Effects of Safety Behaviours with Pesticide Use on Occurrence of Acute Symptoms in Male and Female Tobacco-growing Malaysian Farmers

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Abstract: The effects of safety behaviours associated with pesticide use on the occurrence of acute organ symptoms in 395 male and 101 female tobacco-growing farmers in Malaysia were studied. We used a 15-questionnaire checklist on safe pesticide-use behaviours and a 25-questionnaire checklist on acute organ symptoms reported shortly after spraying pesticides. Results of stepwise multiple linear regression analysis indicated that no smoking while spraying, good sprayer-condition, and changing clothes immediately after spraying significantly prevented occurrence of acute symptoms just after pesticide spray in male farmers; in female farmers, only wearing a hat while spraying significantly prevented the symptoms. Safety behaviours in pesticide use in male and female tobacco-growing farmers are discussed in the light of these findings.

Key words: Pesticide poisoning, Safety behaviour, Organ symptom, Tobacco-growing farmer, Gender difference, Occupational Health, Developing Country

Introduction

In developing countries, pesticides are the most hazardous chemicals in the workplace. Organophosphates, carbamates and pyrethroids are commonly used by agricultural workers for crop protection. Occupational exposure to these pesticides occurs through poor hygiene practices and lack of proper personal protective equipment (PPE). Poor hygiene practices such as use of leaking pesticide sprayer and prolonged bodily contact with pesticides would lead to excessive dermal, pulmonary and intestinal absorption, thereby resulting in occurrence of acute poisoning. Also, absence or improper use of PPE such as rubber gloves, coverall, facemask and head cover, could lead to acute pesticide exposure¹⁾.

At the moment, very few epidemiological studies have been conducted to examine the effects of safety behaviours on occurrence of acute pesticide poisoning²⁻⁷⁾. Previous reports on pesticide toxicity in tobacco-growing farmers in Malaysia have revealed that more than one-third of farmers suffered from the acute symptoms⁸⁻¹⁰⁾.

In the present study, we assess the effects of safety behaviours associated with pesticide use on the occurrence of acute symptoms in male and female tobacco-growing farmers in Kelantan, Malaysia.

Subjects and Methods

Subjects

In 1993, there were 5000 tobacco-growing farmers registered in 3 sub-districts of Perupok, Telong and Repek

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Table 1. 395 male and 101 female tobacco-growing farmers examined

Variables		Males		Females		Difference (P-value) ^a
		Mean (SD)	No (%)	Mean (SD)	No (%)	
Demographic:	Age (yr)	43.4 (14.8)		43.0 (10.9)		NS
	Education					<0.05
	None (0 yr)		129 (32.7)		47 (46.5)	
	Primary school (6 yr)		195 (49.4)		44 (43.6)	
	Secondary school (11 yr)		71 (18.0)		10 (9.9)	
	Employment					NS
	Employed		111 (28.1)		23 (22.8)	
	Self-employed		284 (71.9)		78 (77.2)	
	Smoking					< 0.001
Occupational:	Not		96 (24.3)		87 (86.1)	
	Yes		299 (75.7)		14 (13.9)	
	Employment (yr)	9.4 (7.9)		12.3 (8.0)		< 0.001
	Spray per season (No)	9.9 (2.9)		10.0 (2.7)		NS
	Spray per week (No)	1.2 (0.5)		1.2 (0.4)		NS
	Spray per day (No)	2.2 (0.9)		2.0 (0.8)		< 0.05
Present illness:	Pesticides used (No)	2.2 (0.5)		2.2 (0.5)		NS
	Hypertension		25 (6.3)		11 (10.9)	NS
	Diabetes mellitus		7 (1.8)		3 (3.0)	NS
	Asthma		33 (8.4)		5 (5.0)	NS
	Skin disease		34 (8.6)		11 (10.9)	NS

^a χ^2 test for education, employment, smoking, hypertension, diabetes mellitus, asthma and skin disease; Student's *t* test for all others; NS = *p*>0.05.

of Bachok District, Kelantan, Malaysia. A 10% random sample of farmers, stratified by the selected sub-districts and sex, was chosen. From July 1 to December 31, 1993, 500 farmers (396 males and 104 females) were recruited. The farmers were contacted through local officers of the National Tobacco Board in each sub-district and through direct approaches at the work place. These contacts and approaches were mediated and supported by the local Tobacco Planters Association of which the farmers were members. According to the farmers interviewed, approximately 30% of tobacco farmers belong to the local Tobacco Planters Association. The purpose of the study was explained and their informed consents were obtained.

