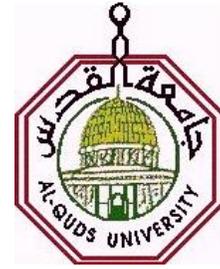


**Deanship of Graduate Studies
Al-QudsUniversity**



**Assessment of Awareness, Biochemical and Hematological
Parameters among Pesticides' Seller in
Gaza Governorate**

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MPH Thesis

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**Assessment of Awareness, Biochemical and Hematological
Parameters among Pesticides' Seller in
Gaza Governorate**

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Al Quds University
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Assessment of awareness, biochemical and hematological parameters among pesticides' sellers in Gaza Governorate

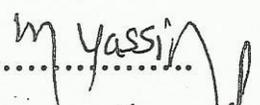
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Al Quds University

July 2011

قال رسول الله صَلَّى الله
عليه وسلم:

" اللهم انفعنا بما
علمتنا،

وعلمنا ما ينفعنا،

وزدنا اللهم علما "

صدق رسول الله

Dedication

*To the Palestinian people who are unwavering and patient on the
beloved land*

of Palestine

To my parents' soul

To my wife, sons and daughters

To my uncles, aunts, brothers and sisters

For their patient, endless support, encouragement and love

Greeting to Arab revolutions, especially the Tunisian and Egyptian

Ibrahim Hassan Lubbad

July 2011

Declaration

I certify that this thesis submitted for the degree of master is the result of my own research, except where otherwise acknowledged, and that this thesis or any of its parts has not been submitted for higher degree to any other university or institution.

July 2011

Signed

Ibrahim Hassan Lubbad

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28 July 2011

Abstract

Pesticides sellers are exposed to multiple pesticides such as insecticides, herbicides and fungicides. An exploratory awareness and health study was conducted to assess awareness, biochemical and hematological parameters among pesticides' sellers in Gaza Governorate. A cross section of 26 pesticides sellers were asked to fill in a questionnaire on knowledge, attitudes, practice towards pesticide handling, and work and health aspects. Biochemical and hematological parameters of 14 pesticides sellers and 14 controls with no history of pesticides exposure were also examined. T-test and one-way ANOVA test were applied. The mean age of pesticides' sellers was 34.3 ± 9.7 years. Fifteen (57.7%) of them were owners and 11 (42.3%) were employees. The shops were well ventilated, and 18 (69.2%) of the sellers admitted that they have no special place for eating and drinking in the shop. All sellers have knowledge about the types and ways of pesticides use, and adverse health effects. Half of them had knowledge on alternatives of pest control. Twenty five (96.1%), 24 (92.3%) and 23 (88.5%) knew that pesticides exposure through oral, inhalation and skin, respectively. Attitude toward pesticides use and effectiveness of protective gear particularly gloves and mask was positive.

Half of the sellers throw the empty pesticide containers in the garbage site or in the street. Protective measures in use was generally poor except for gloves 19 (73.1%) and masks 18 (69.2%). Pesticide sellers who wore gloves and masks had more knowledge on route of pesticides exposure through inhalation, skin and oral than those who did ($P < 0.05$). Serum alanine aminotransferase and aspartate aminotransferase were significantly increased in cases compared to controls. Urea and creatinine were also higher.

Such increase was statistically significant for urea ($P = 0.007$). White blood cell count was higher in cases ($p = 0.047$). In contrast, blood platelets and red blood cells were significantly lower in cases ($p = 0.002$ and $p = 0.027$, respectively). In parallel, hemoglobin and hematocrit showed no significant decrease in cases. Mean corpuscular volume, mean corpuscular hemoglobin and mean corpuscular hemoglobin concentration exhibited no significant changes ($P > 0.05$). ALT, AST, urea and creatinine showed successive increase with increase work duration, whereas blood

platelets exhibited successive decrease. Conducting of educational awareness programs on pesticides alternatives and training courses related to extension and health impact of pesticides are recommended.

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Chapter 1

Introduction

1.1 Background

Pesticides are substances intended to control a variety of pests. Pests can be insects, mice and other animals, unwanted plants (weeds), fungi, or microorganisms like bacteria and viruses (Environmental Protection Agency, EPA, 2008). Though often misunderstood to refer only to insecticides (Kill insects and other arthropods), the term pesticide also applies to herbicides (kill weeds and other plants that grow where they are not wanted), fungicides (kill fungi including blights, mildews, molds, and rusts), rodenticides (control mice and other rodents), and various other substances used to control pests. Under United States law, a pesticide is also any substance or mixture of substances intended for use as a plant regulator, defoliant or desiccant (Environmental Protection Agency, EPA, 2008).

Pesticides are biologically active compounds, used often in agriculture without any medical control, remain an important source of poisoning. In addition, pesticides' sellers usually handle such highly toxic compounds without safety precautions. Intoxication associated with pesticides exposure usually follows absorption either through skin, by inhalation or by ingestion (Iorrizo et al., 1996). Pesticides are sold and extensively used in the Gaza strip and the developing countries with applying poor safety tools (Forget 1991; Yassin et al., 2002; Safi et al., 2005).

