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Farm Workers' Knowledge, Habits and Health Issues Associated with Pesticide Use

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Abstract

Although pesticides are used to mitigate crop losses by pests, farm workers' poor knowledge and bad habits during application may cause serious health consequences. This study investigates the knowledge and habits of farm workers in the Sultanate of Oman and how these are related to the self-reported acute symptoms caused by pesticide exposure. A total of 153 pesticide workers in Al Batinah Region of Oman were interviewed face to face about their pesticide knowledge, habits and self-reported acute symptoms. About 57% of the farm workers either had no formal education or had only some primary school education, and 80% had no knowledge of warning labels and the names of banned pesticides. There was a significant difference ($p < 0.001$) in self-reported symptoms among those 20 years or less and those 50 years or older. Among those that did not attend school, 85% reported pesticide related symptoms compared to 55% among those who completed secondary education. Self-medication was the commonly used treatment option (42%), followed by local pharmacy (35%), private clinic (14%) and government hospital (9%). Reduction in pesticide related health symptoms could be achieved by mandatory training of farm workers on the use of personal protection equipment, as well as the enforcement of legislation to restrict the availability of the most hazardous pesticides, and the promotion of non-chemical methods of pest control.

Keywords: Pesticides, knowledge, habits, acute symptoms, Oman

1. Introduction

Pesticides are widely used in most sectors of agricultural production to prevent or reduce losses by pests (Cooper and Dobson 2007). However, this is not without costs, as the World Health Organization (WHO) and the United Nations Environmental Program estimate that there are one to five million cases of pesticide poisoning each year, with about 20,000 fatalities (WHO 1990). The biggest impacts among human populations have been on the farmers who face the occupational hazards of working with, and often living in close proximity to these toxic agents (Kedia & Palis (2008).

In many developing countries, pesticide use is unregulated either because no pesticide laws exist or are not enforced. Nausea, dizziness, vomiting, blurred vision, headaches, skin irritation, chest pain and breathlessness are some of the acute toxic symptoms associated with pesticide exposure and may appear immediately or within 24 hours of exposure (Ecobichon, 2000). On the other hand, chronic pesticide related symptoms such as cancer, depression, neurological deficits, miscarriages and birth defects may not appear until several years after exposure to a pesticide (Ecobichon, 2000). The causes of chronic illnesses are particularly difficult to document because the illness takes many years to develop, and may result from exposure to multiple pesticides (or other environmental toxins) at multiple times and locations (Strong et al. 2004).

In Oman, the Al Batinah Region produces most of the nation's dates, fruits and vegetables, and although pesticides are widely used in this Region, information about farm workers' pesticide knowledge and their habits during and after pesticide applications is very scanty. The present study which investigates the knowledge and habits of farm workers and how these impact their self-reported acute symptoms is an attempt to fill this information gap.

2. Methods

The study was conducted between October 2008 and February 2009, a period coinciding with the planting season in Al Batinah Region of Oman. Following an approval by the Texas Southern University Committee for Protection of Human Subjects, a standardized questionnaire was prepared in order to obtain data on farm worker' pesticide knowledge and habits, as well as the acute health symptoms experienced during the period of pesticide application. The questionnaire was divided into four sections. The first section focused on demographic characteristics, such as age, marital status, years of education and years of pesticide work. The second section addressed the subjects' knowledge of the importance of reading warning labels; the names of banned pesticides; the routes of entry of pesticides into the human body; the usefulness of pesticide training; and the fate of pesticide residues. The third section was about their habits during and after pesticide application. They were asked whether they smoked cigarette, chewed gum, ate or drank any liquid during application; whether or not they applied the recommended pesticide concentration; and whether personal protection equipment (PPE) was used. Regarding post- application habits, the respondents were asked whether or not they showered immediately after pesticide application; and whether they changed and washed their work clothes separately from other clothes. Finally, in the fourth section, the subjects were asked to provide a list of all pesticides used

and the acute toxic symptoms experienced since the onset of pesticide application in the past three months. Copies of the questionnaire were administered to a total of 153 randomly selected farm workers by trained extension officers in the Ministry of Agriculture, followed by a face to face interview. Prior to the interview, the subjects were briefed about the objectives of the study and were assured that their responses would be treated with confidentiality

The Chi-square analysis was used to determine the significance of differences between two or more categorical variables. The Yate's correction factor was applied where not more than 20% of the cells had an expected frequency of less than five. All analyses were done with the Statistical Package for Social Sciences (SPSS, Chicago, IL, USA).

