STUDENTS' CORNER
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Practice and effect of pesticide use on farmers' health in Sindh, Pakistan

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Abstract

Objective: To identify the frequency and mode of pesticide application, its adverse health effects, and to assess farmers' knowledge and practice of precautionary measures.

Methods: The cross-sectional study was conducted in Matli, Badin in the Sindh province of Pakistan from February to April 2020, and comprised farmers. Data was collected through face-to-face interview using a validated questionnaire. Data was analysed using SPSS 22.

Results: Of the 332 farmers, 329(99.1%) were males. The overall mean age was 31.18±12.79 years (range: 21-30 years). Also, 269(81%) of them had not attended formal schooling, and the mean duration of farming practice was 1.64±0.859 years.` Further, 136(41%) participants did not follow the recommended frequency of pesticide application, accidental ingestion was reported by 208(62.7%) participants, and inhalation by 203(61.1%). Dumping of pesticide containers in open fields was a common practice for 247(74.4%) subjects, and 223(67.2%) showed interest in safety training sessions.

Conclusions: Farmers of Sindh were found to be seriously exposed to pesticide risk because of inadequate knowledge.

Keywords: Developing country, Farmers, Pakistan, Personal protective equipment, Pesticides. (JPMA 72: 587; 2022)

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Introduction

With an increase in pesticide application over the past decade, its resultant adverse health effects have been a growing public health concern. Farmers are being encouraged to use pesticides to increase crop productivity in developing countries. However, for preventing adverse health effects, pesticide poisoning and food contamination, it is crucial that agriculture workers should have sufficient knowledge related to its appropriate use and disposal. Unfortunately, a large number of people worldwide die annually due to pesticide exposure.[1,2]

The World Health organisation (WHO) and the Food and Agriculture Organisation (FAO) of the United Nations have recommended steps to reduce pesticide poisoning among the users. However, several pesticides used in developing countries are extremely hazardous for health.[1] An Ethiopian survey observed unprotected pesticide use in approximately 42% farmers.[2] Another research from Tanzania revealed 68% of farmers suffered from skin and neurological symptoms after exposure to pesticides.[3] Similarly, headache, nausea and skin problems were noted in Chinese pesticide users.[4] In Pakistan, pesticide poisoning cases have been reported among cotton and fruit farmers of Karachi.[5] Limited knowledge of farmers regarding harmful effects of pesticides, acute pesticide poisoning, importance of personal protective equipments (PPEs), unsafe pesticide storage at home and poor disposal of empty pesticide container have been reported by various studies.[3,6]

Pakistan is an agricultural country, with the national economy largely depending on agriculture.[7] Residents of rural areas are mostly farmers. Pesticide application is a common practice among agriculture workers of rural Sindh, but not many studies have emerged from this region focussing on routine frequency, application methodology, disposal of pesticides and their adverse effects on farmers' health.[8,9] Rural Sindh is a major contributor to the national agricultural output[10] and, as such, studies from the said region are needed to fill the gap.

The current study was planned to assess the knowledge of farmers regarding pesticide application and its harmful effects, their frequency of pesticide application, methods of disposal, self-reported adverse health effects, and use of PPEs.

Materials and Methods

The community-based descriptive cross-sectional study was conducted from February to April 2020 in the Matli village of Badin district in the Sindh province of Pakistan. After approval from the ethics review board of Jinnah Sindh Medical University (JSMU), Karachi, the sample size was calculated using OpenEpi calculator[11] with 95% confidence interval (CI) (z score: 1.96), 68.5% prevalence on the basis of literature[12] and 5% allowable error of known prevalence.

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The sample was raised using non-probability convenience sampling technique from among the local farmers who practiced agriculture work for a minimum one year and were involved in pesticide application. Farmers with a history of chronic respiratory, neurological and skin diseases were excluded. All non-consenting farmers and those who had not been exposed to pesticides were also excluded.

