The Exposure of Farmers and their Families to Pesticides in an Agricultural Community

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Introduction:

Pesticides are substances that are used to prevent, repel, or destroy pests organisms that compete for food supply, adversely affect comfort, or endanger human health (FIFRA, 1996).

Children represent a sensitive sub-population in terms of exposure to pesticides because they have high metabolic rates and immature immune systems (curl *et al.*, 2002). Children eat more food per Kg compared to adults and have distinctive patterns of activity and behavior (Lu C., 2004). Children can be exposed to pesticides through a variety of pathways, including dietary and nondietary ingestion, inhalation of indoor and outdoor air, and dermal contact with contaminated surfaces (Lu. *et al*., 2000).

The present work have been conducted in Wadi Al-Fara'a, which is located in Al-Fara'a catchment in the northeastern part of the West Bank and extends from the ridges of Nablus Mountains down the eastern slopes to the Jordan River and the Dead Sea.

The first aim of the present work are to study the effect of using excessive amount of pesticides on the health of the farmers and their families in agricultural area in eastern of Nablus. The second aim is to obtain data about the utilization and handling of pesticides in the agricultural community. The third aim is to estimate the influence of exposure to pesticides on the health of the farmers and their families through a questionnaire investigator after an interview with the farmers. The fourth aim is to investigate the take-home path-way of pesticide exposure among agricultural families. The final aim is to establish a baseline of exposure in communities in Palestine.

Samples were collected from Wadi Al-Fara'a and analyzed for the presence of chlorpyrifos, methamedophos, endosulfan, penconazole, and triadimenol, which were chosen because of their frequent use and associated toxicity.

Materials and Methods:

Laboratory equipment: Soxhlet extraction apparatus, consist of 125-ml round bottom flask, siphon100-ml capacity (33×80mm thimble), and a regulated heating mantle.

Preparation of pesticides standard solutions:
Stock 1000 ppm solutions of chlorpyrifos, methamedophos, endosulfan, penconazole, and triadimenol were prepared for quantitative analysis.

Quantitative determination of pesticides in environmental samples:

The collected samples were soil from inside the greenhouses, soil from the open field farms, dust from in front of the farmer's houses, dust from the vehicles used by farmers for transportation between their houses and farms and dust from the farmer's private pesticide stores.

The five pesticides (chlorpyrifos, methamedophos, endosulfan, penconazole, and triadimenol) were targeted for analysis in the collected samples.

Questionnaire:

A questionnaire was prepared to be filled by the farmer to obtain data about the utilization and handling of pesticides in an agricultural community, and to estimate the influence of exposure to pesticides on the health of the farmers and their families. To investigate the take-home path-way of pesticide exposure among agricultural families and to establish a baseline of exposure in communities in Palestine. The first section included questions related to social information. The second section included practice questions. The third section contained questions related to the health impact of exposure to pesticides. The questionnaire was based on United States Environmental Protection Agency questions, WHO questions, and on that used in similar studies with some modifications (Yassin M. *et al*., 2002). Statistical analysis was performed using statistical package for social sciences (SPSS).

Gas chromatographic/ mass spectrometric conditions

The soil and dust extracts containing pesticides were analyzed using GC/ MS apparatus (QP 5000, SHIMADZU, Japan) in the selected ion monitoring mode. It was supported with auto injector (AOC-17) Class 5000 software and capillary column DB-SMS (5% phenyl Methylelopolysiloxane) of 0.25µm film thickness, 30 meters length and 0.25mm I.D (J. and W. Scientific). The obtained results were compared with the results obtained for standards analyzed under the same conditions.

Results and Discussion:

Quantitative determination of pesticide residues in the soil inside the green houses:
Twenty two samples of soil collected from the green houses were analyzed for pesticide residues. The obtained results are presented in Table 1.

Table 1: Pesticide residues in soil samples inside the green house.

Location	Pesticide residue median (ppm)				
	Tamaron Methame-dophos	Dursban® Chlorpyriphos	Ofir® Penconazol	Payfidan® Triademanol	Thionex® Endosulfan
Al-Bathan	0.631	0.138	0.08	0.676	0.179
Al-Fara'a	1.12	0.228	0.088	0.734	1.04
AlNasarya	0.635	0.119	0	0.343	0.193

Quantitative determination of pesticide residues in soil of open fields:

Twenty one samples of soil from the open field in Al-Bathan, Al-Fara'a, and An-Nassariyya were collected and analyzed for the quantitative determination of the five pesticides under investigation. The obtained results are presented in Table 2.