Questionnaire studies

We developed and pre-tested structured questionnaires on pesticide use and acute symptoms of pesticide poisoning in the local Malaysian language. There were three sections in the questionnaires: (1) four demographic and five occupational characteristics, and four present illness (Table 1), (2) fifteen safety behaviours associated with pesticide use (Table 2 and Appendix 1), and (3) twenty-five organ symptoms associated with pesticide use (Table 3 and Appendix 2). The questionnaires on safety behaviours were

based on the World Health Organization reports^{11, 12)} concerning pesticide use in agriculture. Also, those on organ symptoms were based on acute symptoms commonly reported^{13–19)} and validated^{7–10, 20–24)} in various studies of organophosphate, carbamate and pyrethroid poisonings. A list of the types of pesticides used by farmers is given in Appendix 3. Methamidophos, acephate, cypermethrin, chlorothalonil and dithiocarbamate were the principal pesticides used on tobacco farms⁸⁾.

Trained interviewers administered the questionnaires to the farmers either before commencement of their work, during rest periods, or at home. Of the 500 questionnaires administered and collected, 4 were excluded because of incomplete replies; the remaining 496 questionnaires (395 males and 101 females) were used in the present study. The study was approved by the Research and Bioethics Committee of the School of Medical Sciences, University of Science Malaysia.

Statistical analysis

Gender differences in demographic and occupational characteristics and present illness were analysed by Student's *t* test for continuous data and by chi-square test for categorical data. Also, those in safety behaviours and organ symptoms

Table 2. Differences in prevalence of safety behaviours associated with pesticide use between 395 male and 101 female tobacco-growing farmers

Safety behaviours	Males ^a		Females ^a		Differences ^b	
	No	(%)	No	(%)	χ^2 test	ANCOVA
Use device	292	(73.9)	80	(79.2)	NS	NS
Wear facemask	223	(56.5)	46	(45.5)	NS	NS
Wear boots	271	(68.6)	59	(58.4)	NS	NS
Wear gloves	263	(66.6)	70	(69.3)	NS	NS
Wear hat	373	(94.4)	87	(86.1)	< 0.01	< 0.01
Wear goggles	44	(11.1)	5	(5.0)	NS	NS
Wear shirt	392	(99.2)	99	(98.0)	NS	NS
Wear long pants	389	(98.5)	88	(87.1)	< 0.001	< 0.001
Not drink	389	(98.5)	100	(99.0)	NS	NS
Not eat	389	(98.5)	100	(99.0)	NS	NS
Not smoke	377	(95.4)	98	(97.0)	NS	NS
Bathe	385	(97.5)	99	(98.0)	NS	NS
Wash hands/face	298	(75.4)	71	(70.3)	NS	NS
Good sprayer-condition	356	(90.1)	93	(92.1)	NS	NS
Change clothes	295	(74.7)	57	(56.4)	< 0.001	< 0.001

^a No=Number of 'yes' responses; % = Percentage of 'yes' responses. ^b ANCOVA=Analysis of covariance controlling for education, smoking, duration of employment, and number of pesticide spray per day; NS = $p > 0.05$.

were tested by chi-square test with Yates' correction for continuity; Fisher's exact test was used when applicable. The analysis of covariance (ANCOVA) was conducted to compare safety behaviours and organ symptoms between male and female farmers, controlling for education, smoking, years of employment, and hours of pesticide spray per day; dummy variable coding was used for each of the 15 safety behaviours and 25 organ symptoms ('yes' = 2, 'no' = 1).

To determine the effects of safety behaviours on organ symptoms in male and female farmers, we conducted stepwise multiple linear regression analysis in which age was always included in the regression model and all other independent variables were entered and removed at $p < 0.05$. In male farmers, we first selected the following 21 independent variables which had significant correlations with dependent variables (numbers of organ symptoms) in univariate analysis at the significance level of $p < 0.1$; 13 safety behaviours (use device, wear facemask, wear boots, wear goggles, wear shirt, wear long pants, not drink, not eat, not smoke, bathe, wash hands/face, good sprayer-condition, and change clothes), 2 demographic (education and employment), 3 occupational (employment, spray per week, and number of pesticides), and 3 present illness variables (hypertension, asthma, and skin disease). Similarly, in female farmers, 17 independent variables were selected: 9 safety behaviours (use device, wear facemask, wear boots,

wear hat, not drink, not eat, not smoke, wash hands/face, and change clothes), 2 demographic (employment and smoking), 3 occupational (employment, number of spray per week, and number of pesticides used), and 3 present illness variables (hypertension, asthma, and skin disease). Categorical variables were coded as dummy variables ('yes' = 2 and 'no' = 1). Then, using these variables as independent ones, stepwise multiple regression analyses were conducted with the numbers of symptoms in each organ system as dependent variables.

