ISSN : 0974 - 7451 Volume 8 Issue 3

Trade Science Inc.

Environmental Science
An Indian Journal

Current Research Paper

ESAIJ, 8(3), 2013 [106-114]

Work and health profile of farmers exposed to organophosphates, carbamates and pyrethroids

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ABSTRACT

This study tried to look into the most prevalent health problems that may be associated with pesticide exposure among farmers in the largest vegetable producing region in the Philippines, and to identify common work practices of farmers in relation to pesticide application. Using cluster sampling based on communities and zones and with significance level at p=0.05, 400 farmers were chosen for the study. Tools used consisted of 1) survey questionnaire; 2) physical examination guide for toxicological and neurologic assessments.; and 3) blood extraction of for blood cholinesterase, complete blood count and serum creatinine. Majority of the farmers used pyrethroids (70.3%), organophosphates (67.5%). and carbamates (56.8%). 41.8% had abnormal clinical diagnosis. The top three abnormal physical findings included ear problems (23.8%), oropharyngeal swelling and inflammation (21.3%) and eye problems (17%). 9.2% had abnormal neurologic exams. 17.7% had abnormal hemoglobin values, indicating anemia. 93 (23.3%) of the blood cholinesterase results were abnormal indicating organophosphate poisoning. Statistical analysis showed association of abnormal neurologic examination with certain unsafe work practices. This study has shown the health risks of pesticide exposure. It is imperative that local government push for better regulation on the use of pesticides targeting not only farmers, but also manufacturers and traders of pesticides.

KEYWORDS

Carbamtes;
Organophosphates;
Pyrethroids;
Vegetable farmers;
Blood cholinesterase;
Unsafe work practices.

INTRODUCTION

In the Philippines, agriculture has been one of the primary economic avenues contributing to about 20% to the gross domestic product. Crops comprise about 47.56% of the total agricultural sector and have contributed to about 510 billion pesos (P510B= 10 Billion USD) to the country's national income[4]. Crop damage therefore would paralyze many families so farmers rely on pesticide use for vector management due to its apparent lesser costs.

Health and environmental impacts of pesticide misuse on the other hand greatly affect the farming communities here in the Philippines negating the economic advantages of its use. Many researchers both locally and abroad have correlated the extent of direct and

indirect pesticide exposure and health hazards such as increased mortality, dermal contamination, depression in cholinesterase level, fetal abnormalities, and spontaneous abortion among pregnant women[1,6,15,18]. It is a discouraging fact though, that with knowledge of health risks, many Filipino families still perceive that crop yield outweighs the health risks associated with pesticide use.

As a solution to the hazardous problem contributed by pesticides, appropriate efforts were undertaken such as shifting to new methods like organic farming and integrated pesticide management[6]. Along with alternative methods on pest control, extensive education campaign on pesticide contamination and exposure health risks is already observed but not strongly sustained.

Benguet is a province in the northern portion of the Philippines belonging to the Cordillera Administrative Region. It has about 2,599.4 km^2 of land area with a population of 372,533. The province is known as the 'salad bowl' of the Philippines as its major crops are tubers, roots and bulbs, and leafy vegetables, stems and flowers.

The objectives of the study were to identify the most prevalent health problems that may be associated with pesticide exposure among farmers, and to identify common work practices of farmers in relation to pesticide application.

METHODS AND MATERIALS

Using cluster sampling based on communities and zones, and with significance level at p=0.05, 400 farmers were chosen for the study. Physical health examination was done for 395 respondents. Five were not examined due to non refusal to participate in the medical physical examination. Blood samples were taken from 376 respondents; the others refused blood extraction. Tools used consisted of 1) survey questionnaire with items on demographics, past and present medical histories, family medical histories, obstetric-gynecological history for females, pesticide use and practices. The interviewer guided questionnaire was conducted by research assistants/ medical doctors; 2) physical examination guide for toxicological and neurologic assessments. Twenty to thirty doctors from the regional and municipal health offices conducted the physical examination; and 3) blood extraction of ten to fifteen millimeter for blood cholinesterase, complete blood count and serum creatinine. Blood extraction was done by a licensed medical technician.

Blood samples were sent for laboratory analysis. Blood vials were transported on ice and were analyzed within 12 hours of extraction. The health and work practices data, including the physical and neurological examinations and blood examination results, were encoded and analyzed using SPSS 13.0 program, and GIS 3.2. Data were analyzed with descriptive statistics, and chi square test of independence.