Awareness on handling of pesticides was investigated in different countries. In Gaza Strip a little articles emerged on awareness of farm workers towards pesticides and showed that farm workers had good knowledge on the health impact of pesticides and that the use of protective measures was poor (Abd Rabou et al., 2002; Yassin et al., 2002). The World Health Organization estimated that there may be one million serious intentional poisonings each year in addition two millions people hospitalized for suicide attempts with pesticides (Jeyaratnam.,

1990). Several cases of chronic toxicity or death have been reported and proven among humans exposed to different types of pesticides in the Gaza Strip and other developing countries (El-Sebae, 1993; Safi et al., 2000; Safi, 2002; Eddleston et al., 2006).

1.2 Research problem

Research articles have been addressed the action of pesticides on biochemical and hematological parameters in farm workers and sprayers in the Gaza Strip and worldwide (Patil et al., 2003; Yassin, 2003; Hernández et al., 2006; Azmi et al., 2009), little attention has been paid to their effects on pesticides' sellers particularly in the Gaza Strip. Occupational exposure to pesticides has toxic effects on almost every organ of the body including liver, kidney and blood (Kossmann et al., 2001; Safi et al., 2005; Khan et al., 2008; Adigun et al., 2010).

The present study is aimed to assess for the various aspects of awareness among pesticides' sellers in the Gaza Governorate. In addition, biochemical and hematological parameters in response to pesticide exposure were investigated. This will provide us with new information on the health impact and safety measures of pesticide exposure in pesticides' sellers in the Gaza Strip, where data are rare in this regard.

1.3 Justification of the study

There are excessive use of pesticides in the Gaza Strip where farmers thought that pesticides increase agricultural production and don't know what are the hazards of pesticides on the human health and the environment. Therefore, sellers sold excess pesticides to which they exposed. In addition, there is no data concerning knowledge, attitude and practice towards pesticides and their health effects on pesticides' sellers in the Gaza strip.

1.4 General objective

The general objective of the present study is to assess awareness, biochemical and hematological parameters in pesticides' sellers in Gaza Governorate.

1.5 Specific objectives

1. To investigate various aspects of awareness including knowledge, attitude and practice of pesticides' sellers in Gaza Governorate.
2. To study work aspects and health impact of pesticides.
3. To assess liver function of pesticides' sellers through determination of alanine aminotransferase and aspartate aminotransferase activities and compared them with control subjects.
4. To test kidney function of pesticides' sellers through determination of creatinine and urea and compared them with controls.
5. To measure CBC of pesticides' sellers and controls.

1.6 Research questions

- What is the sellers' knowledge about pesticides?
- What is the sellers' attitude towards pesticides?
- What is the sellers' practice about pesticides?
- What are the safety measures they are applying?
- What is the health impact of pesticides on pesticides' sellers?

1.7 Demographic context

The total surface area of Palestine is approximately 27,000 square km, out of which 704 square kilometer is water surface constituting Lake Hula, Lake Tiberias, and one half of the Dead Sea. The entire area of historical Palestine is about (27,000 Km²). Palestine has an oblong shape, measuring from north to south some 430 km. Its width varies from 51 to 70 km in the north and from 72 to 95 km in the middle. In the south, however, it becomes wider, extending to some 117 km. It then narrows again into a triangular shape, the tip of which

touches on the Red Sea (Geography of Palestine, 1991). Palestine stretches from Ras Al-Nakoura in the North to Rafah in the South. The Gaza Strip is a part of the Palestinian coastal plain. The total surface area of the Gaza Strip is (378 Km²) and its population is estimated to be 1416543 people (Palestinian Central Bureau of Statistics, PCBS 2009). This figure classifies the Gaza Strip as one of the most densely populated area in the world. The Gaza Strip is divided geographically into five Governorates: Northern, Gaza, Mid Zone, Khan Younis and Rafah. Gaza Governorate occupies an area of 73.35 km², and its population has been estimated to be 534,558 people (PCBS 2009). It comprises GazaCity, the main city in the Gaza Strip and one of the main refugee camps, the Beach Camp.

