Field Study

Pesticide Poisoning among Farmers in a Rural Province of Korea

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Abstract: Pesticide Poisoning among Farmers in a Rural Province of Korea: Seok-Joon SOHN, et al. Department of Preventive Medicine, Chonnam National University Medical School and The Research Institute of Medical Science, Chonnam National University—Pesticide poisoning is one of the most important occupational health hazards for farmers, but the exact prevalence or incidence of the poisoning has not been fully investigated in Korea. The present study assessed the pesticide poisoning in a rural province of Korea based on episodes reported by farmers. The total number of interviewees in this survey was 8,831. Of these, only 8,420 farmers who worked longer than one hour every day during the past one year were included in the analysis. Questionnaires collected from 8,420 persons were analyzed by means of a SAS statistical package. The average days spent for pesticide spraying was 6.8; the farmers at work experienced pesticide-related symptoms during the last one-year period at the rate of 7.0%; the average length of a hospital stay was 4.4 d; and the period of clinic visit averaged 1.7 d. Pesticide poisoning was statistically related with age, sex, region of residence and degree of pesticide use. Among the complaints in the farmers' syndrome, pesticide poisoning was significantly related with shoulder stiffness, sleeplessness, dizziness and a feeling of abdominal fullness, but not with lumbago, limb paresthesia, nocturnal frequency or dyspnea. The present data offer the baseline for the health resources planning and rural health program.

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Almost daily the mass communication media are flooded with alarms on the threat of pesticides to our health or our environment. The pesticide problem

concerns not merely the chemical industry and farmers, but also foresters and others who wish to protect wild life., as the pesticides are biocidal agents widely applied to control a vast variety of organisms so that they ultimately pose a great threat to the health of mankind. Presently 657 kinds of pesticides are produced and used in Korea and they are all complex organic compounds¹⁾.

A list of 168 pesticides that have caused death or serious illnesses appears in the index under studies in humans²⁾. But information on morbidity is not collected and recorded as systematically as that on mortality. The number of cases of non-fatal poisoning has, therefore, been estimated by using various models. One approach has been to determine the ratio of fatal to nonfatal cases. And the other is the population-based case ascertainment²⁾.

In 1983, the American Association of Poison Control Centers (AAPCC) began a pilot project to collect epidemiological data on poison exposure reported to the poison control centers nationwide in the U.S.A. The 16 participating centers reported 251,012 human poison exposures during the first year. In 1984, 4.0% of them involved exposure to pesticides³⁾. The Environmental Protection Agency (EPA) attempts to estimate pesticide poisonings from various sources on a periodic basis. All data sources have limitations, but the EPA estimated in 1992 that the annual number of physician-treated pesticide poisonings among agricultural workers is between 10,000 and 20,000⁴⁾. In Korea, however, no such data have been available so far. According to the data source for the year 1982⁵⁾, 23% of all farmers experienced some symptoms—headache, dizziness, fainting, numb fingers, nausea, abdominal pain, skin problems, and general fatigue—which might be related to pesticide use. This emphasises the urgent need for systemic investigation of agricultural pesticide poisoning in Korea, prompting us to undertake the present study. The objectives are 1) to provide actual figures on the present status of pesticide poisoning in a rural province, the largest agricultural province in Korea, 2) to estimate the medical care and costs incurred by the pesticide poisoning, and 3) to offer

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Table 1. Age and sex distribution of respondents

	Male		Female		Total	
	n	%	n	%	n	%
20–29	71	1.7	124	2.9	195	2.3
30–39	471	11.5	601	13.9	1,072	12.7
40–49	816	20.0	851	19.6	1,667	19.8
50–59	1,278	31.3	1,407	32.5	2,685	31.9
60–69	999	24.4	910	21.0	1,909	22.7
70–	453	11.1	439	10.1	892	10.6
Total	4,088	48.6	4,332	51.4	8,420	100.0

n=Number of subjects.

baseline data for future planning of rural health programs and allocating health resources.

Subjects and Methods

Data were obtained from the 1998–1999 database on farmers' syndrome in a rural Province of Korea. The sample population was selected by the stratified cluster sampling method to represent all 27 counties in a rural province. The structured questionnaire that had been completed after several field pretests was applied by trained field health workers. The interviewees were asked to participate four times to evaluate seasonal fluctuation in farmers' syndrome. The farmers' syndrome first named by Huji is a symptom complex typically complained of by the rural population and includes the following eight features: shoulder stiffness, dizziness, sleeplessness, abdominal fullness, lumbago, limb paresthesia, nocturnal frequency and dyspnea.

Information about pesticide poisoning was collected along with third serial implementation of the farmers' syndrome survey. The total number of interviewees in this survey was 8,831. Of this, only 8,420 farmers who worked longer than one hour every day during the past year were included in the analysis.

