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Pesticide Exposure and Health Risks: The Case of Pesticide Traders

Jovita O. Esechie

Department of Political Science, Texas Southern University, Houston, TX 77004, USA

Tel: 1-832-746-1089 E-mail: jovita.esechie@tsu.edu

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Abstract

There is a paucity of information worldwide on the health problems among pesticide traders that are occupationally exposed to pesticides. A study was conducted in the Sultanate of Oman to investigate pesticide handling and their health risk perception by pesticide traders, and how these are impacted by their level of education, training, and the use of personal protection equipment (PPE). A total of 63 traders were randomly selected in four Regions (Al Batinah, Al Dhahirah, Al Dakhiliyah and Al Sharqiyah) in the Sultanate of Oman. Participation was based on full informed consent and assurances of confidentiality. The survey adopted the interview format, using hard copies of questionnaires. About 90% of the traders with formal pesticide training used some form of PPE, compared to 19% among those with no pesticide training. All (100%) of the trained traders had knowledge of pesticide regulations, informed customers on the proper use of pesticides and knew that pesticides could be dangerous. The corresponding percentages among the untrained traders were 13, 12 and 60, respectively. Among all the traders, the most reported health symptoms were headache (73%), skin irritation (71.4%) and salivation (63.5%). In as much as many farm workers and other pesticide end-users depend on the traders for information on pesticides, it is suggested that training be made mandatory for all pesticide traders. The use of PPE should also be made mandatory and pesticide inspectors should be made to inspect the pesticide shops regularly to ensure compliance.

Keywords: Pesticide traders, personal protection equipment, pesticide training, Oman

1. Introduction

Modern agriculture depends heavily on pesticide use, which has successfully increased productivity but has also led to increasing concerns regarding farmers' health (Antle and Pingali, 1994). According to Esechie and Ibitayo (2011) and Esechie et al. (2012), mishandling of pesticides continues to pose serious health problems for farmers, especially in developing

countries. Annually, 26 million cases of pesticide poisoning result in 220,000 deaths worldwide (Richter, 2002). In Central America, between 1992 and 2000, the importation of pesticides increased noticeably resulting in an upsurge in the incidences of acute pesticide poisoning from 6.3 per 100,000 population to 19.5 per 100, 000 population, and the mortality rate increased from 0.3 per 100,000 population to 2.1 per 100,000 (Henao and Arbelaez, 2000). An estimated 99% of human pesticide fatalities occur in developing countries, although these countries account for only 20% to 30% of pesticide use (Dinham, 1993). In the United States alone, Pimentel (2005) estimates that the public health cost of pesticide use amounts to $1.1 billion per year.

In many developing countries, pesticides are usually sold to consumers by private traders and/or wholesalers. In some of these countries, there are no age restriction policies baring youths or underage persons from selling pesticides on the streets or in the open market, or on ~~the~~ road-side shops. This lack of policy means these pesticide traders may be exposed to the adverse effects of pesticides, such as acute and chronic poisoning. Some of these chemical products are repackaged, without adequate protection from exposure, and sold in shops/stores that are not properly ventilated. Quite often, some pesticide containers arrive at the traders' shops broken, leading to possible exposure.

In Bangladesh, Dasgupta et al. (2005) found that most of the pesticide traders had little or no knowledge about the adverse health effects of pesticides. This lack of knowledge is important for two reasons. First, the traders are not likely to protect themselves against exposure to pesticide contamination. Second, the traders are likely to pass the erroneous information to farmers and farm workers who seek their advice on the use of pesticides. The influence of pesticide dealers on farmers decisions is well documented worldwide in studies conducted in South Africa (Rother et al., 2008), Tanzania (Alam & Wolff, 2016) and the United States (Wolf, 1995).

There is a paucity of information on the health problems among pesticide traders that are occupationally exposed to pesticides. According to Tahir and Anwar (2012), studies of the health effects of pesticide exposure on dealers are practically non-existent in Pakistan and most of the information is available on farmers' health. Evidence from Oman has shown a similar trend (Esechie and Ibitayo, 2011; Esechie et al., 2012; Esechie, 2018; Esechie, 2020). The human and environmental risk from the handing of pesticides at retail outlets is a particular problem in developing countries due to lack of infrastructure (FAO, 1988). Designing intervention blueprint for pesticide traders will obviously benefit from more research. Sapbamrer and Thammachai (2020) have shown that an evidence-based understanding of factors influencing pesticide safety practices has the benefit of facilitating the design of intervention strategies to minimize exposure to pesticides. Accordingly, a study was conducted in the Sultanate of Oman, a country located in the southeast of the Arabian Peninsula, to investigate pesticide handling and their health risk perception by pesticide traders, and how these are impacted by their level of education, training, and the use of PPE.