1.8 Environmental aspects

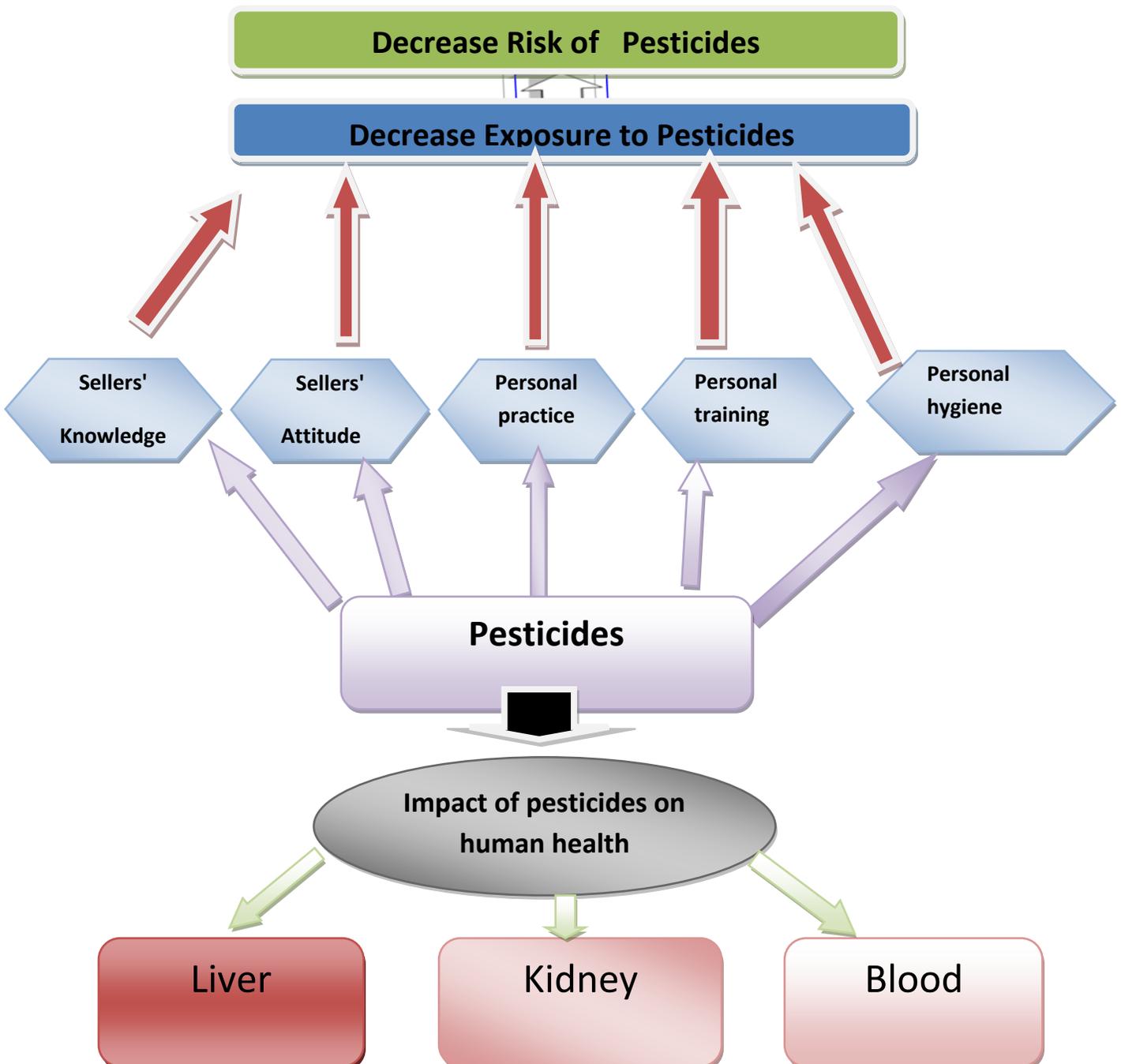
Excessive use of pesticides, inadequate disposal of municipal solid waste and improper design of sewage network infrastructure are the main environmental health problems in the Gaza Strip (Safi, 1998; Yassin et al., 2002; Yassin et al., 2008; Abu libda, 2010). Pesticides are widely sold in the Gaza Strip and pesticides' sellers deal with pesticides without taking safety precautions. Pesticides shops are concentrated in the GazaCity (Fras area). Depending on their experience, most of the pesticides' sellers are usually provide instructions and advice to the farmers who buy and use pesticides.

Safi, M. (1998) "The state of environmental in Gaza Strip Balex Screen Exchang"

Chapter 2

Literature Review

2.1 Conceptual Frameworks



2.2 Definition

A pesticide is any substance or mixture of substances intended for preventing, destroying, repelling or mitigating any pest (Environmental Protection Agency, EPA, 2007). A pesticide may be a chemical substance, biological agent (such as a virus or bacterium), antimicrobial, disinfectant or device used against any pest. Pests include insects, plant pathogens, weeds, molluscs, birds, mammals, fish, nematodes (roundworms), and microbes that destroy property, spread disease or are a vector for disease or cause a nuisance. Although there are benefits to the use of pesticides, there are also drawbacks, such as potential toxicity to humans and other animals. According to the Stockholm Convention on Persistent Organic Pollutants, 10 of the 12 most dangerous and persistent organic chemicals are pesticides (United Nations Environment Programme, 2005; Gilden et al., 2010).

2.3 Classification of pesticides and their use in Gaza Strip

Table 2.1 summarizes the different classes of pesticides (http://www.alanwood.net/pesticides/class_pesticides.html, 2010). Pesticides are heavily used / and or misused in Gaza Strip mainly in agriculture sector with poor protection measures.

