Research Article

Association of Precautionary Measures of Pesticides Use with Health Concerns

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Abstract | Pesticides are the most harmful set of toxins to the ecosystem and human health. To find out their toxic effects on human health and environment, the present study was carried out in the four districts (Dera Ismail Khan, Swat, Charsadda and Mansehra) of Khyber Pakhtunkhwa selected through multi-stage sampling technique. Furthermore, four union council viz. Band Kurai, Baidara, Khanmai and Baffa from the sampled districts were selected. A total of 384 respondents were selected through unknown population sampling formulae i.e. 96 from each Union Council. Data were collected using well-structured interview schedule through personal interview method whereas binary logistic regression model was utilized (binary responses (1 if exists 0 otherwise) both of dependent and independent variables) to find out the effect of precautionary measures and Personal Protection Equipment on self-reported acute poising cases. Binary logistic regression analysis depicted highly significant negative association between adverse effects of pesticides like headache, dizziness, feeling weak, difficulty in seeing, chest pain, burning sensation, and fever with precautionary measures/Personal Protection Equipment's recommending that these precautionary measures and PPEs must be adopted to avoid from these health concerns.

Received | January 08, 2019; **Accepted** | February 14, 2019; **Published** | March 07, 2019
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Citation | Ullah, R. and K. Nawab. 2019. Association of precautionary measures of pesticides use with health concerns. *Pakistan Journal of Agricultural Research,* 32(2): 287-292.
DOI | http://dx.doi.org/10.17582/journal.pjar/2019/32.2.287.292
Keywords | PPE, Pesticides, Precautionary measures, Acute poisoning, Regression

Introduction

Pesticides are poisonous by nature and constitute one of the most hazardous groups of toxins to the ecosystem and human health (Hoi et al., 2009; Ahouangninou et al., 2012). The hazardous effects of pesticides use are increasing day by day particularly in the developing countries on account of its abrupt usage (Hoi et al., 2013; Jansen and Dubois, 2014) and are definitely a public health concern globally (Wesseling et al., 2001). This public health concern has more risks in the developing countries in comparison to the developed ones.

Pesticides on one hand fights against the agricultural pests but on the other hand has an antagonistic effect both on the health of the human beings and the environment. Agricultural pests can cause considerable reductions in farm yields and income. As a result, pesticides are profoundly used to alleviate this problem. But unfortunately, some pesticides even not arrive at the intended pests and according to an estimate, 85-90% of pesticides never even arrive at their intented organisms (Repetto and Baliga, 1996). It is very likely that many non-target organisms are exposed to multiple pesticides throughout their lifetimes.

According to WHO estimates in 1973 the human poisoning cases reported annually were 0.50 million whereas in 1986 it was more than one million plus 20,000 deaths. Similarly, a joint study by United Nation Environmental Program and WHO in 1990 reported three million cases whereas 2.20 million results in fatalities (WHO, 1990). The situation is more alarming in developing countries where the people death rate is high instead of infections. As farmers use increasing quantity of pesticides, poisonings will continue to increase (WHO, 1990). Unsafe use of pesticides is damaging the health of the farmers and the community in Pakistan as well and thus resulting in annual deaths of 10,000 whereas 500000 suffered from poisoning (Dawn, 2004).

Furthermore, potential acute health effects of pesticide exposure include skin irritation, eye irritation, shortness of breath, salivation, nausea, vomiting, abdominal cramps, excessive fatigue, headache, muscle twitching, and numbness. Extreme cases of acute pesticide exposure or pesticide poisoning can result in death. Health outcomes such as Attention Deficit Hyperactive Disorder (ADHD) and Parkinson's disease have also been linked to exposure to certain classes of pesticides (Risk, 1990).

Keeping in view the importance of health effects of pesticides the present study was designed in order to find out the effect of PPE and precautionary measures taken while using pesticides on the acute poisoning cases.

Materials and Methods

The cross-sectional survey was carried out in Khyber Pakhtunkhwa (KP) which is divided into 4 Agro Ecological Zones Viz. Northern Mountainous Zone, Eastern Mountainous Zone, Central Plain Valley and Southern Piedmont Plain. Therefore, a Multistage Sampling technique was utilized for selection of respondents.