All analyses were carried out using SPSS version 6.1²⁵ in the Department of Public Health and Occupational Medicine, Graduate School of Medicine, The University of Tokyo.

Results

Differences in prevalence of safety behaviours associated with pesticide use between 395 male and 101 female tobacco-growing farmers are shown in Table 2. Proportions of wearing hat, wearing long pants, and changing clothes were significantly higher in male farmers than in female farmers (analysis of covariance). Also, differences in prevalence of organ symptoms associated with pesticide use in 395 male and 101 female tobacco-growing farmers are shown in Table 3. The differences were not significant when analysed by

Table 3. Differences in prevalence of organ symptoms associated with pesticide use between 395 male and 101 female tobacco-growing farmers

Symptoms		Males ^a		Females ^a		Differences ^b	
		No	(%)	No	(%)	χ^2 test	ANCOVA
Central nervous system:	Dizziness	139	(35.2)	35	(34.7)	NS	NS
	Headache	60	(15.2)	16	(15.8)	NS	NS
	Confusion	62	(15.7)	13	(12.9)	NS	NS
	Blackout	28	(7.1)	7	(6.9)	NS	NS
	Unusual tiredness	28	(7.1)	5	(5.0)	NS	NS
	Nervousness	24	(6.1)	8	(7.9)	NS	NS
	Fainting	4	(1.0)	4	(4.0)	NS	NS
	At least one symptom	203	(51.4)	48	(47.5)	NS	NS
Digestive:	Bitter taste	109	(27.6)	35	(34.7)	NS	NS
	Nausea	64	(16.2)	18	(18.1)	NS	NS
	Increased salivation	26	(6.6)	2	(2.0)	NS	NS
	Stomach cramps	22	(5.6)	3	(3.0)	NS	NS
	Bloating	8	(2.0)	1	(1.0)	NS	NS
	Anorexia	5	(1.3)	2	(2.0)	NS	NS
	Diarrhoea	5	(1.3)	0	(0.0)	NS	NS
	At least one symptom	164	(41.5)	44	(43.6)	NS	NS
Respiratory:	Cough	93	(23.5)	16	(15.8)	NS	NS
	Chest tightness	53	(13.4)	7	(6.9)	NS	NS
	Shortness of breath	45	(11.4)	10	(9.9)	NS	NS
	Runny nose	27	(6.8)	3	(3.0)	NS	NS
	Wheeze	19	(4.8)	3	(3.0)	NS	NS
	At least one symptom	137	(34.7)	23	(22.8)	<0.05	NS
Eye:	Runny eyes/tearing	76	(19.2)	27	(26.7)	NS	NS
	Blurred vision	50	(12.7)	6	(5.9)	NS	NS
	At least one symptom	105	(26.6)	27	(26.8)	NS	NS
Skin:	Skin rash	52	(13.2)	8	(7.9)	NS	NS
	Facial burning	30	(7.6)	8	(7.9)	NS	NS
	Tingling	25	(6.3)	4	(4.0)	NS	NS
	Numbness	16	(4.1)	5	(5.0)	NS	NS
	At least one symptom	92	(23.3)	19	(18.8)	NS	NS
Total:	At least one symptom	317	(80.3)	70	(69.3)	<0.05	NS

^{a, b} As in Table 2.

ANCOVA controlling educational career, smoking, duration of employment and number of pesticide spray.

Results of stepwise multiple linear regression analysis on the effects of 15 safety behaviours, 4 demographic, 5 occupational, and 4 present illness variables on number of organ and total symptoms in 395 male and 101 female farmers are shown in Table 4. In males, no smoking while spraying was inversely related to total and respiratory symptoms. Also, in males, good sprayer-condition was inversely related to total symptoms and central nervous system, digestive, eye and skin symptoms; changing clothes was inversely related to total and respiratory symptoms. On the other hands, in females, wearing hat was inversely related to total and skin

symptoms. Figures 1 and 2 illustrate the effects of those safety behaviours on total number of symptoms in male and female farmers.