Specific information on pesticide poisoning surveyed for included: the patterns of pesticide use; personal experience of pesticide poisoning during the preceding year and throughout his/her lifetime; medical care when poisoning occurred; and specific conditions which could increase the risk of pesticide poisoning, such as working in a vinyl or green house.

The information collected was analyzed with other possible subsets of data, such as status on farmers' syndrome and general health condition of the interviewees. Annual as well as life-long experience of pesticide poisoning and subsequent medical care were also estimated. Age and sex were adjusted to obtain the best possible representation. Data were analysed with the SAS program.

Table 2. Average number of days spent for pesticide spray in the past year

Age	Male	Female	Total
20–29	5.3 ± 2.5*	7.5 ± 4.1	6.3 ± 3.1
30–39	9.2 ± 5.4	6.7 ± 3.7	8.0 ± 4.5
40–49	8.0 ± 4.1	6.9 ± 3.0	7.5 ± 3.8
50–59	7.8 ± 4.3	5.9 ± 2.9	6.9 ± 3.7
60–69	6.9 ± 3.9	4.9 ± 2.3	6.1 ± 3.3
70–	5.1 ± 3.3	4.0 ± 2.2	4.7 ± 2.8
Mean	7.5 ± 4.1	6.0 ± 2.9	6.8 ± 3.6

*Mean ± standard deviation.

Results

General characteristics of the respondents

48.6% of the respondents were men and 51.4% were women. The largest age group comprising 31.9% of the whole sample were in their 50s, which reflects the trend in the rapidly aging rural population in Korea (Table 1). The majority of the respondents were educated at the primary school level or below (70.7%). All of the respondents were covered by either medical insurance or the public medical assistance system, and about three-fourths of the medical security is provided by regional medical insurance.

Pesticide use

On the average, each respondent spent 6.8 days spraying pesticides in the past year, men spending longer than women (7.5 vs 6.0 days). The 30–49-yr age group spent more days than the younger or older age groups (Table 2).

Incidence of pesticide poisoning

About 7.0% of all respondents (587 out of 8,420), reported to have experienced pesticide-related symptoms

Table 3. The distribution of the pesticide poisoning frequency by sex

	1	2	3	≥4	Total (rate)	Mean (SD)
Male	165	85	44	44	338 (8.3%)	1.9 (1.1)
Female	144	38	15	52	249 (5.7%)	1.9 (1.2)
Total	309	123	59	96	587 (7.0%)	1.9 (1.1)

SD=Standard deviation.

Table 4. Medical care for pesticide poisoning

	Male	Female	Total
No. of farmers sought medical attention	338 (8.3)*	249 (5.7)	587 (6.9)
No. of intoxicated farmers who sought medical attention	332 (98.2)	248 (99.6)	580 (98.8)
No. of admitted farmers	266 (80.1)	172 (69.4)	438 (75.5)
Average length of hospital stay (days)	4.7 ± 3.3**	3.8 ± 3.0	4.4 ± 3.2
Average frequency of clinic visit (days)	1.6 ± 1.2	1.8 ± 1.4	1.7 ± 1.3

*Numbers in parenthesis are percent. **Mean ± standard deviation.

Table 5. Statistical significance between pesticide poisoning and possible risk factors

Significant factors	p value	Not significant factors	p value
Age (more young)	<0.05	Income level, reported	0.87
Sex (male)	<0.01*	Education	0.92
Area of residence (remote)	<0.01*	Duration of farming	
Pesticide spray		-work-year	0.10
-days spent	<0.01*	-daily work-hour	0.58
-frequency of sprays	<0.01*	Working in the green house	
		-days spent	0.87
		-daily work-hour	0.35

*Estimated by chi-square test and others are estimated by the test for linear trend.

during the past year. Men experienced slightly more than women did (8.3 vs 5.7%). Average annual frequency of the events was 1.9 both in male and in female respondents who reported pesticide poisoning (Table 3).

Medical utilization related to pesticide poisoning

During the past one-year period, 580 (6.9%) respondents sought medical treatment because of their pesticide-related illnesses. This means that more than 98.8% of the affected farmers sought medical attention. Among them, 438 (75.5%) were required to be admitted to hospital at least overnight. The average length of hospital stay was 4.4 ± 3.2 d, women tending to stay longer than male patients (4.7 ± 3.3 vs 3.8 ± 3.0 days) (Table 4).

Other factors related to pesticide poisoning

Pesticide poisoning was statistically related with age (the younger the more cases), with sex (males preponderating), region of residence (the remoter the more cases), degree of pesticide use (days spent as well as frequency of spraying), but not with reported income level, education, duration of farming, or working in the vinyl or green houses (Table 5).

Among the complaints belonging to the farmers' syndrome, pesticide poisoning was significantly related with shoulder stiffness, sleeplessness, dizziness and a feeling of abdominal fullness, but not with lumbago, limb paresthesia, nocturnal frequency or dyspnea (Table 6).

