

## **Pesticide toxicity associated with health conditions of the farmers in Sindh, Pakistan**

A. M. Soomro, G. M. Sechar\* and M. I. Bhanger\*\*

Faculty of Pharmacy, University of Sindh Jamshoro Pakistan

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### **Abstract**

Pesticide spray by the farmers in agriculture sector is at large scale, which may alter their health. This work was aimed to assess the health conditions among two groups of the farmers; the subject group comprised 'pesticide spray-workers' and the volunteer controls were those away from this occupation. This study indicated the major difference in health status of the subject and control groups hence revealed the pesticide effects on major organ systems of their body. Conclusively the ill health conditions of the farmers associated with pesticide exposures seem enhanced due to certain allied factors i.e. poor diet, inappropriate protective measures and hot climate. Therefore legislation for Toxic Exposure Surveillance Program (TESP), Crop Management (CM) and Integrated Pest Management (IPM) is suggested for safety of farmers' health.

**Keywords:** Pesticides, Toxicity, Pakistan

### **1. Introduction**

Farmers are reported be involved in pesticide spray over 13.40 million acre cultivated lands in Sindh province of Pakistan hence their health may be affected. They are totally dependent on the success of their crop for their subsistence or livelihood and again depend on good health to produce it. However, a number of the pesticides commonly used are toxic by virtue of their mode of action and so would be expected to negatively affect the health of individuals exposed either directly or indirectly. There are hundreds of chemical compounds marketed as insecticides, fungicides, herbicides, and pesticides causing disorders ranging from topical irritant reactions to complex systemic illness (O'Malley, 1997). One of the crucial problems in developing countries including Pakistan concerns the use of highly toxic pesticides, the use of which very often has been restricted or even banned in the industrialized world (Wesseling, 1997). Beside this the causal factors contributing to acute occupational pesticide poisoning are seen common. This include; sloppy handling during the preparation and spraying of pesticides, using highly toxic pesticide in higher concentrations, direct contact with sprayed crops, going forward against wind during spraying, lack of personal protection and poor personal hygiene (Chen, 1991).

Farmers are generally unaware of the actual short term or long term exposure hazards associated with many pesticide products. After exposures the immediate impacts on health can appear which include; vomiting, head ache, sweating irritation of skin, eye, and respiratory tract, and fatigue. Acute and chronic types of pesticide poisoning have been distinguished according to the risk of pesticide use. The improper use of pesticides and inappropriate protective measures may engender biological effects beyond those for which they were originally manufactured. Adverse effects of agrochemicals may be caused not only by their active ingredients and the associated impurities, but also by solvents, carriers, emulsifiers, and other constituents of the formulated product (WHO/UNEP 1990 and Al-Saleh, 1994).

Pesticide exposure effects are remarkable and have not been seriously noticed in local farmers, which may lead to negative health impacts and in turn hinder their productivity towards overall diminished crop production. Among those who do not recognize health Impairment as one of the chronic effects of pesticide exposure will not balance the effectiveness of the pesticides being used on their farm against the risks involved. Therefore the prime objective of this work was

\* Department of Physiology, University of Sindh Jamshoro, Pakistan

\*\* National Center of Excellence in Analytical Chemistry, University of Sindh Jamshoro Pakistan

aimed around health conditions of the farmers associated with pesticide toxicity, to investigate the extent of the problem and to suggest ways and means for its mitigation.

## 2. Methodology

**Selection of respondents:** age matched two groups of farmers were selected separately as respondents; the controls (n=160) were those who in similar environmental and socio-economical conditions were away occupationally from pesticide sprays. the subjects (n=240) with occupational history of at least two years as pesticide spray-workers and three months consistent working in agriculture fields were selected. this was based on their exposure to various pesticides during handling, mixing, loading and spraying over the crops including cotton, vegetable, rice and fruit farms. all male farmers inclusive both groups were interviewed during the selected area visits. The data were collected by author observation and recalling from memory details of their health conditions. They were inquired about dietary habits adapted by them according to their socio-economical conditions. occupational information of the 'subject' respondents was collected about the pesticide products: spray-tools., number of exposures with duration and protective measures taken while spraying on their crops; a minimum number of ten farmers in study areas were selected from two distant locations of each district; finally findings reported by the farmers and observed by the author were noted and summarized in the results.