Participants were informed about the nature of the study including the research objectives, purposes and goals. They were also informed about the blood extraction procedure, its purposes and risks. They were given written informed consents. Participants were also assured of the confidentiality of data. The informed consent form was duly approved by the Ethics Review Board of the University of the Philippines-National Institutes of Health and accompanied each Interview Schedule.

RESULTS

There were four hundred (400) respondents, 51.8% were males and 48.2% were females. The mean age was 46.26 (SD $\pm$ 11.52). 79.3% were married. Majority were able to finish or at least reach high school level (35.3.%). Most of the farmers have lived in their current residence for more than five years (95.2%).

Only 10.8% of the farmers were smokers with an equal number consuming 1-3 sticks per day, and 16 sticks to a pack of cigarettes/day (2.0% each). Almost half of the farmers (49%) were alcoholic beverage drinkers preferring gin (30.0%) and beer (22.5%). Only about 2 % chewed tobacco and about 4% chewed betel nut.

Only 187 respondents chose to disclose their sexual activity and about 60.43% have been sexually active for the past five years. 0.5% of the women respondents had their menarche before the age of ten. For the women, 87.56% have become pregnant and given birth. Pregnancy ranged from getting pregnant once to as much as twelve times, with a mean of four pregnancies. 7.3% of the women aborted at least once. Some congenital

abnormalities and pregnancy disorders reported were microcephaly, mental retardation, clubfoot, hydatiform mole and ectopic pregnancy. There was a total of 831 pregnancies. 92.06% of them were full term, 2.91% were preterm and 29.07% of them ended in spontaneous abortions (TABLE 1).

TABLE 1 : Percentage distribution of abortive outcomes among the female farmers (n=831)

Pregnancy Outcomes	Frequency	Percentage
pregnancies regardless of outcome	831	-
full term pregnancies	765	92.06
pre term pregnancies	5	2.91
abortions	50	29.07
pregnancy with unknown outcomes	8	4.65
ectopic pregnancies	3	1.74

Pesticide use and exposure

Three hundred eighty four (384) farmers or 96% used pesticides. Half (53.8%) also had family members working with pesticides, 17.25% of them were older children or above the age of 15, and 9.25 % were young children.

Majority of the farmers used pyrethroids (70.3%), organophosphates (67.5%). and carbamates (56.8%). Other pesticides used included organochlorides and nitrites. Fenvalerate (Sumicidine) was the most common pyrethroid at 36.4%, methamidophos (Tamaron) (41.5%) for organophosphate, and mancozeb (Dithane) for carbamate (34.6%). See TABLE 2 and 3.

TABLE 2 : Percentage of type of pesticide used by farmers in benguet (n=400)

Type of Pesticide	Yes		No	
	Freq	%	Freq	%
pyrethroid	281	70.3	117	29.3
organophosphate	270	67.5	128	32.0
carbamate	227	56.8	171	42.8
other pesticide	211	52.8	187	46.8

TABLE 3 : Percentage of type of pesticide by brand name used among farmers (n=400)

Brand name	Active ingredient	Chemical grouping	Yes		No	
			F	P	F	P
Sumicidine	Fenvalerate	Pyrethroid	137	34.3	239	59.8
Sabedong	Cypermethrin	Pyrethroid	49	12.3	327	81.8
Magnum	Cypermethrin	Pyrethroid	44	11.0	332	83.0
Karate	Lambdacyhalothrin	Pyrethroid	70	17.5	306	76.5
Bida	Lambdacyhalothrin	Pyrethroid	55	13.8	321	80.3
Tamaron	Methamidophos	Organophosphate	156	39.0	220	55.0
Selecron	Profenofos	Organophosphate	106	26.5	269	67.3
Manzate	Mancozeb	Carbamate	61	15.3	315	78.8
Cartap	Cartap	Carbamate	52	13.0	324	81.0
Dithane	Mancozeb	Carbamate	130	32.5	246	61.5
Lannate	Methomyl	Carbamate	36	9.0	340	85.0

Pesticide exposure and illness

Of the 400 respondents, 48% reported feeling sick because of work. 4.8% of the illness or complaints were perceived to be accidental, and the rest to be work-related. Occupationally related exposures occurred while applying pesticide in the field (65.8%), mixing (41.3%), loading (37%) or while cleaning the equipment or re-entering recently sprayed areas. Accidental exposure occurred for bystanders (4.5%), or during transportation of the pesticides (2.8%). Exposure occurred in their fields (54.5%), gardens (35.3%), homes (6%) or even in their storage sites (3.5%).

