is a significant social issue for adolescents in some Asian countries, including China (29). In this research, the majority of examples in the 11–14 age group were intentional. Therefore, pesticide suicide in the 11–14 age group has been a grave public health problem in Jiangsu province. Greater attention should be paid to the mental health situation of the 11–14 age group.

In this research, more boys were more poisoned than girls in quantity, similar to previous researches (29,30), possibly due to higher activity among boys. It was found that girls examples were more ordinary in the 11–14 age group. The results were in line with other researches that found an important association between adolescent girls and intentional poisoning (31,32). After seeing these researches, the higher suicide rate among adolescent women is linked to depressive symptoms and romantic frustration. These situations are more famous among girls than among boys. Overall, suicide keeps the leading reason of death among adolescents, and insecticide intake is one of the most ordinary methods of suicide in the world.

Poisoning by organophosphate or carbamate insecticides was most common, which might because of the ordinary application in farm and the quick availability. The management and control should be improved in production and usage of highly toxic pesticides including organophosphorus insecticide, rodenticides, and herbicides.

## Conclusions

This research gave detailed analysis of childhood pesticide poisoning in Jiangsu province, China from 2006 to 2017. Child pesticide poisoning was a grave social issue in Jiangsu and most of the examples happened in 0–5 age group children. The management and control should be improved in production and usage of highly toxic pesticides including organophosphate pesticides, rodenticides, and herbicides. People need to pay more attention to the thoughts of the young people, then the self-harm actions could be reduced. In addition, more effective solutions should be taken to increase people's awareness of the safe use of pesticides.

## Acknowledgments

*Funding*: This work was supported by Outstanding Medical Academic Leaders program of Jiangsu Province (LJ201130), Jiangsu Provincial Youth Medical Talent program (QNRC2016536), Six Talent Peaks Project in Jiangsu Province (WSW-017).

## Footnote

*Conflicts of Interest:* All authors have completed the ICMJE uniform disclosure form (available at http://dx.doi.org/10.21037/jphe.2018.12.04). XL serves as an unpaid Section Editor of *Journal of Public Health and Emergency* from Jan 2017 to Dec 2019. BZ serves as an Editor-in-Chief of *Journal of Public Health and Emergency* from Jan 2017 to Dec 2022. The other authors have no conflicts of interest to declare.

*Ethical Statement*: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The relevant materials and data of the patients required for our research is encrypted by the official pesticide poisoning statistics and ODSRS of the Jiangsu Centers for Disease Control and Prevention. The patient's privacy could be protected. Our research was in line with the Helsinki Declaration (as revised in 2013) and was exempt from institutional ethics review by the Research Ethics Committee of the Jiangsu Provincial Center for Disease Control and Prevention.