Table 2: Pesticide residues in soil samples in open field

Pesticide residues median (ppm)					
Pesticide	**Tamaron® Methamedophos**	**Dursban® Chlorpyriphos**	**Ofir® Penconazol**	**Payfidan® Triademanol**	**Thionex Endosulfan**
Al-Bathan	3.56	0.179	0.034	0.511	0.935
Al-Fara'a	5.25	0.358	0.057	0.65	0.25
An-Nassariyya	0.601	0.062	0	0.274	0.097

Quantitative determination of pesticide residues in the dust of the studied area:

Nine samples of dust from the houses, vehicles, and stores of the farmers were collected for pesticide residue determination. Four dust samples were collected from the houses; three samples were collected from the dust of vehicles while two dust samples were collected from the stores of the pesticides of the farmers. The results are presented in Table 3.

Table 3: Pesticide residues in the dust of the studied area.

Pesticide residues median (ppm)					
Pesticide	**Tamaron® Methamedophos**	**Dursban® Chlorpyriphos**	**Ofir® Penconazol**	**Payfidan® Triademanol**	**Thionex® Endosulfan**
Home dust	0.849	0.090	0.061	1.11	1.104
Vehicle dust	0.705	0.45	0.073	1.03	1.59
Store dust	3.62	2.37	0	2.31	2.14

Questionnaire results:

Knowledge, attitudes, and practices with regard to the use of pesticides:

The questionnaire contained many questions related to the practices of the farmers in the studied area, the total number of questionnaires that were filled out was fifty and all the farmers respond.

Education & Social status:

Analysis of the educational status of the respondent farmers (n = 50) showed that 24% had university degrees, 38% had finished secondary school, 22% had finished preparatory school, 10% had passed primary school, and 6% were illiterate. A low level of illiteracy was recorded among the respondent farmers, reflecting a well educated community.

Types of agricultural field:

The questions related to the type of agricultural field and planted crops illustrated that 48% of the farmers grow their crops in open fields, 28% in closed fields, and 24% grow their crops in both open and closed fields. In addition, 40% of the farmers reported that the agronomists were visiting their farms periodically.

Knowledge of farmers about pesticides:

A total (88%) farmer had knowledge about the adverse health effects of pesticides on human health. A total of (74%) knew that not all pesticides have the same adverse health effects, (90%) knew that the pesticides enter with respiratory system, (84%) knew that pesticides could enter the body through dermal exposure. It was also found that (68%) knew the name of the pesticides they were using. A total of (40%) knew biological and natural control methods as alternatives to pesticides for pest control that to use kind of virus or bacteria that prevent the pest to grow or use alternative methods as cultivated the weed before making seeds. The obtained results are presented in Table 4.

Pesticide residues:

Analysis of farmers responses indicated that the routes of exposure to pesticides according to farmers perception were mainly inhalation (90%) followed by dermal (84%) and then oral route (54%). In terms of knowledge regarding the fate of pesticide residues, the majority of respondents (74%) reported that pesticide residues may be detected in the soil, whereas a smaller number of respondents (52%) reported that pesticide residues may be detected in the fruits and tree leaves. The obtained results are presented in Table 4.

Table 4: Knowledge of farmers about pesticides, positive responses regarding the knowledge

Items assessing the knowledge	(%)
Name of pesticides used	68
Adverse health effects of pesticides on human health.	88
Degree of health impact of pesticides knowing that not all pesticides have the same adverse health effects	74
Pesticides enter with respiratory system	90
Pesticides enter from dermal.	84
Pesticides enter from mouth into the body	54
Fate of pesticide residues in the soil.	74
Fate of pesticide residues in the fruits and tree leaves.	52
Fate of pesticide residues in air	58
Fate of pesticide residues in Groundwater	54

Toxicity symptoms:

Analysis of the responses of 50 farmers indicated that the most frequent symptoms reported were breathlessness (80%), followed by skin irritation, headache, sweating and coughing (76%), nausea (74%), dizziness (72%), burning sensation in the eyes/face (66%), chest pain, itching (64%), diarrhea, vomit (60%), fatigue (52%). Less than half of the agricultural workers reported; leg cramps (42%), high temperature (40%), and forgetfulness (32%).