After taking informed consent from all the subjects, data was collected through face-to-face interview using a self-administered questionnaire. The questionnaire was prepared after extensive literature review and comprised four parts. The first part included demographic data, like name, age, gender, marital status, education, ethnic group and farming years. The second part recorded practices as well as interval of pesticides used, personal protective measures (PPMs) taken during pesticide application, after poisoning, and methods of application of pesticides. The third part inquired about signs and symptoms after pesticide exposure. The fourth part included questions about knowledge of farmers regarding the harmful effects of pesticides, their views regarding the need of pesticide safety training, along with methods of discarding pesticide containers. The questionnaire was developed in English language and was then translated into the local Sindhi language by one of the authors well familiar with both languages. The interviews were conducted by the same author. Farmers were interviewed in their free time in the fields and Autaq premises, which is the traditional meeting place of the locals, with about 20 minutes to record data for each individual.

Data was analysed using SPSS 22. Descriptive statistics were used to determine mean and standard deviation for numerical variables. Categorical variables were expressed as frequencies and percentages. Chi-square/Fischer exact tests was applied to assess any statistical association between pesticide usage and ill effects on farmers' health. P<0.05 was considered significant.

Results

Of the 332 farmers, 329(99.1%) were males. The overall mean age was 31.18±12.79 years (range: 21-30 years). Also, 269(81%) of them had not attended formal schooling, and the mean duration of farming practice was 1.64±0.859 years. A total of 136(41%) participants did not follow the recommended frequency of pesticide application, accidental ingestion was reported by 208(62.7%) participants, inhalation by 203(61.1%), and 178(53.6%) relied on labels on containers as their main source of information related to precautionary measures, and those unable to read depended on retailers, fellow villagers or landlords for explaining the instructions. Exposure to pesticides twice a week was reported by 136(41%) and

Table-1: Distribution of socio-demographic data and knowledge of farmers related to pesticide use.

Socio-demographic Data of Farmers		
Variables	**n (%)**	**Mean±SD**
Gender		
Male	329(99.1)	M:F ratio
Female	3(0.9)	109.6:1
Age (year)		
10 – 20	58(17.5)	
31.18±12.79		
21 – 30	125(37.7)	
31 – 40	92(27.7)	
41 – 50	23(6.9)	
51 – 60	22(6.6)	
61 – 70	7(2.1)	
71 – 80	5(1.5)	
Education Status		
Illiterate	270(81.3)	
Primary schooling	49(14.8)	
Secondary schooling	13(3.9)	
Ethnicity		
Sindhi	303(91.3)	
Saraiki	29(8.7)	
Marital Status		
Married	270(81.6)	
Unmarried	61(18.4)	
Farming Experience in Years		
1 – 10	183(55.1)	1.64±0.859
11 – 20	102(30.7)	
21 – 30	33(9.9)	
31 – 40	11(3.3)	
41 – 50	3(0.9)	
Knowledge of Farmers Related to Pesticide Use		
Pesticides can harm through		
Ingestion	208(62.7)	
Inhalation	204(61.4)	
Eyes	203(61.1)	
Skin	173(52.1)	
Source of Information on Pesticides		
Labels	178(53.6)	
Landlords	117(35.2)	
Grand Parents	56(16.9)	
Price Retailers	6(1.8)	
Practices and effects of Pesticides Use on Farmer's Health		
Activities during pesticide application		
Smoking	62(18.7)	
Drinking	33(9.9)	
Eating	19(5.7)	
Frequency of Pesticides Application		
Daily	29(8.7)	
Alternative Days	43(13.0)	
Twice a Week	136(41.0)	
Once a Week	118(35.5)	
After Two Weeks	5(1.5)	
Every Six Months	1(0.3)	

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Table-1: *Continued from previous column.*