Table 2.1 Classified Lists of Pesticide

| | | |
|-------------------------|--------------------|--------------------|
| Acaricides | Algicides | Antifeedants |
| Avicides | Bactericides | Bird repellents |
| Chemosterilants | Fungicides | Herbicide safeners |
| Herbicides | Insect attractants | Insect repellents |
| Insecticides | Mammal repellents | Mating disrupters |
| Molluscicides | Nematicides | Plant activators |
| Plant growth regulators | Rodenticides | Synergists |
| Virucides | Miscellaneous | Chemical classes |

More than 450 metric tons of pesticides are being used yearly in the Gaza strip. The insecticide represents 70-100 metric tons of these pesticides (Ministry of Agriculture, 2009). Other classes of pesticides used in Gaza Strip include fungicides and herbicides (Yassin et al., 2002). Some of these pesticides have been internationally suspended, banned, or cancelled because of their mutagenicity, teratogenicity, or carcinogenicity (Safi, 2002). Pesticides sellers usually handle such compounds without taking safety precautions. This will put their health at high risk. Under the Montreal Protocol the pesticide methyl bromide is considered to be an ozone depleting substance; it will be phased out in 2005 for industrialized countries and in 2015 for developing countries (United States Environmental Protection Agency 2008).

2.4 Routes of pesticides exposure into human body

There are three routes by which pesticides may enter the human body: ingestion (oral), inhalation (respiratory), and absorption by the skin (dermal).

Oral: The pesticide is ingested via the mouth and digestive tract. In the occupational context, careless behavior such as smoking or eating without washing, contaminating food or blowing out blocked nozzles by mouth, may lead to the oral intake of pesticides (Yassin et al., 2002; Gerozisis et al., 2008).

Respiratory: The pesticide is breathed into the lungs as a gas, or as very fine solid or as liquid particles (Lorizzo et al., 1996).

Dermal: The pesticide is absorbed into the body through the skin. Pesticide contamination of the skin may occur by splashing during mixing or application, by drift during application, by handling contaminated equipment, by wearing contaminated gloves, respirators, overalls and the like (Fuortes et al., 1993; Jensen et al., 2011).

2.5 Health impact of pesticides

Pesticides may cause acute and delayed health effects in those who are exposed. Pesticide exposure can cause a variety of adverse health effects. These effects can range from simple irritation of the skin and eyes to more severe effects such as affecting the nervous system, liver, kidney, blood, mimicking hormones causing reproductive problems, and also causing

cancer (Kossmann et al., 2001; Safi et al., 2005; Khan et al., 2008; Adigun et al., 2010). A systematic review found that "most studies on non-Hodgkin lymphoma and leukemia showed positive associations with pesticide exposure" and thus concluded that cosmetic use of pesticides should be decreased (Bassil et al., 2007). Strong evidence also exists for other negative outcomes from pesticide exposure including neurological, birth defects, fetal death, and neurodevelopmental disorder (Sanborn et al., 2007; Jurewicz & Hanke, 2008). The American Medical Association recommends limiting exposure to pesticides and using safer alternatives (Council on Scientific Affairs, American Medical Association, 1997). Such alternatives may include biological control which is defined as the reduction of pest populations by natural enemies and typically involves an active human role. Natural enemies of insect pests include predators, parasitoids, and pathogens (Wiedenmann, 2000). Particular uncertainty exists regarding the long-term effects of low-dose pesticide exposures. The World Health Organization and the UN Environment Programme estimate that each year, 3 million workers in agriculture in the developing world experience severe poisoning from pesticides, about 18,000 of whom die (Miller, 2004). According to one study, as many as 25 million workers in developing countries may suffer mild pesticide poisoning yearly (Jeyaratnam, 1990). Pesticide poisoning symptoms may include muscarinic symptoms (headache, blurred vision, excessive sweating and salivation, shortness of breath, nausea, vomiting and diarrhea), nicotinic symptoms (muscle weakness), central nervous system symptoms (dizziness, body tremor and numbness) and general signs (itchy skin, red eyes and runny nose) (Safi et al., 2005; Jensen et al., 2011).

2.6 Knowledge, attitudes and practices towards pesticides

In Gaza Strip, knowledge, attitude and practice studies were conducted only among farm workers, but not among pesticides' sellers. In addition, literature on awareness aspects among pesticides' sellers worldwide is limited. Although awareness educational programs regarding pesticides use and health impact are well developed globally, they are still insufficient in developing countries including Gaza Strip.

Mcdougall et al., (1993) demonstrated that farm workers in Saint Lucia, West Indies were unaware that the skin and eyes were important potential routes of absorption of pesticides. About a quarter of the smoker said that they smoked while using pesticides, about a sixth of the survey subjects reported that they ate food while using pesticides and over 60% admitted that they never wore protective clothing.

Safi (1995) stated that inadequate legislation, regulations and guidelines, testing, handling, quality control of specifications and disposal of pesticides are one of the main special problems associated with pesticide use and its management in Gaza Strip. In the West Bank, storage and disposal of pesticides seem to be less than adequate (Saleh et al., 1995).

Studies on knowledge, attitude and practice indicated that unsafe use of pesticides is the rule in developing countries (Wesseling et al., 1997). Surveys carried out in Philippines, Cameroon, Kenya, Zimbabwe, the Jordan valley, China, Bolivia, South Africa and Central America demonstrated inadequate pesticide management such as inaccessible technical assistance, the use of increased dosages and overly frequent spraying work with faulty equipment and without protective devices, or inadequate practices of storage and disposal pesticide containers. These studies also showed that pesticides' users had little knowledge of the risk of pesticides and had received little training.