3. Results

The farm workers were relatively young, 8% being less than 20 years old and 39% were between 21 and 30 years old (Table 1).

Table 1. Farm workers' demographics (n =153)

Characteristics	No. of farm workers n(%)
Age (years)	
20 or less	12 (8)
21 - 30	60 (39)
31 – 40	41 (26)
41 – 50	30 (20)
50 or more	10 (7)
Education level	
Did not attend school	13 (9)
Some primary school	72 (47)
Completed primary school	14 (9)
Some secondary school	43 (28)
Completed secondary school	11 (7)
Years of pesticide work	
>10	62 (40)
8-10	35 (23)
5-7	33 (22)
2-4	20 (13)
<1	3 (2)

Only 7% of the group were 50 years or older. The literacy level of the workers was low, as 56% of them either had no formal education or had only some primary education. Secondary education was completed by a paltry 7%. Regarding work experience, a majority of them (63%) had been on the job for 8 years or more, while those with 4 years or less of service constituted about 15%.

Out of a total of 28 pesticides, 14, including Edosulfan used by 45% of the workers, have been banned by the government of Oman (Table 2).

Table 2. Pesticides frequently used by farm workers in Oman (n =153)

Pesticide	WHO grade*	Chemical class	Legal Status in Oman	Number of farm workers who used pesticides n(%)
Abamectin	IA	Noncholinesterase	Legal	33(22)
Parathion	IA	Organophosphate	Banned	21(14)
Endrin	IA	Organochlorine	Banned	14(9)
Methyl-Parathion	IA	Organophosphate	Legal	11(7)
Monocrotophos	IB	Organophosphate	Legal	93(61)
Methamidophos	IB	Organophosphate	Legal	114(75)
Carbosulfan	IB	Carbamate	Legal	62(41)
Chlorpyrifos	II	Organophosphate	Legal	91(59)
Dimethoate	II	Organophosphate	Banned	63(42)
Dichlorvos	II	Organophosphate	Banned	49(32)
Methidathion	II	Organophosphate	Banned	63(42)
Edosulfan	II	Organochlorine	Banned	69(45)
Lindane	II	Organochlorine	Banned	73(48)
Methyl bromide	II	Organochlorine	Legal	61(40)
DDT	II	Organochlorine	Banned	54(35)
Carbaryl		Carbamate	Banned	34(22)
Permethrin	II	Pyrethroid	Banned	13(8)
Propoxur	II	Carbamate	Banned	9(6)
Fenobucarb	II	Carbamate	Legal	11(7)
Deltamethrin	II	Pyrethroid	Legal	6(4)
Fenvalerate	II	Pyrethroid	Legal	2(1)
Cypermethrin	II	Pyrethriod	Legal	12(8)
Malathion	III	Organophosphate	Legal	65(42)
Diazinon	III	Organophosphate	Legal	43(28)
Metolachlor	III	Chloroacetanilide	Legal	4(3)
Mancozeb	0	Thiocarbamate	Banned	8(5)
Captan	0	Phtalimide	Banned	12(8)
Maneb	0	Thiocarbamate	Banned	7(5)

*IA= extremely dangerous; IB = highly dangerous; II = moderately dangerous; III = slightly dangerous; 0 = not dangerous

Majority of the pesticides, including four classified as extremely or highly dangerous, were organophosphates (38%), followed by organochlorines (19%) and carbamates (15%).

The acute toxicity symptoms reported by the farm workers are listed in Table 3.