**Study Area:** Agriculture fields from fourteen districts of Sindh province included in this study i.e. Badin, Dadu, Ghotki, Hyderabad, Jacobabad, Khairpur, Larkana, Mirpurkhas, Nawabshah, Noshehroferoz, Sanghar, Shikarpur, Sukkur and Thatta.

## 3. Results

Farmer population in this work was between 20 to 60 years of age, initially all the 'subjects' and 'controls' were observed for their diets; they take twice a day in common. The diet include one bread (chapatti) of either wheat or rice with; (i) vegetable, ii) dairy products (milk and lassie) (iii) both vegetable and dairy products and (iv) mixed contents

(meat/fish/chicken); thus divided into four 'diet variety groups'. The farmer's percentages of both groups who take various diets are shown in Figure 1.

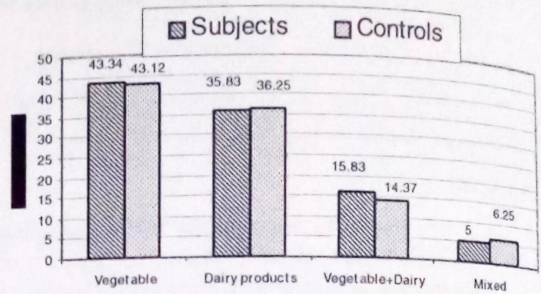


Figure 1. Bar graph shows the diet variety groups and adapting percentage of the Subjects and Controls.

It was noted that the 'backpack spray tanks' as pesticide application tool was used by 95% of 'subjects' in this study. The timings for pesticide spray on crops preferred by them observed over study areas were; morning hours mostly from 6 to 11 A.M. But less than 10% were found engaged at evening time as well. In duration of this work overall 20 pesticide products of organophosphates, pyrethroids, organochlorines, carbamates and miscellaneous groups of agro-chemical compounds were sprayed and/or mixed through water flow in the fields by the subject farmers. Figure 2 shows usage scale in percentage for each pesticide groups.

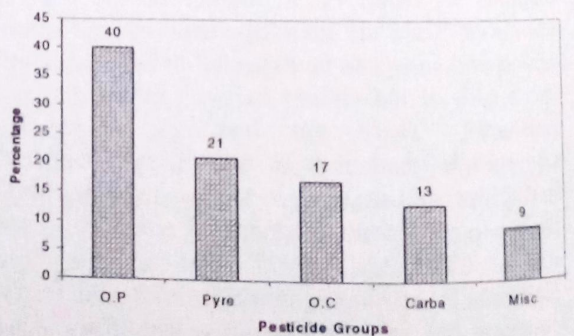


Fig. 2. Bar graph shows the percentage of pesticide groups used by the subject farmers.

During spray the subjects put on sunglasses and cloth mask (of towel/handkerchief/shawl), either single or both as protective measures only. Among 240 a total of 91 had cloth mask, twenty-two reported with sunglasses and 127 appeared without any production

Table 1. District wise position shows behavior of the farmers (Subjects only) toward protective measures while spraying their crops.

S. No.	Districts surveyed	No. of farmers	Cloth mask	Sunglasses	None-protection	Protective measures %
1	Badin	27	08	-	19	29.62
2	Dadu	16	04	03	09	43.75
3	Ghotki	13	04	01	08	38.46
4	Hyderabad	23	06	02	15	34.78
5	Jacobabad	09	02	03	04	55.55
6	Khairpur	25	08	07	10	60.00
7	Larkana	10	06	-	04	60.00
8	Mirpurkhas	22	04	02	16	27.27
9	Nawabshah	12	07	01	04	66.66
10	Noshehroferoz	13	09	01	03	76.92 **
11	Sanghar	20	11	-	09	55.00
12	Shikarpur	15	03	01	11	26.66 *
13	Sukkur	18	10	01	07	61.11
14	Thatta	17	09	-	08	52.94
Total		240	91	22	127	47.08

\* Minimum and \*\* Maximum percentage of protective measures taken by the farmers.

A significant number of surveyed subjects reported their health status with more tendency of suffering from acute illness. The comparative data for health conditions reveals percentage differences in organ/systems illness problems between exposed subjects and unexposed controls, which is given below in Table 2.