Yassin et al., (2002) assessed knowledge, attitude, practice and toxicity symptoms associated with pesticide use and exposure among 189 farm workers in the Gaza Strip. Farm workers reported high levels of knowledge on the health impact of pesticides (97.9%). Moderate to high levels of knowledge were recorded on toxicity symptoms related to pesticides. Most farm workers were aware of the protective measures to be used during applying pesticides. However, no one took precautions unless they knew about the measures.

In their study entitled “rinsing and management of pesticides' containers”, Huyghebaert et al., (2002) stated that in order to reduce the effects on the environment, it is necessary to improve the management of pesticides' containers. Usually, users burn or bury empty containers. These

methods, even though decreasing must be avoided or even forbidden. Their removal must follow a specific removal process by incineration at very high temperature (> 1200 degrees C) with a specific filtration of the smoke.

Salameh (2004) used a standardized questionnaire to assess knowledge, attitude and practice in two Lebanese regions, in which a group of agricultural workers was compared to workers of the general population and a third group of pesticide distributors. Agricultural workers were exposed to pesticides during cropping, mixing, loading, and application (100%). They had low pesticide knowledge scales compared to pesticide distributors and to the general population workers. The preventive measures they took were low, and the lower their knowledge was, the lower were the preventive measures applied. Pesticide safety education is necessary in order to induce protective behavior among agricultural workers. The general population may also benefit from increasing their awareness regarding pesticides.

A specially design questionnaire was used to collect information on end-users' knowledge, attitude, and behavior related to pesticides in the Guanting Reservoir area, North of China (Zhang and Lu, 2007). Most pesticide end-users reported that they took incomplete preventive measures for lack of extensive pesticide knowledge and information. It was recommended that pesticide information, instruction, and training among farmers should be promoted, and governmental intervention is needed to ensure proper management regarding public health risks and environmental hazards.

In their an exploratory study on health risks of employees working in pesticide retail shops in India, Kesavachandran et al., (2009) reported that protective devices were not used by any of the exposed subject. However, all shopkeepers are aware of pesticide toxicity. The workers eat, drink and smoke in the workplace. They take bath in the evening after the business hours of pesticide sales and do not wash hands after each sale of pesticide to customer. Loading and unloading of packets from the cartons and its transport from ware house and showroom is done by bare hands and if load is heavy, they carry them on shoulders or the head.

2.7 Effect of pesticides on liver

Tomei et al., (1998) reported considerable liver damage with significant increase in aspartate aminotransferase (AST), alkaline phosphatase (ALP) and total bilirubin among environmental insecticides disinfectant users in Italy. High degree of abnormal liver function may indicate toxic effects of pesticides and the presence of pesticide residues in blood (Amr, 1999). Pesticides residues and their metabolites in various human tissues and fluid are indicative of past and present exposure.

Goel et al., (2000) demonstrated a significant increase in the level of various serum and liver markers such as ALP, alanine aminotransferase (ALT) and AST due to the effects of the organophosphorus insecticides chlorpyrifos. Greater the degree of pesticide exposure greater would be the levels of liver enzymes as reported in two cases of acute endosulfan toxicity (Yavuz et al., 2007).

A study reported early biochemical changes in serum enzymes after exposure to mixture of pesticides (Hernandez et al., 2006). Altuntus et al., (2002) reported increased activity of ALT and AST in people engaged in agricultural and public health programs due to the effects of Methidathion, one of the most widely used organophosphorus compound.

Bhalli et al., (2006) assessed the genotoxic effects of pesticides on workers involved in the pesticide manufacturing industry. The exposed subjects were 29 and the controls (unexposed) were 35 individuals not involved in pesticide production. A statistically significant ($P < 0.001$) increase in liver enzymes ALT, AST and ALP was detected in exposed workers with respect to the control group. There was a significant ($P < 0.001$) decrease in the level of cholinesterase in the exposed group. Exposed individuals exhibited cytogenetic damage with increased frequencies ($P < 0.001$) of binucleated cells with micronuclei and total number of micronuclei in binucleated lymphocytes in comparison with subjects of the control group. A decrease ($P < 0.001$) in cytokinesis block proliferation index similarly demonstrates a genotoxic effect due to pesticide exposure.

The frequency of plasma pesticide residues above acceptable daily intake (ADI) and its correlation with biochemical markers for assessment of adverse health effects in the tobacco farmers in Pakistan was determined (Khan et al., 2008). A total of 55 tobacco farmers exposed to pesticides and 54 controls were included. The tobacco farmers had multiple pesticides residues above ADI in their blood. Serum ALT, AST, creatine kinase, and lactate dehydrogenase (LDH) were significantly raised in the pesticides exposed farmers as compared to control group ($P < 0.001$). Total pesticides residues revealed a significant positive correlation with AST ($r = 0.42$), LDH ($r = 0.47$) and ALT ($r = 0.20$).