215 farmers had abnormal blood pressure. Majority of them (13.5%) had systolic BP $\geq$ 160 and diastolic BP $\geq$ 100 (14%).The results showed that 19.5% were hypertensive stage I having systolic BP $\geq$ 140 and diastolic BP $\geq$90. Systolic BP ranged from 80-210 with a mean of 129.59 $\pm$ 23.113; diastolic BP ranged from 19-190 with a mean of 81.2 $\pm$15.990. TABLE 4 below summarizes the blood pressure classification of the respondents.

TABLE 4 : Blood pressure classification among farmers (n=400)

Blood Pressure Classification	Number	Percentage
normal	175	43.8
abnormal	215	23.8
pre hypertensive	48	12
hypertension I	78	19.5
hypertension II	82	20.5
hypotensive	3	0.8
wide pulse pressure	4	1

279 or 69.8% had at least one abnormal physical examination finding. However, one hundred sixty seven or 41.8% had abnormal clinical diagnosis. The top three abnormal physical findings included ear problems (23.8%), oropharyngeal swelling and inflammation (21.3%) and eye problems (17%). See TABLE 5.

The mental status examination was given to assess possible mental impairment and dementia. It assessed orientation, registration, attention and calculation, recall and language. Normal patients would have scores

greater than 24. In our respondents, 88% had normal mental status, 9% have mental impairment, and about 8 people have probable dementia (TABLE 6).

TABLE 5 : Percentage of abnormal findings per body region among farmers (n=400)

Abnormal Findings per Body Region	Number	Percentage
Head	21	5.3
Eyes	68	17
Ears	95	23.8
Nose	42	10.5
Oropharynx	85	21.3
Neck	63	15.8
Chest and lungs	23	5.8
Heart	20	5
Abdomen	16	4
Extremities	47	11.8

TABLE 6 : Mental status of farmers based on the mental status Examination (n=400)

Mental Status	Frequency	Percentage
normal	352	88
mental impairment	36	9
probable dementia	8	2

Neurologic examination was also conducted, and 22 had abnormal neurologic exams. In assessing for the individual component of the neurologic exam, 363 (90.8%) individuals had normal cranial nerve function, and 22 (5.5%) had abnormal motor strength. All individuals tested for reflexes, meningeals, and autonomics were normal. Three respondents had cerebellar dysfunction characterized by dysmetria, inability to walk with feet in tandem, and difficulty maintaining balance.

Complete blood counts were done for 378 patients. Hemoglobin was normal for 265 respondents (66.3%) but 17.7% of those with abnormal values had lower hemoglobin values than normal, indicating anemia. 82.3% of the abnormal values were increased. About 1/4 (20.8%) had abnormal hematocrit values.

About 20 respondents had anemia (low hemoglobin), about 7.6% had microcytic anemia as evidenced by corresponding low MCV and low MCH values. Around 7.4% had normocytic anemia by having low hemoglobin with normal MCV and MCH values.

White blood cells are part of the body's immune system. In the respondents, 80.8% had normal WBC counts. Of those with abnormal counts, 5.57% had leukocytosis while 5.84 % had leucopenia. Platelet was abnormal in 5.5 % of the farmers. ¼ had abnormal creatinine clearance. Creatinine clearance ranged from 6.90 to 746.4 ml/min with mean of 82.2 $\pm$ 45.2. See TABLE 7 and 8. TABLE 9 shows that 93 (23.3%) of the blood cholinesterase results were abnormal.

TABLE 7 : Percentage distribution of abnormal blood laboratory results among farmers (n=400)

Blood Parameters	Normal Values	Abnormal	
		No	Percent
Red Blood Cells (RBC)	4.69-61.3 T/L	43	10.8
Hemoglobin	140-181 g/L	113	28.3
Hematocrit	400-537 L/L	96	24
mean corpuscular volume (MCV)	80-97 fL	31	7.8
MCH	27-31.2 pg	255	63.8
mean cellular hemoglobin concentration (MCHC)	310-354 g/L	96	24
White Blood cells	5-10 g/L	43	10.8
Platelet	150-424 G/L	23	5.8
Creatinine Clearance	31-133 umol/L	70	17.5

TABLE 8 : Percentage distribution of type of anemia based on MCV, MCH and MCHC values among farmers with a nemia (n=400)

Anemia Type	MCV		MCH		MCHC	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Microcytic	17	4.3	13	3.3	0	0
Normocytic	3	0.8	7	1.8	20	5
Macrocytic	0	0	0	0	0	0