2. Methods

The study consisted of a survey in which questionnaires were constructed as previously

described for greenhouse pesticide workers (Esechie and Ibitayo, 2011) and open-field pesticide workers (Esechie, 2020), but amended to include such questions as retailers' safety knowledge, pesticide handling practices and health risk factors. The study protocol and data collection procedures were reviewed and approved by the Texas Southern University Committee for Protection of Human Subjects. A total of 63 pesticide retailers were randomly selected from different pesticide sales outlets in four Regions (Al Batinah, Al Dhahirah, Al Dakhiliyah and Al Sharqiyah) in the Sultanate of Oman. Pesticide traders' participation was based on full informed consent and assurances of confidentiality. It was further explained to them that no specific information would be linked to them. The survey was conducted between October 2008 and February 2009 and all survey assistants had college degrees and were fluent in English and Arabic.

Data were coded and statistically analyzed with the Statistical Package for Social Sciences (SPSS, Chicago, IL, USA), as previously described for open- field and greenhouse workers (Esechie, 2020). The Mantel-Haenszel Chi-square test 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 reported *p* values are two-tailed.

3. Results

Most of the pesticide traders (41.5%) were 31 – 50 years old, while 33.3% were 51 – 60 years old (Table 1).

Table 1. Pesticide traders' demographics (n = 63)

Age	Frequency	Percent
20 years or less	3	4.8
21 – 30	5	7.9
31 – 40	16	25.4
41 – 50	10	16.1
51 – 60	21	33.3
More than 60	8	12.5
Total	63	100
Education		
Did not attend school	3	4.2
Some primary school	12	19.6
Completed primary school	18	28.6
Some secondary school	8	12.7
Completed secondary school	8	12.6
Some college	3	4.8
Completed College	11	17.5
Total	63	100

About 33.3% of the traders were more than 60 years old, and a few (4.8%) were 20 years old or less. Only 17.5% of them completed college, while 28.6% completed primary school.

In terms of work experience, 54% had worked for 11 – 20 years, and 4.8% and 9.5% had been trading for more than 20 years and less than 1 year, respectively (Table 2).

Table 2. Work experience and habits of pesticide traders (n = 63)

Work experience	Frequency	Percent
Less than 1 year	6	9.5
1 – 5 years	12	19.0
6-10 years	8	12.7
11 – 15 years	10	15.9
16 - 20 years	24	38.1
More than 20 years	3	4.8
Work habits		
Drink tea/ beverages	52	83
Eat food	44	70
Chew gum	11	17
Smoke cigarette	24	38
PPE protocol		
Face mask	2	3
Gloves	17	27
Long pants	42	67
Overall	23	36

An analysis of the traders' work habits shows that 83% of them drank tea or other beverages in the same room where pesticides were stored. Other habits were food consumption (70%), gum chewing (17%) and cigarette smoking (38%). Personal protective equipment (PPE) usage was as follows: face mask (3%), gloves (27%), long pants (67%) and overall (36%).

Table 3. Classification of pesticides sold by the pesticide traders (n = 63)

Common Name	Trade Name	Chemical Class	WHO Grade*	Traders Selling n (%)
Parathion	Akron, Folidol	Organophosphate	IA	21 (33)
Methyl parathion	Bladan, Dalf	Organophosphate	IA	17 (27)
Endrin	Hexadrin, Endrex	Organochlorine	IA	19 (30)
Oxamyl	Vydate, Throxymil	Carbamate	IB	22 (32)
Carbosulfan	Marshal, Advantage	Carbamate	IB	32 (51)
Monocrotophos	Azodrin, Susrin	Organophosphate	IB	24 (38)
Metamidophos	Monitor, Nitofol	Organophosphate	IB	31 (49)
Endosulfan	Afidan, Endosol	Organochlorine	II	40 (63)
Dichlorvos	Nuvan, Dodak	Organophosphate	II	28 (44)
Chlorpyrifos	Astro, Terminator	Organophosphate	II	18 (29)
Dimethoate	Rogor, Heragor	Organophosphate	II	11 (17)
DDT	Anofex, Neacidal	Organochlorine	II	31 (49)
Methidathion	Somonic, Suprathion	Organophosphate	II	26 (41)
Methyl bromide	Methogas, Zytox	Organochlorine	II	17 (27)
Lindane	Benesan, Aparasin	Organochlorine	II	26 (41)
Carbaryl	Sevin, Adios	Carbamate	II	17 (27)
Fenobucarb	Ecotox, Warden	Carbamate	II	26 (41)
Propoxur	Baygon, Arprocarb	Carbamate	II	13 (21)
Deltamethrin	Decis, Kordon	Pyrethroid	II	12 (19)
Cypermethrin	Cymbush, Kafil	Pyrethroid	II	24 (38)
Fenvalerate	Sumicidin, Pydrin	Pyrethroid	II	21 (33)
Malathion	Carbophos, Cythion	Organophosphate	III	16 (25)
Diazinon	Knockout TM, Basudin TM	Organophosphate	III	13 (21)
Thiram	Aatak, Arasan	Thiocarbamate	III	6 (10)
Mancozeb	Dithane M-45, Nemispot	Thiocarbamate	0	23 (37)
Maneb	Newspor, Manesan	Thiocarbamate	0	12 (19)