Socio-demographic Data of Farmers		
Variables	**n (%)**	**Mean±SD**
Protective Measures taken by farmers during pesticide application		
None	167(50.3)	
Hat, Gloves and Mask	52(15.7)	
Gloves only	23(6.9)	
Mask only	11(3.3)	
Protective Goggles	4(1.2)	
Long Sleeves	9(2.7)	
Oil	49(14.8)	
Disposal of Empty Pesticides Container		
In the Fields	247(74.4)	
In Rubbish Bins	11(3.3)	
Re-used	13(3.9)	
Burn	59(17.8)	
Application of Pesticides		
By Hands	41(12.3)	
By Spray	253(76.2)	
Hygiene Measures		
Take Shower	316(95.2)	
Wash Hands only	12(3.6)	
Signs and Symptoms after Pesticide application		
Body itching and irritation:	277(83.4)	
Pain in eyes:	184(55.1)	
Irritation and itching in eyes:	261(78.6)	
Lacrimation:	267(80.4)	
Stomach ache:	245(73.8)	
Nausea and vomiting:	215(64.8)	
Dry mouth:	224(67.5)	
Cough:	248(74.7)	
Shortness of breath:	254(76.5)	
Runny nose:	224(67.5)	
Headache:	304(91.6)	
Muscle cramps:	267(80.4)	
Excessive sweating:	271(81.6)	
Irritability in nature:	274(82.5)	
Sleep disturbance:	254(76.5)	
Hospital visit in case of accidental exposure		
Frequency of visits	136(41.0)	
Willingness for Safety Training		
Frequency of farmers	223(67.2)	

167(50.3%) did not take any personal protective measures during pesticide handling Dumping of pesticide containers in open fields was a common practice for 247(74.4%) subjects, and 223(67.2%) showed interest in safety training sessions (Table-1).

There was significant association between the use of PPE and level of education (p=0.015), age of the participant (p=0.022), frequency of pesticide application (p=0.000) and following of pesticide safety instructions on labels (p=0.015). The method of pesticide application was significantly associated with certain ill effects on health, including stomachache (p=0.023), shortness of breath (p=0.003), pustule formation (p=0.019), dry mouth (p=0.015) and loss of vision (p=0.001) (Table-2).

Discussion

Pakistan is an agricultural country. With 70% of the total population living in rural areas, about 45% of the manpower is involved in farming. Agriculture does not only make provision of bread and butter to their families, but also contributes to about 23.4% to the national economy.[13] Modern ways of cultivation aim at enhanced crop production and it confers utility of different types of pesticides. Pesticides provide protection to the crops, but, on the other hand, are also harmful to the health of the farmers.[14] Sindh is the southern province of Pakistan with mostly dry and hot climate.[15] Moreover, in about 50 million population of the province, approximately 40% is illiterate, with females comprising double this number.[16] Most of the people are farmers by occupation and are unable to even read safety instructions on the labels themselves.

In Pakistan, a few studies were performed in some rural areas of Punjab[14] and in the northern areas.[17] It was thus much needed that a study should be performed to assess the knowledge of farmers related to pesticides use, frequency of application, PPE use and prevailing ill effects on the health of farmers in the second most populous province of the country. To our knowledge, no similar research has been conducted in the province of Sindh.

In the current study, 329(99.1%) of the respondents were male aged 21-30 years. As reported by other studies from various regions of Pakistan, majority of males in rural areas start working in the fields at a young age, while females are the home-makers. Family tradition of stay-at-home female population and minimal education levels in rural areas can well explain this scenario.[17,18]

Majority 269(81.0%) of the participants in the current study never attended formal school for education. This represents a much higher frequency in comparison to illiterate farmers' population (51.5%) in the Punjab province.[19] A valid association of literacy rate with the adoption of modern farming methods, and adaptation to climate change has been reported from studies on farmers of Pakistan and Nepal.[19,20] The results of our study also endorse this finding.

In the present study, more than half of the participants (53.6%) agreed that labels on pesticide container served as a source of information on pesticide usage, but 36.7% could not read them. In contrast, other studies reported that farmers get information mainly from fellow farmers, followed by pesticide retailers.[14,22,23] A good number of farmers (40.6%) admitted that they never followed safety instructions provided on the labels. WHO and FAO jointly

Table-2: Association of age groups, educations level, pesticide application frequency, methods and adverse health effects with practices of personal protective measures.