Table 3. Self-reported toxicity symptoms among farm workers in Oman (n = 153)

Symptoms	Toxicity symptoms experienced in the past 3 months n(%)
Skin rash	119(78)
Itching	141(92)
Cough	77(50)
Nausea/vomiting	74(48)
Blurred vision	91(46)
Sore throat	69(45)
Increased salivation	81(53)
Runny nose	67(44)
Burning eyes	130(85)
Fatigue	102(67)
Shortness of breath	62(41)
Dizziness	93(61)
Stomach cramps	61(40)
Diarrhea	64(42)
Bloating	53(35)
Numbness	51(33)
Headache	112(73)
Constipation	57(37)

Out of a total of 18 symptoms, itching was the most commonly reported (92%), followed by burning eyes (85%). Other commonly reported symptoms were skin rash (78%), headache (73%) and fatigue (67%). Constipation (37%), bloating (35%) and numbness (33%) were the least reported.

Table 4 shows the breakdown of the self-reported toxicity symptoms among the farm workers by age and where they were treated, their levels of education and years of pesticide work.

Table 4. Prevalence of self-reported toxicity symptoms among farm workers by age, education level and years of pesticide work, and where treatment was administered

Characteristics	No. of farm workers n(%)	p value
Age (years)		
20 or less	11 (91)	<0.001
21 - 30	44 (73)	
31 – 40	33 (80)	
41 – 50	20 (67)	
50 or more	5 (50)	
Years of education		
Did not attend school	11 (85)	<0.001
Some primary school	59 (82)	

Completed primary school	10 (71)	
Some secondary school	31 (72)	
Completed secondary school	6 (55)	
Years of pesticide work		
>10	37 (71)	ns
8-10	25 (71)	
5-7	22 (67)	
2-4	14 (70)	
<1	9(69)	
Where treated was administered		
Self-medication	63(42)	<0.001
Local pharmacy	54(35)	
Private clinic	22(14)	
Government hospital	14(9)	

There were no significant differences in the number of reported symptoms, irrespective of years of pesticide work. There was a significant difference ($p < 0.001$) in self-reported symptoms among the age groups, with those 20 years or less being more impacted than those 50 years or older. There were also significant differences ($p < 0.001$) in the number of reported symptoms with respect to education level. About 85% of those with no formal education reported pesticide symptoms compared to 55% among those who had completed secondary education. Self-medication was the commonly used treatment option (42%). Other options were local pharmacy (35%), private clinic (14%) and government hospital (9%).

The question concerning the workers' knowledge about certain aspects of pesticides required a "yes" or "no" answer. Asked if they had knowledge about warning labels on pesticide containers, some answered yes, meaning that they were aware of and always read warning labels, while others answered no, meaning that they were not aware of and never read warning labels. The breakdown of responses to this question and others are presented in Table 5.

Table 5. Knowledge of pesticide practices by farm workers regarding warning labels, names of banned pesticides, pesticide route of entry into the body, fate of pesticide residues, and usefulness of pesticide training (n = 153)

Knowledge	No.offarm workers n(%)
Warning labels	
Yes	27 (19)
No	126 (81)
Names of banned pesticides	
Yes	31 (20)
No	122 (80)
Entry route of pesticides	
Nasal	
Yes	21 (14)
No	132 (86)
Dermal	
Yes	136 (89)
No	17 (11)

Ocular	
Yes	44 (29)
No	109 (71)
Oral	
Yes	128 (84)
No	25(16)
Usefulness of pesticide training	
Yes	34 (22)
No	119 (78)
Fate of pesticide residues	
Soil	
Yes	121(79)
No	32(21)
Groundwater	
Yes	48(31)
No	105(69)
Air	
Yes	94(61)
No	59(39)
Plants (leaves and fruits)	
Yes	54(35)
No	99(65)

Only 19% had knowledge of warning labels, while 81% had no knowledge. Similarly, concerning knowledge about names of banned pesticides, 20% answered yes, while 80% answered no. With respect to knowledge of the entry route of pesticides into the human body, the percentages of yes and no responses were 14 and 86 for nasal; 89 and 11 for dermal; 29 and 71 for ocular; and 84 and 16 for oral, respectively. A majority of the respondents (78%) did not know that pesticide training was necessary. Asked if they believed that the soil, groundwater, air and plants (leaves and fruits) could be contaminated, 79% agreed that the soil could be contaminated, while 21% did not. The “yes” and “no” responses for groundwater, air and plants were 31 and 69%; 61 and 39%; and 35 and 65%, respectively.