TABLE 9 : Abnormal red blood cell cholinesterase (RBC) readings among farmers (n=400)

RBC	Number	Percentage
Abnormal	93	23.3
Normal	139	34.8

Chi-square and Odds ratio were used to look into association between certain unsafe work practices and related health problems documented in other studies. Weakness was associated with use of damaged backpack sprayer, spills on the back as well as spills while spraying pesticide. Easy fatiguability was associated with non- use of protective clothing, non use of face mask and dermal type of exposure. Eye problems due to pesticide exposure manifested in eye tearing, eye itchi-

ness, photophobia, eye pain and eye redness. The risk factors included use of pyrethroid, spills while mixing, spills while spraying and herbicides. Respiratory symptoms associated with pesticide exposure included breathlessness, noisy breathing, pulmonary secretions, coughing, and pain on breathing. Risk factors included non use of protective clothing. Cardiovascular symptoms noted in the study consisted of chest pain, calf pain, bradycardia, exertional dyspnea, palpitation, pillow orthopnea, exertional dyspnea, syncope, and arythmia. The risk factors associated with such symptoms included wiping sweat with a contaminated fabric, and exposure in greenhouses without vent. Symptoms of the skin or dermatological problems were skin itchiness, skin rashes, blisters, skin discoloration, skin itchiness, pallor, blisters, sweating, nail changes. The

TABLE 10 : Statistical association between risk factors and related health problems using chi square and odds ratio

Health problem	Risk factor	Chi square	Sig	Odds Ratio	95% C.I.	
					Lower	Upper
Weakness	Use of damaged backpack sprayer	4.052	0.044	1.084	0.988	1.177
	Experienced spill on back	4.196	0.041	1.097	0.999	1.205
Easy fatiguability	Non use of protective clothing	5.851	0.016	0.404	0.189	0.868
	Non use of face mask	15.246	0.000	0.691	0.575	0.830
Eye Problems –itchiness, pain, redness, tearing	Experienced spills on the back	4.590	0.032	1.122	0.992	1.270
	Experienced spills while spraying	5.829	0.016	1.121	1.003	1.255
Respiratory problems such as pulmonary secretions, copughing, pain on breathing	Non use of protective clothing	4.787	0.029	0.462	0.229	0.934
Cardiovascular symptoms such as exertional dyspnea, syncope, etc	Pyrethroid use	8.351	0.004	1.149	1.1038	1.273
	Wipe sweat with face with a contaminated piece of fabric	3.975	0.046	1.241	0.997	1.545
	Greenhouses with no vent	4.390	0.036	1.260	1.000	1.587
Skin problems such as itchiness, rashes, discoloration, blisters, etc	Use of damaged backpack sprayer	4.624	0.032	1.087	1.009	1.171
	Wipe sweat face with contaminated piece of fabric	8.392	0.004	1.352	1.101	1.659
	Reentering recently sprayed area	5.052	0.025	1.427	1.044	1.950
	Experienced spills on the back	6.236	0.013	1.117	1.024	1.218

risk factors to these were use of damaged backpack sprayer, spills on the back, re-entry to recently sprayed areas, and greenhouses with no vent. See TABLE 10.

The physical assessment was diagnosed by the attending medical and health personnel as maybe due to pesticide exposure. As such, statistical association was done to ascertain the probability of risk factors to pesticide related abnormal findings. Statistical analysis of abnormal neurologic examination revealed the following- 1) olfactory nerve is associated with lack of equipment care and improper design of sprayers; 2) ergonomic practices such as poor ventilation within greenhouses were related to abnormality in optic nerve 1; 3) Spraying against the wind's direction has significance to vestibule-acoustic nerve; and 4) glossopharyngeal & vagus nerve and spinal accessory were associated with improper cleaning sprayers and devices in creeks and pesticide application in fields, respectively. See TABLE 11.

TABLE 11: Statistical association between risk factors and neurological exam findings using chi square and odds ratio

Risk factors	Cranial Nerve	Chi square	Odds ratio	95% C.I	
				Lower	Upper
Equipment care	Olfactory	8.770	0.157	0.049	0.501
Improper design of sprayers	Olfactory	4.824	0.449	0.274	0.735
Greenhouses with no vent	Optic Nerve (Fundus)	4.615	3.323	0.574	19.246
Spraying against wind direction	Vestibulo-acoustic	7.800	0.265	0.109	0.647
Improper cleaning sprayer and devices in creek	Glossopharyngeal and Vagus	6.997	0.123	0.094	0.162
Pesticide Application in the field	Spinal accessory	4.078	0.195	0.156	0.244

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DISCUSSION

The demographic profile shows an almost equal distribution of males and females indicating that farming is done by both gender. Rola[20] emphasized that farming in the region is family based, that is, more family members are involved in the industry rather than hired help or hands.