Organ/Systems	Subjects	Controls
Eyes	(57) 23.75%	(5) 3.12%
Skin	(48) 20.0%	(7) 4.37%
Respiratory tract	(42) 17.50%	(8) 5.0%
Nervous system	(22) 9.16	(4) 2.5%
Gastrointestinal tract	(20) 8.33%	(6) 3.75%
Total	(189) 78.74%	(30) 18.75%

Table-2. Health problems in percentage as experienced by the number of subjects and controls

The exposure effects and their ratio with illness were detected in the subject farmers. Table 3 unveils the exposures and illness ratio of variances in the subject farmers, hence, alphabetical ranking positions indicate level of population affected at each district.

Table-3. District wise position of farmers in ranks detected with ratio of variances for exposures and illness.

District	Ratio of Variances		Area Ranking
	Exposures	Illness	
Badin	1: 1.26	1: 1.71	C
Dadu	1: 1.26	1: 1.78	C
Ghotki	1: 1.68	1: 1.78	CB
Hyderabad	1: 1.90	1: 2.57	B
Jacobabad	1: 2.46	1: 3.07	A
Khairpur	1: 1.54	1: 2.80	B
Larkana	1: 1.20	1: 1.53	C
Mirpurkhas	1: 2.56	1: 2.83	AB
Nawabshah	1: 1.47	1: 2.23	CB
Noshehroferoz	1: 1.38	1: 2.16	CB
Sanghar	1: 1.00	1: 1.35	C
Shikarpur	1: 2.33	1: 3.90	A
Sukkur	1: 1.44	1: 1.85	C
Thatta	1: 1.08	1: 1.66	C
Total	1: 1.52	1: 2.22	B

Ranking indicators: A=Highest, B=Higher, C=Moderate an C/CB=Mild

#### 4. Discussion

Although 'subjects' expressed concern about the health impacts after using pesticides but in general thought the benefits outweighed the risks. Only few had no concern about the impact of pesticide use on their health. Controls' health history was based on their memory, which they expressed if had any illness pertaining to specified organ/system in a similar environment. In this work the subjects had prominently greater incidence of organ/system disease when compared to control group as shown in Table 2. The subjects' exposure and proximity to pesticide groups may be an important matter contributing to these higher rates of health effects.

Present results show the organophosphates as dominating group of pesticides experienced by the subject farmers (Figure 1). Being cholinesterase enzyme inhibitors they produce neurological problems towards significant morbidity and mortality following accidental or suicidal exposures (Singh, 2000). Greater percentage of affected nervous system, respiratory tract and gastrointestinal tract in the subjects seen in this study as indicated in Table 2, were also reported similarly by Kishi, *et al.*, 1995 among the Indonesian farmers. Consistent health conditions at different regions were also recorded by few more authors (Rosenthal, *et al.*, 1991, O'Malley, 1990 and Azaroff *et al.*, 1999). Having this type of toxicity association, other cholinesterase inhibitor group carbamates were also experienced by the subjects in Sindh province, hence their simultaneous toxic role in addition can not be ignored. The pyrethroids are not classified being as hazardous as cholinesterase inhibiting pesticides but reported to cause acute adverse effects among spray workers in China (Chen *et al.* 1991) and Ecuador (Cole *et al.* 2000). Allergic and other signs/symptoms of neurotoxicity reported by He F 1989 and Dorman *et al.* 1991 for this group pesticides include those which were related with the organ/system seem affected in this work.

Organochlorines mostly used pesticides noted in present work can not be spared for its widespread health effects. It was reported for significant toxicity in animals and human being and documented reaching at epidemic and catastrophic levels

(S.N.1994, Gross *et al.* 1994, Windham B 1999, Colburn T *et al.* 1991 & 1994). Data from animal studies reveal the organs most likely to be affected include kidneys, liver, blood, and the parathyroid gland (USAT 1990). Certain symptoms of ill health conditions in human beings induced by this group product were already reported by some authors (Corrigan 2000, Reichrtova *et al.* 1999 and Smith 1991). Though, the consistent health conditions of the subject farmers in present work may be due to that reason alone.