*IA-extremely dangerous, IB- highly dangerous, II- moderately dangerous, III- slightly dangerous, 0- not dangerous

A classification of the pesticides sold by the traders is shown in Table 3. Out of a total of 26 pesticides, three are extremely dangerous (IA) as per WHO grading and were sold by 30% of the traders. About 43% of the traders sold the highly dangerous pesticides (IB), 35% sold the moderately dangerous ones (II), and the slightly dangerous pesticides (III) were sold by 19% of the traders. The pesticides were chemically classified as organophosphate, organochlorine, carbamate, thiocarbamate or pyrethroid.

Table 4 shows the health symptoms reported by the pesticide traders. The most reported symptoms were headache (73%), skin irritation (71.4%), salivation (63.5%) and dizziness (58.7%). Others were vomiting (54%), blurred vision (39.7%), burning sensation (36.5%) and breathlessness (3.3%). Do these traders know the exposure routes of pesticides? A summary of their responses is presented in Table 5.

Table 4. Reported health symptoms by pesticide traders

Symptoms	Frequency	Percent
Skin Irritation	45	71.4
Dizziness	37	58.7
Chest pain	14	22.2
Headache	46	73.0
Salivation	40	63.5
Vomiting	34	54.0
Burning sensation	23	36.5
Weakness	18	28.6
Blurred Vision	25	39.7
Breathlessness	21	33.3
Cough	18	28.6

Table 5. Pesticide traders' perceptions of exposure routes of pesticides

Exposure Route	Frequency	Percent
Nasal	22	34.9
Dermal	20	31.7
Ocular	3	4.8
Oral	15	23.8
Not Sure	16	25.4

About 34.9% of the traders had knowledge of nasal route of entry of pesticides into the human body. Other routes of entry were dermal (31.7%), ocular (4.8%), and oral (23.8%). About 25.4% of the traders had no knowledge about pesticide routes of entry into the human body.

Table 6. Effect of training on pesticide traders' knowledge and habits

(Traders with training, n – 10; traders without training, n = 53))

	Traders with training n(%)	Traders without training n(%)	p value
Used some form of PPE	9(90)	10(19)	<0.001
Informed customers on the benefits of using PPE	9(90)	11(21)	<0.001
Have knowledge of Pesticide Regulations	10(100)	7(13)	<0.001
Informed customers on the proper use of pesticides	10(100)	12(23)	<0.001
Know that pesticides could be dangerous	10(100)	32(60)	<0.05

Table 6 shows the effect of training on pesticide traders' knowledge and habits. Knowledge and habits investigated include PPE usage, whether customers were informed about the benefits of PPE, and possible dangers in pesticide handling. Others were knowledge about pesticide regulations, and whether they informed their customers about the proper usage of pesticides. All responses are presented in absolute frequencies (n) and relative frequencies (%). Only 10 traders had formal pesticide training, while 53 had none. The trained pesticide traders were significantly more knowledgeable ($p < 0.001$ *or* $p < 0.05$) than the untrained traders.

4. Discussion

Pesticide handling and their health risk perception by pesticide traders, and how these are impacted by their level of education, training, and the use of personal protection equipment (PPE) were investigated in this study. Over 70% of the traders completed primary school, secondary school, or college, therefore they were reasonably literate. However, most of them drank tea, ate food, chewed gum, or smoked cigarette in rooms where pesticides were stored or displayed. The use of PPE, such as face masks and gloves, was not well embraced by many of these traders, resulting in pesticide exposure. Damalas & Koutroubas (2016) have reported that oral exposure can occur when hands are not properly washed before eating or smoking. There is also a high risk of exposure to toxic pesticides through lack of protective gear and storage of pesticides near food (WHO, 1990), while smoking and chewing of gum may deter the use of face masks (Esechie, 2020). About 54% of the pesticide traders have had 11 - 20 years of pesticide trading experience and may have assumed wrongly that long working experiences were good substitutes for personal protection devices. Some pesticide workers even believe that, over a long period of time their bodies could develop resistance against pesticides (Yassin et al., 2002). However, according to Mekonnen & Agonafir (2002), although care is advisable in pesticide handling, the use of PPE is an added insurance that minimizes the risk of direct contact. The most widely used PPE was long pants (67%) and agrees with Sapbamrer and Thammachai (2020) who reported that the most basic PPE worn among pesticide handlers in all world regions are long sleeve trousers.