41.8% reported living within 1-50 meters away from the plantation. This is a relevant finding since proximity to farms increases pesticide concentration within inhaled areas as supported by the study of Kawahara et al.[14]. They said that outdoor and indoor concentrations of applied pesticide were shown to increase with decreasing distance from the pesticide-applied farm and led to illnesses.

The medical history of the respondents is consistent with Philippine data on morbidity citing cardiovascular disease as the number one cause of morbidity in the country. The incidence of diabetes is also rising probably due to better reporting of the disease and simple methods of diagnosis.

For the women respondents, obstetric and gynecological problems were also apparent in the survey. 7.3% of the women had abortive outcomes. Some congenital abnormalities and pregnancy disorders reported include microcephaly, mental retardation, clubfoot, hydatiform mole and ectopic pregnancy. It was found that infertility is more common in women involved in agriculture and those who live in farms. The study of Beam in 2004 reported that babies born to women with high levels of pesticides in their blood are lighter than babies who had not been exposed to the chemicals. In China's rural Anhui province, it was indicated that at DDT concentrations present in young women there, the pesticide can affect both menstrual cycles and can cause miscarriages in the first few weeks of pregnancy. Aside from abortion, there is also an increased risk of childhood leukemia and orofacial clefts in their children[17,21].

In this study, 9% of the children with ages less than 15 years old were exposed to pesticide use. Guillette et al.[10] conducted a study on effects of pesticide exposure on preschool children in Mexico. While children exposed to pesticides were not different anthropometrically from children who were not, there were significant psychological and physiological differences. Children who were exposed had less generalized physical endurance, decrease in ability to catch a ball, lesser fine eye hand coordination, difficulty grasping the concept of repeating the numbers, 30 minute recall and ability to draw persons.

Organophosphates, carbamates and pyrethroid pesticides were the most commonly used type of pesticides among the farmers. Researches showed that data on most frequently used pesticide seem to be changing. In the study of Clarke et al.[5], in Ghanna, organophosphates were the most commonly used pesticides followed by carbamates and organochlorines. A study done locally by Baurdoux, et.al.[2] also found prevalent use of and easy access to pesticides classified by the WHO as highly or moderately hazardous and some pesticides tagged for restricted use by Environmental Protection Agency among farmers in the Cagayan Valley.

Of the 400 respondents, about 192 or 48% reported feeling sick because of work. 23.8% of the farmers showed abnormal blood pressure. Elevated BP was found among residents who experienced roadside spill of a toxic pesticide compared to those from a nearby but unexposed town.

Meanwhile, 17% showed eye problems such as unreactive pupils, scarred cornea, pterygium and pale palpebral conjunctiva. Sluggish pupillary reactions can indicate that there is an abnormality in either the optic nerve or the oculomotor nerve. The optic nerve is responsible for light perception while the oculomotor nerve is responsible for the motor control of the pupillary con-

stricting muscles. Abnormalities in either cranial nerve may be caused by injury to the nucleus of the nerve such as in cases of cerebrovascular accidents or stroke; it can also be caused by electrolyte abnormalities or intoxication. However, in a study by Jaga et al, abnormalities have been observed in the conjunctiva, lens, retina and optic nerve among Japanese people who live in areas with vast use of organophosphate pesticides. This is described as Saku disease which is an optico-autonomic peripheral neuropathy.

15.8% showed cervical lymphadenopathies. Cervical lymphadenopathy is a non specific response of the body to an infection either in the face, head, neck, chest or lungs. Anterior neck masses, most commonly indicative of goiter tend to reflect a population whose diet is lacking or competes with the absorption of iodine.

Also, impaired mental status is consistent with the findings of Kamel and Hoppin[13] on those exposed to pesticides.11% showed mental impairment and possible dementia. Chronic pesticide exposure, particularly organophosphate, is associated with neurological deficits in terms of alterations in mood, cognitive impairment and occurrence of suicidal ideation.