## References


1. Zhang M, Fang X, Zhou L, et al. Pesticide poisoning in Zhejiang, China: a retrospective analysis of adult cases registration by occupational disease surveillance and reporting systems from 2006 to 2010. BMJ Open 2013;3:e003510.
2. Yimaer A, Chen G, Zhang M, et al. Childhood pesticide poisoning in Zhejiang, China: a retrospective analysis from 2006 to 2015. BMC Public Health 2017;17:602.
3. Wang BS, Chen L, Li XT, et al. Acute Pesticide Poisoning in Jiangsu Province, China, from 2006 to 2015. Biomed Environ Sci 2017;30:695-700.
4. Jensen HK, Konradsen F, Jors E, et al. Pesticide Use and Self-Reported Symptoms of Acute Pesticide Poisoning among Aquatic Farmers in Phnom Penh, Cambodia. J Toxicol 2011;2011:639814.
5. Konradsen F. Acute pesticide poisoning--a global public health problem. Dan Med Bull 2007;54:58-9.
6. Hudson NL, Kasner EJ, Beckman J, et al. Characteristics and magnitude of acute pesticide-related illnesses and injuries associated with pyrethrin and pyrethroid exposures--11 states, 2000-2008. Am J Ind Med 2014;57:15-30.
7. Henao S, Arbelaez MP. Epidemiologic situation of acute pesticide poisoning in Central America, 1992-2000. Epidemiol Bull 2002;23:5-9.
8. Thundiyil JG, Stober J, Besbelli N, et al. Acute pesticide poisoning: a proposed classification tool. Bull World Health Organ 2008;86:205-9.
9. Moradi M, Ghaemi K, Mehrpour O. A hospital base epidemiology and pattern of acute adult poisoning across Iran: a systematic review. Electron Physician 2016;8:2860-70.
10. Stallones L, Beseler CL. Assessing the connection between organophosphate pesticide poisoning and mental health: A comparison of neuropsychological symptoms from clinical observations, animal models and epidemiological studies. Cortex 2016;74:405-16.
11. Zhang X, Zhao W, Jing R, et al. Work-related pesticide poisoning among farmers in two villages of Southern China: a cross-sectional survey. BMC Public Health 2011;11:429.
12. Azemi M, Berisha M, Kolgeci S, et al. Frequency, etiology and several sociodemographic characteristics of acute poisoning in children treated in the intensive care unit. Mater Sociomed 2012;24:76-80.
13. Lekei E, Ngowi AV, London L. Acute Pesticide Poisoning in Children: Hospital Review in Selected Hospitals of Tanzania. J Toxicol 2017;2017:4208405.
14. Balme KH, Roberts JC, Glasstone M, et al. Pesticide poisonings at a tertiary children's hospital in South Africa: an increasing problem. Clin Toxicol (Phila) 2010;48:928-34.
15. Lamireau T, Llanas B, Kennedy A, et al. Epidemiology of poisoning in children: a 7-year survey in a paediatric emergency care unit. Eur J Emerg Med 2002;9:9-14.
16. Sahin S, Carman KB, Dinleyici EC. Acute poisoning in children; data of a pediatric emergency unit. Iran J Pediatr 2011;21:479-84.
17. Simcox NJ, Fenske RA, Wolz SA, et al. Pesticides in household dust and soil: exposure pathways for children of agricultural families. Environ Health Perspect 1995;103:1126-34.
18. Lu C, Fenske RA, Simcox NJ, et al. Pesticide exposure of children in an agricultural community: evidence of household proximity to farmland and take home exposure pathways. Environ Res 2000;84:290-302.
19. Sun J, Guo X, Zhang J, et al. Incidence and fatality of serious suicide attempts in a predominantly rural population in Shandong, China: a public health surveillance study. BMJ Open 2015;5:e006762.
20. Senarathna L, Jayamanna SF, Kelly PJ, et al. Changing epidemiologic patterns of deliberate self poisoning in a rural district of Sri Lanka. BMC Public Health 2012;12:593.
21. Cha ES, Khang YH, Lee WJ. Mortality from and incidence of pesticide poisoning in South Korea: findings from National Death and Health Utilization Data between 2006 and 2010. PLOS One 2014;9:e95299.
22. Roberts JR, Karr CJ. Pesticide exposure in children. Pediatrics 2012;130:e1765-88.
23. Liu J, Schelar E. Pesticide exposure and child neurodevelopment: summary and implications. Workplace Health Saf 2012;60:235-42, 243.
24. Forrester MB. Pediatric insecticide chalk exposures reported to Texas poison centers. Hum Exp Toxicol 2013;32:554-8.
25. Trueblood AB, Forrester MB, Han D, et al. Pesticide-related poison center exposures in children and adolescents aged </=19 years in Texas, 2000-2013. Clin Toxicol (Phila) 2016;54:852-6.
26. Freeman NC, Hore P, Black K, et al. Contributions of children's activities to pesticide hand loadings following residential pesticide application. J Expo Anal Environ Epidemiol 2005;15:81-8.


 

27. Ram P, Kanchan T, Unnikrishnan B. Pattern of acute poisonings in children below 15 years--a study from Mangalore, South India. J Forensic Leg Med 2014;25:26-9.
28. Hawton K, Ratnayeke L, Simkin S, et al. Evaluation of acceptability and use of lockable storage devices for pesticides in Sri Lanka that might assist in prevention of self-poisoning. BMC Public Health 2009;9:69.
29. Gunnell D, Eddleston M, Phillips MR, et al. The global distribution of fatal pesticide self-poisoning: systematic review. BMC Public Health 2007;7:357.
30. Lee WJ, Ko Y, Cha ES. Acute pesticide poisoning among children in South Korea: findings from National Health Insurance claims data, 2006-2009. J Trop Pediatr 2014;60:4-9.
31. Rajapakse T, Griffiths KM, Christensen H, et al. A comparison of non-fatal self-poisoning among males and females, in Sri Lanka. BMC Psychiatry 2014;14:221.
32. Gutiérrez W, Cerda P, Plaza-Plaza JC, et al. Characterization of pesticide exposures reported between 2006 and 2013 to a poison information center in Chile. Rev Med Chil 2015;143:1269-76.

doi: 10.21037/jphe.2018.12.04
**Cite this article as:** Wang B, Li X, Han L, Shen H, Zhang J, Sun D, Gao D, Zhu B, Zhu B. Childhood pesticide poisoning trend analysis of 13 years in Jiangsu, China. J Public Health Emerg 2018;2:32.

 