The respondents were then asked about their habits, such as smoking, drinking and eating during pesticide application. They were also asked whether they showered immediately after spraying, and whether they changed and washed their clothes separately. Their responses are presented in Table 6.

Table 6. Habits of farm workers during and after pesticide application (n = 153)

Habits	No. of farm workers n(%)
Habits during pesticide application	
Smoke cigarette	
Yes	74 (48)
No	79(58)
Chew gum	
Yes	78 (51)
No	75 (49)
Eat	
Yes	11(8)
No	142(92)

Drink water	
Yes	67(44)
No	86(56)
Pesticide concentration applied	
Recommended	78(51)
Less than recommended	21(14)
More than recommended	54(35)
Use personal protection equipment (PPE)	
Yes	50(33)
No	103(67)
Habits after pesticide application	
Shower immediately	
Yes	61 (40)
No	92 (60)
Change clothes	
Yes	64 (42)
No	89 (58)
Wash clothes separately	
Yes	84 (55)
No	69(45)

A majority of the workers (51%) chewed gum during pesticide application. Eating, cigarette smoking and drinking of water during spraying were habits of 8%, 48% and 44%, respectively. While 51% of the workers used the recommended concentration of pesticides, 21% and 54% used less and more than recommended, respectively. Only 33% used personal protection equipment (PPE) during pesticide application and 60% failed to shower immediately after pesticide application; 58% did not change their work clothes and 45% did not wash their clothes separately.

4. Discussion

A knowledge of the route of entry of pesticides into the body is probably the first best line of defense. In the current study, majority of the respondents had no knowledge of nasal (inhalation) and ocular routes of pesticide entry into the body. However, as high as 80% of them knew about dermal and oral entry routes and is consistent with previous results (Yassin et al. 2002). It was, therefore, inconceivable to note that as many as 48%, 51%, and 44% of the respondents smoked cigarette, chewed gum or drank water, respectively, during pesticide application. Smoking during spraying pesticides could increase the absorption of pesticides through inhalation of both airborne particles and through ingestion of particles attached to the cigarettes. It could also exacerbate underlying respiratory diseases such as bronchitis and asthma by delivering irritating smoke and pesticide aerosols to the respiratory airways (Nordin et al. 2002). Additionally, residues that remain on treated plants can contaminate food, drinks, or cigarettes brought into the field.

The post-application habits of the respondent farm workers were also of concern. A majority of them did not shower immediately after application, nor did they change their clothes. Over 40% failed to wash their work clothes separately from their other clothes. Delay in changing

clothes could result in longer duration of body contact with pesticides and thus increasing the risk of inhalations from the lungs and absorption of pesticides from the skin area (Mekonnen, & Agonafir 2002). Changing of clothes immediately after pesticide spray significantly prevented respiratory symptoms in Indonesian farm workers (Nordin, et al. 2002). It is suggested that the potential risk of prolonged bodily contact with pesticides through delay in changing clothes and/or showering be clearly explained to farm workers.

Over 60% of the farm workers failed to wear pesticide protection equipment (PPE) during pesticide application, a trend that has been reported in many developing countries (Yassin et al 2002; Clarke et al. 1997). The worst case scenario is probably a study in Egypt where as many as 97% of the respondents did not wear PPE when mixing or applying pesticides (Ibitayo 2006). In the current study, the poor compliance with the use of protective covering obviously exposed the farm workers to direct contact with pesticides. Wearing of gloves was found to be the most effective protection against pesticide exposure among Danish greenhouse workers, and the practice reduced dermal exposure among US citrus farmers by 27% (Damalas & Koutroubas 2016).