2.8 Effect of pesticides on kidney

In their studies on humans, Gallo and Lawryk, (1991) reported that pesticides elevated frequently serum creatinine, creatinine phosphokinase, and serum ALT. The fact that LDH and serum AST do not undergo a parallel change, and that creatinine occurs almost exclusively in the muscles, suggest that the striated muscles undergo hypoxic damage during poisoning and exclude substantial liver involvement. However, temporary liver damage (increased urinary urobilinogen, or delayed excretion of bromosulphothalein) may occur.

Abend et al., (1994), reported that rhabdomyolysis is a well-known complication of severe poisonings and appears to be also relatively frequent in severe pesticide intoxication including diazinon. In the acute phase this may cause acute renal failure and in later stages paresis if not treated correctly. Acute renal insufficiency has been described in one patient exposed to malathion spray (Reynolds, 1996).

Biological parameters of organophosphorus sprayers in the Gaza Strip were assessed (Yassin, 2003). Seventy-four organophosphorus sprayers were commonly engaged in spraying methamidophos, chlorpyrifos and dimethoate. The reference group was represented by thirty individuals selected from the general population on the basis of being never been exposed to pesticides. Exposure of sprayers to different OP lowered significantly the activity of serum cholinesterase (mean = 3891 ± 178 v 3226 ± 152 IU/L, % difference = 17.1, $p = 0.011$).

Concentrations of serum urea and uric acid were significantly increased (22.9 ± 1.0 v 26.0 ± 1.1 mg/dl, % difference=13.5, $p=0.048$ and 5.07 ± 0.17 v 5.69 ± 0.20 mg/dl, % difference=12.2, $p=0.045$, respectively). Serum creatinine was increased in comparison with controls, but the change was not significant (1.08 ± 0.02 v 1.16 ± 0.03 mg/dl, % difference=7.4, $p=0.076$).

Yousaf et al., (2003) reported subtle nephrotoxic changes in occupational exposure to pesticides with higher levels of serum creatinine and urea. Exposure to pesticide in a chemical plant also showed a significantly higher serum creatinine concentration which supports the subclinical kidney impairment (Kossmann et al., 2001). Attia (2006) reported serum creatinine and urea in upper reference range in the pesticide applicators.

Balali-Mood and Balali-Mood, (2008) reported that acid-base and electrolyte disturbances are common during severe pesticide exposure. Arterial blood gas analysis and estimation of serum electrolytes, liver and kidney function tests, amylase, creatine kinase, and lactate dehydrogenase may be required for the management of patients. Hypokalemia and hyperglycemia are common and should be considered and corrected. Transient elevation of liver enzyme, hematuria, leukocyturia, and proteinuria, may be observed during nerve agent poisoning. Serum urea and creatinine were found to be significantly raised in tobacco farmers exposed to pesticides compared to controls (Khan et al., 2008).

Clinical examination was conducted on shopkeepers selling pesticides in urban areas of India (Kesavachandran et al., 2009). The study revealed significant slowing of motor nerve conduction velocity and low peak expiratory flow rate among shopkeepers as compared to control subjects. Prevalence of significantly higher gastro-intestinal problems was also observed among exposed subjects. Significantly higher relative risk for sickness related to cardio-vascular, genito-urinary, respiratory, nervous and dermal was observed among exposed subjects compared to controls.

2.9 Effect of pesticides on blood

Pesticides have been shown to have hematotoxic properties and may cause aplastic anemia, agranulocytosis, neutropenia, and thrombopenia (Parent-Massin ; Thouvenot, 1993). Far more serious and long-term consequences have been seen in humans by Khristeva and Mirchev, (1993). 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 glucose 6 phosphate dehydrogenase deficiency and thalassemia.

Lander and Ronne (1995) found significant odds ratio for leukemia among farmers. This pointed out the role of pesticides in carcinogenesis and disruption of hematopoiesis. Genotoxicity has also been linked to pesticides (Varona et al., 2003; Undeger and Basaran, 2005). Changes in hemoglobin levels as well as electrocardiograms have been previously associated with early hexachlorocyclohexane exposure (Srivastava et al., 1995). A similar association between RBC count and pesticide use was also reported with hexachlorocyclohexane by Shouche and Rathore, (1997). In addition, Casale et al., (1998) have found that pesticide use is a significant predictor of RBC count and hematocrit and that extensive use of pesticides significantly reduces serum complement activity.

A total of 85 pesticide sprayers exposed to different classes of pesticides for 3 to 10 years were compared with 75 controls (Jyotsna et al., 2003). Significant decrease was observed in serum cholinesterase and hematological parameters viz. Hb, Hct and RBC in exposed group compared to control. The effect of pesticides on Hb in exposed humans has been observed (Ray, 1992).