First, District Dera Ismail Khan (D. I. Khan) from Southern Piedmont Plain, Charsadda from Central Plain Valley, Mansehra from Eastren Mountainous Zone and Swat was selected from Northern Mountainous Zone respectively. In second step Tehsil Paharpur from district D. I. Khan, Charsada from district Charsada, Mansehra from district Mansehra and Matta was selected from Swat district respectively. These Tehsils were selected in collaboration of Agriculture Extension Department Govt. of KP. From each tehsil union council was selected in next step. Thus, Union council Band Kurai, Baidara, Khanmai, Baffa was selected from tehsil Paharpur, Matta, Charsadda and Mansehra respectively. From each union council farmers were included in the study according to the formula for unknown population as suggested by Kasely and Kumar (1989).

$$n = \frac{Z^2 V^2}{d^2}$$

Where;
Z= Reliability coefficient (Constant)= 1.96; n= Sample size; V= 50% this is because similar studies were difficult to find and taking the assumption that 50% of the farmers will be using pesticides in their fields; d= assumed marginal error (5%).

$$n = \frac{(1.96)^2 (50)^2}{(5)^2} = 384$$

Therefore, through equal allocation formulae, 96 respondents were selected from each union council.

The selected farmers were inquired through interview schedule having open, close and partially open-ended questions regarding the precautionary measures and PPE used while using pesticides and self-reported acute poisoning cases. Before the collection of actual data, 30 farmers were investigated and Cronbach's alpha test was applied to check the reliability of the questionnaire. The Cronbach alpha value obtained was 0.831 representing good internal consistency.

Data collection

After the Cronbach alpha test, the primary data was collected from the selected farmers through interview schedule whereas secondary data was obtained from various published and unpublished sources.

Statistical analysis of data

Binary Logistic regression was utilized to find out the extent of dependency of the acute poisoning cases with the precautionary measures.

Results and Discussion

Binary regression of diseases associated with precautionary measures

The results of binary logistic regression analysis of

Table 1: *Binary Logistic Regression of Diseases associated with Precautionary Measures.*