Association of Level of Education with use of Personal protective Equipment					
Education level:	**Use any personal protective equipment n (%)**	**Did not use any personal protective equipment n (%)**			***p*-value ±**
Illiterate:	133 (40.06)	137 (41.2)			0.015
Primary:	33 (9.94)	16 (4.8)			
Higher secondary:	10 (3.0)	3 (0.9)			
Association of Age groups with use of Personal protective Equipment					
Age group (year)	**Use any personal protective equipment n (%)**	**Did not use any personal protective equipment n (%)**			***p*-value ±**
10-20	36 (10.84)	22 (6.62)			0.022
21-30	64 (19.27)	61 (18.37)			
31-40	33 (9.93)	59 (17.77)			
41-50	12 (3.61)	11 (3.31)			
51-60	12 (3.61)	10 (3.01)			
61-70	6 (1.81)	1 (0.30)			
71-80	2.(0.60)	3 (0.90)			
Association of frequency of Pesticide application with use of Personal Protective Equipment					
Frequency of pesticide application:	**Used personal protective equipment n (%)**	**Did not use personal protective equipment n (%)**			**p-value ±**
Daily:	9 (2,71)	20 (6.02)			0.000
Alternative days:	17 (5.12)	26 (7.83)			
Twice a week:	88 (26.5)	48 (14.45)			
Once a week:	50 (15.06)	68 (20.5)			
Every six months:	0 (0)	1 (0.30)			
After two weeks:	1 (0.30)	4 (1.20)			
Following safety instructions on labels					
Education level	**Follow pesticide safety instructions: n (%)**	**Did not follow pesticide safety instructions: n (%)**			**p-value ±**
Illiterate:	133 (40.06)	137 (41.2)			0.015
Primary:	33(9.94)	16 (4.8)			
Higher secondary:	10 (3.01)	3 (0.90)			
Association of Methods of pesticide application with self-reported adverse health effects					
Self-reported sign and symptoms after pesticide usage	**By hands**	**By spray**	**By tractor**	**By hands and spray both**	**p-value**
Body irritation	34 (10.24)	209 (62.95)	2 (0.60)	32 (9.63)	0.501
Scar formation	27 (8.13)	164 (49.39)	2 (0.60)	30 (9.03)	0.106
Pain in eyes	18 (5.42)	145 (43.67)	0 (0)	21 (6.3)	0.086
Lacrimation	31 (9.33)	202 (60.84)	3 (0.90)	31 (9.33)	0.413
Loss of vision:	17 (5.12)	52 (15.66)	0 (0)	15 (4.51)	0.001
Stomachache:	26 (7.83)	197 (59.33)	2 (0.60)	20 (6.02)	0.023
Diarrhoea:	20 (6.02)	98 (29.51)	2 (0.60)	10 (3.01)	0.054
Loss of appetite:	23 (6.92)	143 (43.07)	1 (0.30)	14 (4.21)	0.265
Constipation:	17 (5.12)	92 (27.71)	2 (0.60)	11 (3.31)	0.575
Nausea and vomiting:	22 (6.62)	172 (51.80)	2 (0.60)	19 (5.72)	0.168
Cough:	26 (7.83)	195 (58.73)	3 (0.90)	24 (7.22)	0.156
Shortness of breath:	23 (6.92)	205 (61.74)	2 (0.60)	24 (7.22)	0.003
Chest tightness:	23 (6.92)	169 (50.90)	2 (0.60)	21 (6.32)	0.107
Runny nose:	23 (6.92)	176 (53.01)	3 (0.90)	22 (6.62)	0.194
Wheeze:	2 (0.60)	2 (0.60)	0 (0)	0 (0)	0.140
Vertigo:	24 (7.22)	181 (54.51)	2 (0.60)	24 (7.22)	0.415
Dizziness:	26 (7.83)	153 (46.08)	1 (0.30)	22 (6.62)	0.767
Muscle cramps:	31 (9.33)	204 (61.44)	1 (0.30)	31 (9.33)	0.347
Irritability:	31 (9.33)	210 (63.25)	2 (0.60)	31 (9.33)	0.422
Pustule:	24 (7.22)	106 (31.92)	1 (0.30)	23 (6.92)	0.019
Irritation and itching in eyes:	30 (9.03)	203 (61.14)	3 (0.90)	25 (7.53)	0.390
Dry mouth:	31 (9.33)	160 (48.19)	2 (0.60)	31 (9.33)	0.015
Headache:	34 (10.24)	234 (70.48)	3 (0.90)	33 (9.93)	0.183
Sleep disturbance:	32 (9.63)	190 (57.22)	2 (0.60)	30 (9.03)	0.543