About 37% of the traders had quantities of the extremely dangerous (IA) and the highly dangerous pesticides (IB) in their showrooms. Parathion, for instance, is classified as extremely dangerous, and according to Garcia et al. (2003), it is extremely toxic from acute (short-term) inhalation, oral, and dermal exposures. Therefore, the central nervous system, blood, respiratory system, eyes, and skin are the organs most affected by acute exposure. Endrin, an organochlorine, is also an extremely dangerous pesticide that affects the nervous system, causing convulsions, tremors, seizures, and fatalities (Reigart & Roberts, 1999). Monocrotophos is classified as highly dangerous, and according to WHO (2009), this chemical can be absorbed following ingestion, inhalation, and skin contact. When inhaled, it affects the respiratory system and may trigger bloody or runny nose, coughing, chest discomfort, difficulty breathing or shortness of breath and wheezing due to constriction or excess fluid in the bronchial tubes. Therefore, it was unthinkable to see these chemicals being handled by some traders without hand gloves and face masks. Only 3% of the traders used face masks, while 27% used hand gloves. Incidentally, parathion has been banned in Sultanate of Oman, but some of the smaller retail shops had it on display. The sale of banned or unregistered

pesticides has also been reported in pesticide retail stores in Tanzania (Lekei et al., 2014). Esechie (2018) has suggested that more resources be made available towards ensuring that banned chemicals do not get into the country and into the hands of farm workers who do not have the skills to handle them. According to Farah (1993), 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.

Concerning health symptoms, my interest was in self-reported occurrence of acute pesticide poisoning within the last 3 months. Out of a total of 12 health symptoms, the most reported by the pesticide traders was headache (73.0%), followed by skin irritation (71.4%) and salivation (63.5%). In a study conducted by Mourad (2005), 62.5% of the participants experienced burning sensations in the eyes or face and 37.5% experienced itching or irritated skin after spraying organophosphate insecticides. However, it must be pointed out that these findings, including those reported in the current study, have limitations. The first limitation is that all symptoms were self – reported and I did not have the resources to confirm their authenticity. Secondly, most of the health symptoms may have been caused or aggravated by factors other than pesticide exposure. Headache, for instance, may be caused by stress, or sleep deprivation, among others. However, the health symptoms reported here tend to mimic those earlier reported among greenhouse pesticide workers (Esechie & Ibitayo,2011) and open-field pesticide workers (Esechie, 2020), thus giving the current results some credibility. According to Ecobichon (2000), 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. 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 (Strong et al., 2004). The current study investigated only acute toxic symptoms.

The traders' perception of the exposure routes of pesticides was poor. This was unexpected, especially since the traders were relatively literate. The lack of knowledge of pesticide related occupational hazards among pesticide dealers has also been reported in Karachi, Pakistan (Anwar et al., 2017). Palis et al. (2006) have suggested that the main cause of pesticide poisoning is ignorance about its dangers. In the current study, only 34.9% knew about nasal route of entry of pesticides into the human body, and face masks were used by only 3% of the traders. Had they been more aware of this route of entry, majority of them would probably have embraced the use of face masks during pesticide handling. Face masks would minimize oral pesticide entry, therefore eating food, chewing gum, and smoking in the workplace would have been discouraged. Similarly, ocular entry would have been reduced by using goggles. Only 4.8% of the respondents knew that pesticides could enter the body through the eyes. A study in Jamaica shows a better awareness, as 77% of the participants knew that pesticides could enter the body through the eyes (Ncube et al., 2011).

This study confirms the importance of training on pesticide traders' knowledge and habits. All the trained traders were knowledgeable about pesticide regulations, informed their customers about the proper use of pesticides and 90% of them used some form of PPE. On the other hand, traders without training had minimal knowledge about pesticide regulations and hardly used

some form of PPE. According to Dasgupta et al. (2005), they are likely to pass the erroneous information to farmers and farm workers who seek their advice on the use of pesticides.

5. Conclusion

Some pesticides distributed by pesticide traders in Oman are extremely or highly dangerous (WHO Class IA and IB, respectively). Additionally, some of the traders displayed banned pesticides in their shops and majority did not use any form of PPE. These unsafe practices are likely to contribute to increased risk to the traders, the farm workers and other end-users who buy and use these pesticides. The current study has shown that the pesticide traders with training used some form of PPE, informed customers about the benefits of PPE and had knowledge of pesticide regulation. They were also aware that pesticides are generally dangerous chemicals that must be used properly to avoid occupational exposure. In as much as many farm workers and other pesticide end-users depend on the traders for information on pesticides, it is suggested that training be made mandatory for all pesticide traders. The use of PPE should also be made mandatory and pesticide inspectors should be made to inspect the pesticide shops regularly to ensure compliance.

Ethical Approval

The study was approved by the Texas Southern University Committee for the Human

Subjects on November 24, 2008.

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