Independent Variable	Headache		Excessive sweating		Sneezing		Cough		Nausea	
	Nagelkerke R^2=0.349 $X^2(9)$=150.11** Likelihood=253.33		Nagelkerke R^2=0.063 $X^2(9)$=18.215** Likelihood=496.47		Nagelkerke R^2=0.57 $X^2(9)$=218.37* Likelihood=313.69		Nagelkerke R^2=0.66 $X^2(9)$=249.5** Likelihood=243.39		Nagelkerke R^2=0.55 $X^2(9)$=204.61** Likelihood=321.11	
	β	Wald	β	Wald	B	Wald	β	Wald	β	Wald
Constant	19.774	31.264	-1.265	8.811	-21.260	0.002	-20.819	0.001	-19.312	0.003
TBAPU	-2.286**	18.164	-0.203 ns	0.522	-0.410 ns	1.362	-.756 ns	3.305	0.685 ns	3.358
SWS	1.668**	0.350	0.510 ns	2.304	0.492*	2.090	-.292 ns	0.494	1.915**	27.253
CCAPP	-1.207 ns	0.267	-1.210**	13.413	0.298 ns	0.822	1.296 ns	5.660	-2.217*	33.289
CNM	-0.038 ns	0.966	-0.340 ns	0.713	-0.241 ns	0.300	-.179 ns	0.115	-0.729 ns	2.526
EDWS	0.371 ns	0.31	0.286 ns	1.226	-0.825 ns	5.896	-.083 ns	0.043	0.055*	0.026
UFS	-0.104 ns	0.108	0.126 ns	0.110	18.251 ns	0.001	16.920 ns	0.021	-20.690**	4.81
UR	-1.42 ns	0.269	-0.139 ns	0.130	-4.234**	29.739	-2.726**	6.083	-1.449**	9.891
	Dizziness		Feeling Weak		Difficulty in Seeing		Diarrhea		Shortness of Breath	
	Nagelkerke R^2=0.80 $X^2(9)$=299.167** Likelihood=130.49		Nagelkerke R^2=0.28 $X^2(9)$=91.28** Likelihood=420.71		Nagelkerke R^2=0.699 $X^2(9)$= 251.719** Likelihood=196.86		Nagelkerke R^2=0.431 $X^2(9)$=144.76** Likelihood=356.78		Nagelkerke R^2=0.634 $X^2(9)$=231.168** Likelihood=248.93	
	B	Wald	β	Wald	β	Wald	β	Wald	B	Wald
Constant	-18.102	0.032	-0.132	0.417	-20.214	0.002	-20.978	0.021	0.782	0.803
TBAPU (D)	-5.643**	53.503	-1.819**	31.375	-3.058**	19.066	-0.771 ns	5.019	-1.500 ns	5.025
SWS(D)	4.300**	26.362	-093ns	0.084	.135 ns	0.091	0.506 ns	2.009	4.336**	37.482
CCAPP(D)	0.874 ns	2.211	-0.934**	8.650	2.658 ns	39.294	-1.542*	18.182	-5.769*	53.834
CNM (D)	-2.902**	15.171	-1.110**	6.959	-0.626*	1.079	-1.896**	16.494	-0.847**	.969
EDWS (D)	1.546 ns	4.943	-0.925 ns	10.749	3.532*	31.507	1.555*	20.019	-4.481 ns	30.697
UFS (D)	-0.241 ns	1.301	-2.390 ns	9.467	1.521ns	1.32	21.460 ns	2.481	-0.934**	4.617
UR (D)	-20.704**	14.312	4.035 ns	26.864	-19.908**	19.21	-0.236 ns	0.348	-0.059 ns	.019
	Chest Pain		Blisters		Burning Sensation		Body Pain		Fever	
	Nagelkerke R^2=0.722 $X^2(9)$=258.289** Likelihood=177.322		Nagelkerke R^2=0.428 $X^2(9)$=145.646** Likelihood=368.166		Nagelkerke R^2=0.631 $X^2(9)$=205.53** Likelihood=205.409		Nagelkerke R^2=0.22 $X^2(9)$=228.61* Likelihood=165.88		Nagelkerke R^2=0643 $X^2(9)$=252.6** Likelihood=279.72	
	B	Wald	β	Wald	β	Wald	β	Wald	β	Wald
Constant	-19.580	0.001	-2.297	21.331	-3.029	17.621	-2.074	2.966	-1.181	4.073
TBAPU (D)	-1.215**	6.631	0.296 ns	0.773	-0.963**	4.027	-1.225 ns	3.070	-1.059**	5.975
SWS(D)	0.809**	2.422	1.638 ns	15.308	0.743 ns	1.233	-1.379 ns	4.400	2.785**	29.490
CCAPP(D)	-3.604*	55.118	-3.612**	54.652	-.696 ns	1.289	-5.171**	73.580	-3.902**	49.727
CNM (D)	-1.583**	6.813	-3.416 ns	34.108	-2.946**	21.799	0.619 ns	.870	-2.690**	16.847
EDWS (D)	1.838**	16.469	.087 ns	0.088	0.988 ns	5.715	-2.398 ns	18.937	3.316**	65.420
UFS (D)	17.779 ns	2.38	3.630 ns	28.206	-4.947**	33.607	3.039 ns	6.355	-1.793*	5.840
UR (D)	1.246 ns	1.104	-2.940 ns	18.348	0.683 ns	0.359	-1.664 ns	2.957	-3.097**	18.318

TBAPU: *Taking Bath after Pesticide Use;* **SWS:** *Smoking While Spraying;* **CCAPP:** *Change clothes after application of pesticides;* **CNM:** *Covering Nose and mouth;* **EDWS:** *Eat or drink while spraying;* **UFS:** *Using face shield;* **UR:** *Using respirator;* **D:** *Dummy (0=No 1= Yes).*

diseases associated with precautionary measures are presented in Table 1. The regression analysis revealed that taking bath after pesticide use can highly significantly (P≤0.01) reduces the headache (-2.286), dizziness (-5.643), feeling weak (-1.819), difficulty in seeing (-3.058), chest pain (-1.215), burning sensation (-0.963), and fever (-1.059). This might be due to the fact that the pesticides content which might absorbed by the clothes came in contact with the body. Therefore, taking bath after the pesticides practices