± Pearson chi-square test

recommend strict compliance with the instructions provided on the pesticide labels to ensure the safety of the farmers and environment.[24]

A considerable number (41%) of the participants declared having applied pesticides in the fields more frequently than the recommended guidelines. A high frequency of pesticide application to the crops per season can be harmful to the soil and may contaminate the crops. Moreover, there is increased exposure of participants to the pesticides which can lead to significant health problems. WHO, FAO and other studies recommend time- and space-bound pesticide usage along with maintaining a record of all activities.[24,25] Major cause of noncompliance with the guidelines was lack of knowledge of the farmers in the current study.

The guidelines also emphasise upon avoiding certain activities during pesticide application process.[25] For instance, the self-reported frequency of smoking (18.27%), drinking water (9.9%) and having meals (5.7%) during pesticide application among the study participants was worrisome. This frequency is, however, lower than that reported in a study from Punjab.[7]

Proper disposal of empty pesticide containers has been emphasised in order to reduce environmental pollution and prevent harmful effects. Less damage is caused by burying and burning the empty container.[26] The WHO also recommends proper disposal by the suppliers.[24] Not following the proper disposal measures, 74.4% farmers reported throwing empty pesticide containers in fields, while 17.8% burnt and 3.3% threw them in rubbish bins in the current study. The finding was in accordance with studies from India and New Guinea.[23,26] However, a somewhat better disposal practice was reported from China.[22]

Pesticides, on the one hand, are expensive, while, on the other, they can cause toxicity to nervous, gastrointestinal or respiratory system. Adverse health effects can be prevented by following proper safety instructions and using protective gears which include overall, gloves, boots and mask.[25] Nearly half of the respondents denied using PPEs during pesticide handling. About 15.7% farmers in the current study wore hats, masks and gloves, whereas 14.8% applied oil on skin for protection. Similar statistics were reported from Punjab.[7] A comparatively better practice of using PPEs was reported from New Guinea.[26] Once again, it is evident that taking precautionary measures and following guidelines related to PPE usage depended largely on education levels, knowledge of farmers and years of experience, as was noted in the current study.

A diverse range of self-reported symptoms were recorded by the the participants in the current study. This included headache (91.6%), followed by body itching and irritation (83.4%). However, the actual cause of these symptoms could not be confirmed as to whether they were post-exposure or there were some other triggering factors involved.

Spraying was the preferred method for majority of the farmers (76.2%). The positive finding was that most of them took a shower or maintained good hygiene after handling pesticides. The recommended post-exposure protective methods are washing hands, face and taking a shower.[25]

In terms of limitations, the results of the current study may not be generalised over the entire population of Sindh. It is possible that farmers in other towns and districts may have better knowledge of pesticide handling. Chance of recall bias is a possibility as participants might not have been able to remember all the symptoms related to a particular exposure. Moreover, the current study was based on farmers' self-reported signs and symptoms after the use of pesticides.

In order to avoid adverse health effects, the farmers should follow instructions provided on pesticide labels and should ensure wearing of PPE gear which include gloves, boots, mask and goggles.

Conclusion

Farmers of Sindh were found to be greatly exposed to pesticides. Accidental ingestion was commonly reported. Headache, generalised itching and irritability were frequent side-effects of pesticide exposure. Majority of the farmers had never attended formal schooling and thus their knowledge related to pesticide usage and ill effects was inadequate. Personal protective measures were not practised as recommended. Hospital visits were rare in case of accidental exposure. Common practice of dumping of pesticide containers in open fields posed a great threat to environmental health. On the positive side, majority of the farmers showed interest in safety training sessions.

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