Regarding the toxicity symptoms associated with pesticide exposure, results show that the most commonly self-reported toxicity symptoms were itching, burning eyes, skin rash, headache and fatigue. Similar data have been reported elsewhere (Yassin et al. 2002; Beshwari et al. 1999). In the current study, toxicity symptoms were reported by 91% of those who were 20 years or less, compared to 50% among those who were 50 years or older. This was probably because the younger farm workers often express themselves better than the older workers, who sometimes hesitate to complain (Yassin et al. 2002). Others have reported that the older farm workers did not perceive the symptoms to be the effects of pesticide poisoning and so they continued to do their work in disregard of the indications they were feeling (Kedia & Palis 2008).

There was a relatively low level of education among the farm workers in the current study and agrees with earlier reports from many developing countries (Mekonnen & Agonafir, 2002; Ibitayo 2006). In Brazil, poor literacy skills and the inability of Amazon farmers to understand information displayed on product labels were linked to increased occupational exposure to pesticides and vulnerability to acute and chronic poisoning (Waichman et al. 2007). In the current study, a higher percentage (85%) of the farm workers with no formal education reported toxicity symptoms compared to 55% of those with secondary education. Those with no formal education were also the least likely to wear PPE to protect the body from the adverse health effects of pesticides. Paradoxically, however, pesticide workers in Gaza Strip who were highly educated and had knowledge about the protective advantages of PPE failed to wear them (Yassin et al. 2002). I did not explore why awareness does not necessarily translate into action; this needs further investigation and could be a subject for future research.

Extremely dangerous pesticides, such as Parathion & Endrin, banned in Oman and used by 9% of the workers may have contributed to the large number of toxic symptoms. It is suggested that more resources are made available towards ensuring that these banned

chemicals do not get into the country and into the hands of farm workers who do not have the skills to handle them. About 25% of developing countries lack any kind of legislation to control the distribution and use of pesticides, and 80% lack the resources to implement and enforce the legislation that does exist (Farah 1993). Oman, however, has very strict pesticide regulations, similar to many developed countries, but the enforcement of these regulations remains a serious concern.

The low education level of the farm workers may also account for their poor knowledge about the fate of pesticide residue. Over 60% of the farm workers had no knowledge that pesticide residue could be found in groundwater and plants (leaves and fruits). This knowledge gap is troubling because almost all the workers live in or near the farms and they obtain their drinking water from wells dug in the farms. There is no record on the level of pesticide pollution of water in farms in Oman where pesticides are heavily used, and it seems that this could be a subject for future research. In the current study, the farm workers with no knowledge about pesticide residues on plants will consider it safe to consume fruits and vegetables that have just been treated with pesticides. Anecdotal evidence suggests that these farm produce do end up in the local vegetable markets, thus putting the consumers at risk.

When asked where they were treated for the pesticide related toxicity symptoms experienced, self-medication, local pharmacy, private clinic and government hospitals were the four options, with self-medication being the most commonly used and government hospital the least. Oman has a national health scheme but it does not cover immigrant farm labourers, hence the low percentage (9%) of workers visiting government hospitals. Many of these workers who were mostly from the Indian subcontinent claimed that they brought some medications such as antibiotics, laxatives and essential oils from their home countries during their first hire or when they went on vacation. Most of these medications were indiscriminately used, as illustrated by the following examples: For fatigue and body pains, a back massage with essential oil was used because they believed that the back pain was a result of the heavy sprayer carried on their backs. Unknown to these workers, muscle weakness and fatigue are early symptoms of organophosphate pesticide poisoning (Schultze et al. 1997). Some took a one-time dosage of two capsules of ampicillin as antidote for excessive salivation, while some took laxative as a “cure all” for constipation, stomach cramps and bloating. Obviously, a better approach is to consult a medical personnel in the event of pesticide toxicity, even though in some cases health officers may always not correctly diagnose pesticide poisonings (Mendoza 2008).

In conclusion, the incidence of pesticide exposure was exacerbated by the bad habits of the farm workers during and after pesticide application, as well as their poor knowledge of pesticides. Reduction in exposure can be achieved by training the workers on the use of PPE, enforcing the existing pesticide legislation, and the adoption of integrated pest management approaches.

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