can significantly minimize the poisoning cases. Similarly, the precautionary measures were also associated with the factor of smoking while spraying (Table 1). It was found that those who are smoking while spraying, highly significantly (P≤0.01) influenced and found victim of headache, nausea, dizziness, shortness of breath, chest pain and fever whereas others were significantly found victims of sneezing. During the application of pesticides, more specifically with the power sprayer the pesticides take the form of mist when sprayed. This mist easily enters the body of the pesticides applicator personnel/ farmer. During the smoking, the applicator regularly inhales the chemical mist due to the fact that he is not covering his mouth or nose. Our results are in in conformity with that of Manyilizu et al. (2017) who also reported that Smoking was associated with an increased incidence of chest pain, while eating and chewing gum during pesticide use was associated with increased levels of diarrhea.

Change clothes after application of pesticides (CCAPP) also highly significant reduces the adverse effects like headache (-0.221), excessive sweating (-1.210), feeling weak (-0.934), blisters (-3.612), body pain (-5.171) and fever (-3.902) whereas significantly reduces the nausea (-2.217), diarrhea (-1.542), shortness of breath (-5.769) and chest pain (-3.604) as shown in Table 1. Changing clothes was also found to be important factor in order to minimize the acute poising cases which might be due to the fact that the clothes after application of pesticides might accumulate the pesticides contents and thus results in blisters etc.

Covering nose and mouth is also considered as one of the most important precautionary measures and this covering response in relation to health concerns are given in Table 1. It was observed that covering nose and mouth had highly significantly (P≤0.01) reduces the dizziness (-2.902), feeling weak (-1.110), diarrhea (-1.896), shortness of breath (-0.847), chest pain (-1.583), burning sensation (-2.946), fever (-2.690) and difficulty in seeing (-0.626) in comparison to those who not covers the nose and mouth.

Eating and drinking in the field is common phenomena in the field by the farming community. Since they use pesticides and eat and drink as well in the field. Thus, they were investigated regarding the eating and drinking habit while they use pesticides and it was found that Eating and Drinking while spraying (EDWS) had negative highly significant (P≤0.01) contribution towards chest pain 1.838) and fever (3.316) however significant (P≤0.01) negative contribution towards nausea (-0.055), difficulty in seeing (3.532) and diarrhea (1.555) was found (Table 1). This showed that after the application of pesticides those respondents who use to eat or drink significantly affected from the chest pain, fever, nausea, diarrhea etc.

Use face shield (UFS) had also highly significant (P≤0.01) negative contribution towards nausea (-20.690), shortness of breath (-0.934), burning sensation (-4.947) whereas significant negative contribution towards fever (-1.793) was found. Moreover, UR had highly significant (P≤0.01) negative contribution towards sneezing (-4.234), cough (-2.726), nausea (-1.449), dizziness (-20.704), difficulty in seeing (-19.908) and fever (-3.097) was also found in the present study (Table 1). Using face shield and respirator is important PPE while doing pesticides practices. The instant results showed that the chances of nausea, shortness of breath, burning sensation and fever can be significantly minimized with the use of the face shield.

Conclusions and Recommendations

The instant results depicts that farmers are not cautious to the health concerns and they apply the pesticides without any precautionary measures. The poor handling includes the irregular use of PPE and other precautionary measures which significantly contribute towards the acute poisoning cases. Therefore, it is suggested that in order to minimize the poor handling practices of the farming community and increasing the farmer's knowledge about pesticides hazards, a safety educational trainings and certification programs should be developed. The trainings must include the health hazards of pesticides, safe handling, application and use of PPE. Moreover, agriculture extension department and private pesticides companies should take initiatives in order to promote safe pesticides use.

Author's Contribution

The present study was the part of PhD dissertation, the whole study was conducted under the supervision of the Prof. Dr. Khalid Nawab. The study was

designed by Prof. Dr. Khalid Nawab whereas data collection, analysis and write-up was done by Rehmat ullah. Moreover, final revision before submission was also given by Prof. Dr. Khalid Nawab.

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