Regarding toxicity symptoms associated with pesticides, results showed that common self reported toxicity symptoms among farmers were common manifestations of AChE inhibition as was previously stated regarding Organophosphates (Yassin M. *et al*, 2002). The obtained results are presented in Table 5.

Table 5: Adverse or toxic effects reported by farmers (n=50)

Symptoms	(%)
Breathlessness	80
burning sensation in the eyes/face	66
Chest pain	64
Itching	64
Skin irritation	76
Headache	76
Sweating	76
Coughing	76
Dizziness	72
Forgetfulness	32
Fatigue	52
Diarrhea	60
Nausea	74
Vomit	60
High temperature	40
Leg cramps	42

Protective clothes:

A total of (80%) farmers had information that gloves and goggles can protect the skin of the hands and the eyes from the adverse health effects of pesticides, while a total of (64%) believed that wearing a wide hat can protect the head from pesticides and a total of (68%) believed that wearing a special boots can protect the feet from pesticides. A total of (80%) responded that wearing an oral–nasal mask can prevent entrance of the pesticide drifts through the mouth or nose into the human body. A total of (98%) reported that wearing protective gear as overalls can protect the whole body. The obtained results are presented in Table 6.

Table 6: Believes of farmers (n = 50) about protective clothes.

Protective measures in use (%)			
Protective measures	**yes**	**no**	**I don not know**
Wear gloves	80	16	4
Wear goggles	80	14	6
Wear wide hat	64	32	4
Wear nasal mask	80	16	4
Wear special boots	68	26	6
Wear overalls	98	2	0

Attitudes of farmers towards pesticides:

Only (32%) farmers were against the use of pesticides for pest control even though they still use them. On the other hand, a total of (68%) reported that use of pesticides is the best and most efficient way for pest control. In term of body susceptibility to pesticides, a total of (40%) farmers (n = 50) believed that their bodies has developed resistance to pesticides, whereas (34%) had the opposite opinion. In addition, a high percentage of the interviewed farmers believed that their bodies could develop resistance against pesticides.

Practices towards pesticides:

The majority (96%) of farmers used pesticides; and (68%) knew the names of the pesticides used. Almost all farmers (96%) had an extra space as a store in the farm, and only (12%) stored pesticides in the houses. In most cases, the farmers disposed the empty pesticide containers within the farm, while (74%) burned them, or left it in the field, many farmers reutilize the containers for other purposes (e.g., for water storage (8%), or pesticide storage (14%). On some farms, the empty containers were taken to the local waste containers (62%), or threw it along the street. Although a low percentage of the interviewed farmers store pesticides in the house (12%), this practice still puts children and adults at risk. In addition, the high percentage of interviewed farmers who dispose the empty containers on the garbage site or along the street could put the general population at risk. A highest percent of respondents (64%) wear hand gloves then wear oral–nasal masks (62%) a lower percent (44%) wear goggles during preparation and application of pesticides. The number of farmers who mentioned not smoking, avoided drinking, avoided eating, and not chewing gum during application of pesticides were (66%), (80%), (88%), and (92%), respectively. Respondents who showered after application of pesticides were (76 %). The activities of farmers with potential for exposure to pesticides showed that a total of (80%) used the recommended concentration of pesticides; only (10%) did not use specific concentrations. Only (4%) farmers used more than the recommended concentration, but (8%) farmers used less than the recommended concentration. A total of (72%) farmers reported that they mixed two or more pesticides before they applied them.

Conclusions and Recommendations:

Regardless of residential or occupational use of pesticides, some of these chemicals will eventually be brought into the house or become available for exposure to the residents. The presence of pesticides on children's hands and toys is of particular concern, since the likelihood of ingestion through hand-to-mouth contact is great among preschool children.

The results of our study are consistent with the theory of a para-occupational or take-home exposure pathway; agricultural pesticides move from the workplace to residential environments through the activities of farmers.

These results demonstrate that children of agricultural families have a higher potential for exposure to pesticides than children of nonfarm families in this region.

A number of long persistent organochlorines and highly toxic organophosphates, which have been banned or severely restricted, are still marketed and used in many developing countries. In West Bank, among 123 pesticides currently being used, fourteen pesticides are internationally suspended, cancelled or banned, Endosulfan one of them (Saleh *et al.*, 1995). Steps should to be taken to reduce the use of pesticides in the farms of agricultural areas. Further investigation is needed to assess the impact of pesticides on human health. Implementations of a primary prevention program would include health education regarding the use of protective gear and monitoring the health status of workers exposed to pesticides.

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