Table 6. Statistical significance between pesticide poisoning and symptoms of the farmers' syndrome

Significant factors	p value	Not significant factors	p value
Shoulder stiffness	<0.01*	Lumbago	0.29
Dizziness	<0.05	Limb paresthesia	0.63
Sleeplessness	<0.01	Nocturnal frequency	0.16
Abdominal fullness	<0.01	Dyspnea	0.60

*Estimated by the test for linear trend.

Discussion

The use of any biologically active compound poses potential problems in toxicology. Persons most likely to be affected are those with direct contact, including those who manufacture, formulate, and distribute, but if the material is used in or around ordinary households, many more people are affected and, it then poses a grave threat to the general population, referred to as the pesticide problem⁶. Studies in developed countries have related long-term pesticide exposure to cancer, adverse reproductive effects, and damage to the immune system^{7,8}.

Having the largest arable land area in Korea, the subject rural province is the greatest agricultural area producing staple foods for the whole nation all year round, and is therefore has the reputation of being the most pesticide-utilizing province. The potential health hazard inevitably accompanying the excessive use of pesticides therefore concerns us greatly, but no serious attention has been focused on this, as evidenced by the unavailability of reliable data thus far. For that reason we have undertaken the present cross-sectional study of pesticide exposure and poisoning in the subject rural province.

The assessment measure used in this study was a questionnaire to determine the history of exposure and to identify the of general characteristics. But this standard tool for an epidemiological study has its own advantages and disadvantages⁹. An actual case of poisoning can only be verified through a review of the medical outcome, which we did not attempt in this study. Therefore, the results of this study should be interpreted with appropriate reservations.

Since 1986, pesticide poisoning has accounted for approximately 4.3% of all human poisoning cases reported at Minnesota Regional Poison Centers in the United States. This figure agrees well with the reports in the AAPCC³. In Sri Lanka, there are a few estimates of the incidence of occupational poisoning based on episodes reported by farmers. 7% and 22% of farmers are reported to have suffered from a pesticide-related acute illness in the past¹⁰. In Korea, however, no such data are at hand so far. A survey by Lim⁵ is the only one to report that about 23% of farmers felt some symptoms of pesticide

poisoning. The positive rate of 7.0% in our study was quite low compared with his. This may partly be due to the different survey methods or due to our underestimation because of biases in reporting or recall. But the possibility of an actual decrease in exposure and a subsequent decrease in pesticide poisoning could not be excluded. In fact, there is no standard case definition of pesticide poisoning that can be used for epidemiological purposes, and symptoms of pesticide poisoning are usually non-specific as for pesticide exposure¹⁰. At any rate, our positive rate of 7.0% may also represent a rough incidence rate of pesticide poisoning in the subject rural province at present.

A gender difference in pesticide poisoning was found as expected, because men participate in pesticide use more frequently than women^{5,6}. The association with area of residence and with the degree of pesticide spray could also be easily foreseen because of the increased risks. Nevertheless, our present data did not reveal any relationship between working in vinyl or green houses and pesticide poisoning. The vinyl or green house is a closed environment which may increase the hazard of atmospheric pollution due to pesticides. One of the possible explanations would be the more careful use of lower doses by the users who are well aware of the possible hazard. Seasonal factors may also play a role. Densely and well arranged crops in the limited area, plus low seasonal activity of insects, would allow closer application of pesticide to the crops. It may be compared to the result of a survey on vinyl-house workers by Lee *et al.*¹¹, who showed that vinyl-house workers used much more pesticide, but pesticide poisoning was significantly higher in male than in female workers.

Among the eight symptoms included in the farmers' syndrome¹², four were revealed to have significant association with pesticide poisoning. This agrees well with the findings of Lim⁵ that the main symptoms of agricultural pesticide poisoning were headache, dizziness, general fatigue and abdominal pain, which were included in or associated with the farmers' syndrome. This may indicate that agricultural pesticide use is one of the major determinants in the farmers' syndrome⁶. Therefore, closer management of pesticide use will significantly reduce

the incidence of farmers' syndrome.

Farmers are aware of the standard safety precautions to prevent exposure during spraying, but very few, if any, of the various preventive measures are actually practised. Farmers are aware of the health risks of several hazardous practices but prefer continuing to changing owing to convenience¹⁾. Therefore, current emphasis on programs that promote the safe use of pesticides through education and training of farmers will be ineffective in Korea. Pesticide poisoning can be reduced by shifting to less toxic pesticides and promotion of alternative, non-chemical methods of pest control^{1), 10)}.

Our present data are probably the first on the actual incidence of pesticide poisoning in a rural province in Korea. Therefore, this study would offer baseline data for future planning of rural health programs and allocating health resources to the authorities concerned. More detailed studies based on more objective criteria of pesticide poisoning may provide further comprehensive information.

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