Hematological biomarkers in 48 farm workers exposed to organophosphorus in the Gaza Strip were assessed (Safi et al., 2005). Results showed significant decreases in Hb content and hematocrit value for farm workers across a shift from beginning of a spraying day to end the same day (14.63 ± 1.18 g/dl and 45.58 ± 4.64 % v 14.20 ± 1.25 g/dl and 43.81 ± 4.16 %, $P < 0.05$). However, in farm workers, white blood cell count and platelets counts significantly elevated ($6.64 \pm 1.73 \times 10^3$ cell/ μ l and $194.4 \pm 85.93 \times 10^3$ cell/ μ l v $7.44 \pm 2.01 \times 10^3$ cell/ μ l and $225.4 \pm 72.77 \times 10^3$ cell/ μ l, $P < 0.01$ and $P = 0.04$, respectively) at the end of spraying day compared with the beginning of the same spraying day.

In their cross-sectional study, Leilanie Prado-Lu, (2007) determined associations between hematologic indices with illnesses related to pesticide exposure among cutflower farmers in Philippines. One hundred two randomly selected cutflower farmers underwent comprehensive, personal physical health and laboratory examinations and answered a questionnaire on work practices and illness. Results showed that illness due to pesticides ($p = 0.005$) was correlated with abnormal MCV. Significant associations were also found for hemoglobin, hematocrit, RBC, white blood cell (WBC) and platelet count.

Rastogi et al., (2008) evaluated the health impact of spraying pesticides in 34 male sprayers in the mango belt of Malihabad, North India. Plasma BuChE and complete blood count were assessed among sprayers after spraying pesticides and the findings obtained were compared with those determined in a reference group ($n=18$). Plasma BuChE was significantly decreased in workers. The results indicated significant decrease in the mean value of hemoglobin, hematocrit and platelets count; however, significantly higher count of leukocytes was also observed in the exposed group (sprayers) compared to that observed in the control group ($P<0.05$).

Chapter 3

Material and methods

3.1 Study design

A cross-sectional design was used in the present study. Cross-sectional studies involve data collected at a defined time. They are often used to assess the prevalence of acute or chronic conditions, or to answer questions about the causes of disease or the results of medical intervention. They may also be described as censuses. Cross-sectional studies may involve special data collection, including questions about the past, but they often rely on data originally collected for other purposes. It is moderately expensive, not suitable for rare diseases. Difficulty in recalling past events may also contribute bias.

3.2 Setting of the study

This study was carried out on pesticides' sellers in Gaza Governorate. Blood samples were collected from pesticides' sellers and from control individuals.

3.3 Target population

The target population was 26 pesticides' sellers in Gaza Governorate.

3.4 Sample size

The Sample size included all pesticides' sellers in Gaza Governorate. The number of interviewed pesticides' sellers was 26. Although the researcher encourage the sellers to provide them with their blood analysis results to give an idea about their health, only 14 of them respond to give blood samples. Therefore, blood samples were drawn from 14 sellers

who agreed to give the sample. A total of 14 individuals with no history of pesticides handling were taken as referents, or the control group. They were matching the pesticides sellers as can as possible for age, residency and socioeconomic status.

3.5 Response rate

All pesticides sellers participate (26) in the questionnaire interview with response rate 100%. Out of 26, 14 pesticides sellers gave blood samples with response rate 53.8%.

3.6 Eligibility

3.6.1 Inclusion criteria

All pesticides sellers in Gaza Governorate: owners and employees in pesticides shops.

3.6.2 Exclusion criteria

Customers and visitors of pesticides shop.

3.7 Period of the study

The study was conducted through the years 2010/2011. The proposal was approved by the School of Public Health –Al Quds University in July, 2010. The actual data collection commenced in August, 2010 and completed by November, 2010. Then data were analyzed and the final results were available by January, 2011.

3.8 Ethical consideration

The necessary approval was obtained to conduct the study from Helsinki committee in the Gaza Strip (Annex 1). The approval was issued in 7- 6 - 2010. Helsinki committee is an authorized professional body for giving permission to researchers to conduct their studies with ethical concern in the area. The participants were given a full explanation about the purpose of the study and assurance about the confidentiality of the information and that the participation is optional.

3.9 Study instrument: questionnaire interview

Face to face interviewed questionnaire was used for filling in the questionnaire which was designated for matching the study need. All interviews were conducted face to face by the researcher. The questionnaire (Annex 2) was based on pesticide exposure study with some modifications (Yassin et al., 2002). During the study the interviewer explained to the pesticides' sellers any of the vague questions that may not be clear to them. Most questions were one of two types: the yes/no question, which offer a dichotomous choice; and the multiple choice question, which offers several fixed alternatives (Backestrom; Hursh-Cesar, 1981). The questionnaire was validated by seven experts in the field of public health, environmental health and epidemiology. The questionnaire was also piloted with 6 pesticides' sellers, who were included in the study sample. The questionnaire included questions related to: personal information age, education and marital status; work aspects; owner or employee, previous job, work duration; Knowledge on types of pesticides sold, pesticides used, other ways for pest control, effect of pesticides on human health, and the route of pesticide entry into the human body; and attitudes regarding the use of pesticides and protective equipment or clothes during preparation of pesticides. Practice questions included: following label instructions, the wearing of protective clothes, smoking, eating, drinking, or chewing gum during handling pesticides, store empty pesticides bottles and whether washing hands and having a water bath or not. Questions on health impact and attending training courses were included: pesticides poisoning or death cases, existence of toxicological or medical center, first aid box in the shop and receive training on safe handling or the use of pesticides.