Discussion

Results of stepwise multiple linear regression analysis indicated that no smoking, good sprayer-condition, and changing clothes are most important safety behaviours for prevention of the occurrence of acute symptoms just after pesticide spray in male farmers; on the other hand, in female farmers, wearing a hat is most important.

No smoking significantly prevented occurrence of

Table 4. Effects of safety behaviours and demographic, occupational and present illness variables (independent variables) on numbers of total and organ symptoms (dependent variables) in 395 male and 101 female tobacco-growing farmers: Stepwise multiple linear regression analysis

Dependent variables ^a	Males		Females	
	R ^b	Independent variables selected ^c	R ^b	Independent variables selected ^c
Total symptoms	0.25	Not smoke (-0.16)** Good sprayer-condition (-0.15)** Change clothes (-0.10)*	0.17	Wear hat (-0.17)*
Central nervous system symptoms	0.14	Good sprayer-condition (-0.14)**	0.24	No of pesticide (0.24)*
Digestive symptoms	0.23	Wash hands/face (-0.17)** Good sprayer-condition (-0.15)**	0.28	Wear facemask (-0.26)*
Respiratory symptoms	0.32	Not smoke (-0.12)* Change clothes (-0.11)*		
Eye symptoms	0.22	Good sprayer-condition (-0.15)**	0.20	Not smoke (-0.20)*
Skin symptoms	0.23	Wear facemask (-0.18)** Wear gloves (-0.14)** Good sprayer-condition (-0.12)*	0.31	Wear hat (-0.23)* Change clothes (-0.22)*

^a Number of symptoms. ^b Multiple regression coefficient. ^c Total number of independent variables tested was 21 for males and 17 for females as in Statistical Analysis of the text; figures in parentheses denote standardized partial regression coefficients. * $P < 0.05$, ** $P < 0.01$.

Fig. 1. Differences in total number of symptoms between male tobacco-growing farmers with and without safety behaviours.

Numbers of farmers are shown in parentheses. Values are means $\pm$ SD. P values are based on the Student's *t* test.

respiratory and total symptoms in male farmers. Smoking while spraying could increase the absorption of pesticides through inhalation of both the airborne particles and through oral ingestion of the particles attached to cigarettes. Smoking while spraying pesticides could also exacerbate underlying respiratory diseases such as bronchitis and asthma by delivering irritating smoke and pesticide aerosols to the

respiratory airways. The pesticides inhaled could cause respiratory symptoms and then systemic symptoms after absorption. Special efforts should be made to curb Malaysian farmers from smoking while spraying in order to prevent occurrence of effects of pesticides.

Using pesticide sprayer in good condition significantly prevented digestive, central nervous system and total

Fig. 2. Differences in total number of symptoms between female tobacco-growing farmers with and without safety behaviours.

Numbers of farmers are shown in parentheses. Values are means $\pm$ SD. P values are based on the Student's *t* test.

symptoms also in male farmers. Leakage of pesticide during pesticide spray is a serious problem among agricultural workers in developing countries^{7, 8, 24, 26–29}. Socio-economic factor has been cited as the main reason for poor maintenance of pesticide sprayers²⁴. Pesticides leaking through sprayers' defects could cause local symptoms in the skin, eyes and digestive organs through body contact and oral ingestion as well as central nervous system symptoms through absorption^{8, 9}. We should advise the National Tobacco Board of Malaysia to provide those farmers with regularly subsidized spray maintenance program in order to use sprayers in good conditions as the farmers are using defective spray devices due to high costs for repair and maintenance of sprayers⁸.

Changing clothes immediately after pesticide spray significantly prevented respiratory and total symptoms in male farmers. This is consistent with data in Indonesian farmers, in which farmers wearing clothes soaked with pesticides reported a greater number of symptoms compared with those wearing clothes not soaked⁷. Delay in changing clothes could result in longer duration of body contact with pesticides and thus increase the risk of inhalations from the lungs and absorption of pesticides from the skin area. The quality of clothing worn could also be important in determining the extent of pesticide absorption since material of poor quality could potentially allow greater pesticide penetration and hence skin absorption. Therefore, knowledge

on the potential risk of prolonged bodily contact with pesticides through delay in changing clothes should be fully explained to farmers.