Usually farmer belongs to poor communities therefore seem at the greatest risk from pesticide poisoning (Tinoco, 1998). Poor economical conditions of the farmers in Sindh province forced them to survive on insufficient diets, which can be imagined by their dietary habits. Present work reveals that the dietary habits of both control and subject groups are almost same (Figure 1) but the increased rate of systemic illness in the subject farmers indicate the effects of pesticide exposure as shown in Table 2. Population sustaining on nutritionally inadequate diets may be more prone to the toxic effects of pesticides as compared to those having nutritional adequacy (Bulusu, 1988). Therefore, systemic studies pertaining to such conditions reported the toxic effects in liver especially those on low protein diets were seen more susceptible (Bulusu, 1984, Singh, *et al.* 1988). However, grounds of dietary habits may be associated with pesticides toxicity to understand the exposure effects as well.

In fact, the inappropriate protective measures during pesticide application practices are not changed even after witnessing consequences of toxic exposures. In this work small number of the subject group had seem using the respirators/cloth masks, while "sunglasses" were taken for their eye protection. District wise position of protective measures as indicated in Table 1 is not sufficient because most areas of Sindh province seen with less than 50% of such so called protection. Adapting the protective means during spray at nominal level may be due to hot climates particularly in selected crop seasons. Whereas overall behavior toward protective measures seem observed is not encouraging. However such conditions exist with little difference to the persisting conditions in Sri Lanka, Malaysia,

and Thailand, those in addition had polythene bags used as "hand gloves". The alternative is European recommended protection uniform like 'space-mans', which is unacceptable in such environment that may kill the farmers (Wasilewski, 1987). Along with poor protective measures in such environmental conditions and use of 'backpack spray tanks' to spray those increase the chances of greater exposure limits, may be reasoned for impaired health, especially in areas of Sindh province because these are out of control of the subject farmers.

Increasing rate of pesticide exposure is considered responsible for higher toxic effects. In this work area wise distribution of the farmers, who fall sick after repeated exposures to multiple pesticides was further analyzed for "ratio of variances" (Table 3). It was observed that subjects at 'Jacobabad' and 'Shikarpur' were highest affected. More exposures and hot climatic conditions at both districts, which is reported to enhance dermal absorption of many pesticides may reason for highest toxicity association. Second higher exposure effects were seen at Hyderabad and Khairpur districts. This was followed by moderate to mild affected areas; Badin, Dadu, Larkana and Sanghar. Changes in toxic effect levels among the districts may be distinguished by crop types cultivating tendency that varied at different geographical locations, which require the change in selection of pesticides to spray at respected areas. Furthermore the influence of pesticide exposures for generating the ill health conditions in the farmers was seen in this work (Table 3). Hence, ratio of pesticide exposures to each farmers may establish the concept; "larger the pesticide exposure → higher the ill health".

Some researchers suggest that different approaches are needed to prevent acute pesticide poisonings, such as banning the most highly toxic pesticides that available in Sindh and implementing alternative agricultural methods to reduce the use of pesticides (Brandt *et al.* 2001; Kishi *et al.* 1995; McConnell *et al.* 1993 and Soomro *et al.* 2003). Generally the lack of adequate legislation, ignorance of standards, poor labeling, illiteracy and lack of protective clothing increase the hazards to agriculture workers and environment (Ndoye, 1998; Yousefi, 1999 and Partanen, *et al.*, 1999). Therefore

the pesticide-related illness and injury surveillance programs are supported in many states (NIOSH 2004), which are needed to identify outbreaks and emergency pesticide health effects in local areas as well. Following these intimations the integrated pest management (IPM) and crop management have been suggested most suitable alternatives for safe environment and safety of the farmers' health.

## 5. Conclusion

Present work concludes the significant ill health conditions of farmers exposed to pesticides; Increased ratio of exposure; climatic conditions and poor protective measures were mainly responsible for higher level toxic effects. This describes the plans for the development of a pesticide control areas in Sindh that will help to elucidate where and why pesticides are used, potential risks to farmers' population and the health consequences after their exposure.

## 6. Suggestions

It is suggested that 'Toxic Exposure Surveillance Program' (TESP) may be brought about with proper legislation for safety of farmer's health. A commonly recommended solution to health conditions associated with pesticide exposures is to improve the dietary conditions of the farmers, to provide them health education and training, to promote the use of appropriate protective equipment and teaching farmers to handle pesticides carefully.

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