20.8% of the respondents have abnormal hematocrit value. Hematocrit reflects concentration of packed red blood cells volume. It increases in cases of dehydration or increased cellularity of blood. The mean corpuscular volume or MCV is an index of RBC size and computed by dividing the hematocrit over the RBC count. The mean cellular hemoglobin concentration (MCHC) is the average concentration of hemoglobin in a given volume of red blood cells; the mean corpuscular hemoglobin (MCH) is the weight of hemoglobin of the average red blood cell. All three give an insight into the type of anemia a person has if present. Although, there are abnormalities found in the values of some of the respondents compared with the index or reference, their significance lies in identifying possible etiology of anemia.

Also, 7.6% and 7.4% have microcytic and normocytic anemia, respectively. Microcytic anemia is most commonly caused by iron deficiency through inadequate intake, poor absorption, excessive iron requirements, or chronic blood loss. Normocytic anemia is seen among patients who is experiencing acute blood loss, hemolytic disorders, or who has been suffering from a chronic disease.

In Thailand, pesticide use has been correlated with the occurrence of aplastic anemia. Aplastic anemia is defined as a total reduction in blood cells with a corresponding hypocellular marrow. In the study, there is a relative risk estimate of 2.1 for organophosphates and 6.4 for DDT and 7.4 for carbamates[11].

In our patients however, most of those with anemia at the time of extraction did not exhibit pancytopenia, making aplastic anemia an unlikely impression. Increases in hemoglobin, hematocrit, and RBC may be reflective of polycythemia secondary to high altitude. Benguet province is 5000m above sea level. As the altitude increases, the atmospheric pressure decreases. This means that the oxygen pressure in air also decreases which in turn leads to a decrease in the capacity of red blood cells to bind oxygen. The human body adapts to this by increasing the volume of erythrocytes or red blood cells.

Certain hematological parameters were also abnormal, namely hemoglobin, hematocrit, and eosinophil count. These laboratory findings are similar to those found by Svoboda[23].

93 farmers have abnormal cholinesterase levels. Cholinesterase actually corresponds to two enzymes – acetylcholinesterase and butyrylcholinesterase (also called plasma cholinesterase). The activity of cholinesterase enzymes in the blood can be utilized as a biomarker for the effect of organophosphates. An exposed person will show abnormally low levels of activity of cholinesterase enzymes measured in the serum or in red blood cells (as RBC cholinesterase). The latter is more closely correlated with cholinesterase activity in the nervous system[24].

Many other hematologic changes secondary to acute and chronic pesticide exposure have been documented in both humans and animals[16,22]. Pesticides have been shown to have hematotoxic properties and may cause aplastic anemia, agranulocytosis, neutropenia, and thrombopenia[19]. In rats, Fujitani, et.al.[8] found that subchronic exposure to chlopropham induced dose-dependent, although reversible methemoglobinemia, anemia, splenomegaly and pathological lesions indicating hemolytic anemia. Irreversible changes included increased hemosiderin deposition and splenic capsular fibrosis. Far more serious and long-term consequences

have been seen in humans by Khristeva and Mirchev[8]. They found that both acute and chronic exposure to toxic doses of pesticides as well as drugs and heavy metals may induce hematologic congenital abnormalities, particularly G6PD deficiency and thalassemia.

This study was cross sectional in nature. A longitudinal and case control study is a better study design to differentiate exposures between cases and controls. This study can serve as baseline information for health symptoms and health problems that may be associated with pesticide exposures.

The physical examination shows abnormal findings that may or may not be attributable to pesticide exposure. This was addressed in the paper through statistical analysis with level of confidence set at p=0.05.

CONCLUSIONS

Pesticide is a useful chemical in the prevention of crop losses. However, its harmful effects may be minimized if it is properly used.

Most of the symptoms reported by the respondents seem to be of the acute type. But chronic exposure to pesticide causes neurologic and mental deficits. While there is an improvement in terms of safety practice compared to that described by Rola in 1989 and by Cheng and Bersamina in 1994 in the same area, many changes are still necessary to promote safety in handling pesticides.

This study has shown the health risks of pesticide exposure as well as the risk factors associated with it. It is imperative that local government in the country push for better regulation on the use of pesticides targeting not only farmers, but also manufacturers and traders of pesticides. For the farmers, information dissemination can be done on work safety and occupational health standards to lower pesticide exposure. This includes proper care of backpack sprayer to prevent leaks, proper labeling, not spraying against the wind, proper design of greenhouse and proper body mechanics. These are simple and ingenuous ways of lowering exposures. The use of integrated pesticide management should also be encouraged.

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