On the other hand, in female farmers, wearing hat was inversely related to skin and total symptoms. Many women in tropical countries perceive their head cover worn for religious purposes as adequate protection from the adverse effects of pesticides^{8–10}. These head covers were made of thin cotton that could be easily penetrated by pesticides deposited while spraying. Wearing a proper hat while spraying would protect them against deposition of pesticides on their head and neck, thus preventing the cutaneous and systemic effects. Religious and health authorities are also advised to develop a health education program on using PPE such as a hat for female tobacco-growing farmers.

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Appendix 1. Checklist of safety behaviours associated with pesticide use

Please answer 'yes' or 'no' to the following questions:

Safety behaviours	Abbreviations
1. Do you usually use device for mixing pesticide?	Use device
2. Do you usually wear facemask while spraying?	Wear facemask
3. Do you usually wear long boots while spraying?	Wear boots
4. Do you usually wear rubber gloves while spraying?	Wear gloves
5. Do you usually wear hat while spraying?	Wear hat
6. Do you usually wear goggles while spraying?	Wear goggles
7. Do you usually wear long sleeve shirt while spraying?	Wear shirt
8. Do you usually wear long pants while spraying?	Wear long pants
9. Do you usually drink water and/or other beverage while spraying?	Not drink
10. Do you usually eat while spraying?	Not eat
11. Do you usually smoke tobacco while spraying?	Not smoke
12. Do you usually bathe immediately after spraying?	Bathe
13. Do you usually wash your hands and face immediately after spraying?	Wash hands/face
14. Do you usually use pesticide sprayer in good condition for spraying?	Good sprayer-condition
15. Do you usually change your clothes immediately after spraying?	Change clothes

Appendix 2. Checklist of symptoms associated with pesticide use

Please indicate whether you experience each of the symptoms below during or shortly after you have completed spraying pesticide in the tobacco farm.

Symptoms	Response
1. Runny eyes/tearing	Yes/No
2. Blurred vision	Yes/No
3. Runny nose	Yes/No
4. Increased salivation	Yes/No
5. Nausea	Yes/No
6. Stomach cramps	Yes/No
7. Bloating	Yes/No
8. Diarrhoea	Yes/No
9. Anorexia	Yes/No
10. Cough	Yes/No
11. Shortness of breath	Yes/No
12. Chest tightness	Yes/No
13. Wheezing	Yes/No
14. Nervousness	Yes/No
15. Unusual tiredness	Yes/No
16. Confusio	Yes/No
17. Dizziness	Yes/No
18. Headache	Yes/No
19. Blackout	Yes/No
20. Fainting	Yes/No
21. Skin rash	Yes/No
22. Tingling	Yes/No
23. Numbness	Yes/No
24. Bitter taste	Yes/No
25. Facial burning	Yes/No

Appendix 3. Types of pesticides used by tobacco-growing farmers

No	Group	Brand	Active Ingredient	Content
<i>Insecticide</i>				
1.	Methamidophos	Super Tamaron, Special Tamaron	Methamidophos	70.0%
2.	Acephate	Promax, Otin S75, Halex Acephate	Acephate	75.0%
3.	Thuringiensis	Bee Tee	Tharingien	16,00(K)
4.	Synthetic Pyrethroid (First Generation)	Budgster	Cypermethrin	5.66%
5.	Pyrethroid (Second Generation)	Fastac	Alpha-Cypermethrin	2.27%
<i>Fungicide</i>				
6.	Mancozeb + Carbendazim	Delsene MX200	Mancozeb + Carbendazim	73.8% 6.2%
7.	Maneb	BM Maneb Promaneb	Dithiocarbonate	80.0%
8.	Chlorothalonil	Daconil 500	Chlorothalonil	40.5%
9.	Propanocarb. Dichloride	Previcure N	Propanocarb.dichloride 70%	66.5%
10.	Difenoconazole	Score 250EC	Difenoconazole	25.0%
<i>Herbicide</i>				
11.	Pre-sprouting	Devrinol	Nepropamide	21.8%
12.	Post-sprouting	Drago	Flufenacet	60.0%
<i>Fumigant</i>				
13.	Dazomet	Basamid	Dazomet	98.0%
<i>Bud Toxicant</i>				
14.	Contact	Hading	Fatty Alcohol	85.0%
15.	Localised	Tamex	Butralin	36.4%
	Systemic	Acrotab	Pendimethalin	34.0%
<i>Nematocide</i>				
16.	Fenamiphos	Nemacur 3 G	Fenamiphos	10.0%
17.	Carbofuran	Halex	Carbofuran	3.0%