3.10 Blood samples collection and processing

Venous blood samples (about 8 ml) were drawn by a well-trained medical technologist into vacutainer tubes from pesticides' sellers and the control individuals. About 2 ml blood was placed into EDTA vacutainer tube for complete blood count. The remainder quantity of blood (about 6 ml) was left for a while without anticoagulant to allow blood to clot. Then serum samples were obtained by centrifugation at room temperature at 4000 rpm/10 minutes and then samples were stored in refrigerator for biochemical analysis.

3.11 Biochemical analysis

3. 11.1 Determination of alanine aminotransferase

Serum alanine aminotransferase (ALT) activity is measured by using optimized UV-test according to International Federation of Clinical Chemistry and Laboratory Medicine (IFCC), according to Guder and Zawta method (Guder and Zawta, 2001) using DiaSys reagent kits.

Principle



Reagents

| Components | Concentration |
|-------------------------------|---------------|
| Reagent 1 | |
| TRIS pH 7.15 | 140 mmol/l |
| L-Alanine | 700 mmol /l |
| LDH (Lactate dehydrogenase) | ≥ 2300 U/l |
| Reagent 2 | |
| 2-Oxoglutarate | 85mmol/l |
| NADH | 1 mmol/l |

Monoreagent preparation

Four parts of R1 were mixed with 1 part of R2

(e.g. 20 ml R1 + 5 ml R2) = Monoreagent

Procedure

| | |
|-------------|---------|
| | Sample |
| Monoreagent | 1000 µl |

| | |
|--------|--------|
| Sample | 100 µl |
|--------|--------|

Mix, read absorbance after 1minute. and start stop watch. Read absorbance again1, 2, and 3 min thereafter at 340 nm.

Calculation

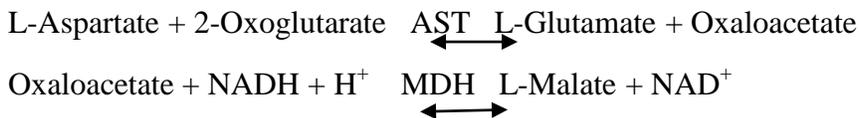
From absorbance reading calculates $\Delta A / \text{min}$ and multiply by the corresponding factor:

$$\Delta A / \text{min} \times \text{factor (1745)} = \text{ALT activity [U/l]}$$

3. 11.2 Determination of aspartate aminotransferase

Serum aspartate aminotransferase (AST) activity was measured by using optimized UV-test according to International Federation of Clinical Chemistry and Laboratory Medicine (IFCC), according to Thomas (Thomas, 1998) using DiaSys reagent kits.

Principle



Reagents

| Components | Concentration |
|----------------------------|------------------------|
| Reagent 1 | |
| TRIS pH 7.65 | 80 mmol/l |
| L-Aspartate | 240 mmol /l |
| MDH (Malate dehydrogenase) | $\geq 600 \text{ U/l}$ |

| | |
|----------------|-------------|
| Reagent 2 | |
| 2-Oxoglutarate | 12 mmol/l |
| NADH | 0.18 mmol/l |

Monoreagent preparation

Four parts of R1 were mixed with 1 part of R2

(e.g. 20 ml R1 + 5 ml R2) = Monoreagent

Procedure

| | |
|-------------|--------------|
| | Sample |
| Monoreagent | 1000 μ l |
| Sample | 100 μ l |

Mix, absorbance was read after 1min. and start stopwatch. Absorbance was read again 1, 2, and 3 min thereafter at 340 nm.

Calculation

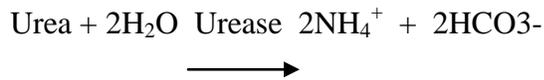
From absorbance reading calculates $\Delta A / \text{min}$ was calculated and multiply by the corresponding factor:

$$\Delta A / \text{min} \times \text{factor (1745)} = \text{AST activity [U/l]}$$

3. 11.3 Determination of urea

Serum urea was determined by using "Urease-GLDH": enzymatic UV test, according to Thomas method (Thomas, 1998) using DiaSys reagent kits.

Principle



GLDH: Glutamate dehydrogenase

Reagents

| Component | Concentration |
|--|---|
| Reagent 1: TRIS pH 7.8 2-Oxaloglutarate ADP Urease GLDH | 150 mmol/l 9 mmol/l 0.75 mmol/l ≥ 7 KU/L ≥ 1 KU/L |
| Reagent 2: NADH | 1.3 mmol/l |
| Standard | 50 mg /dl (8.33 mmol/l) |

Monoreagent preparation

Four parts of R1 were mixed with 1 part of R2

(e.g. 20 ml R1 + 5 ml R2) = Monoreagent

Procedure

| | Blank | Sample or standard |
|--------------------|-------|--------------------|
| Sample or standard | - | 10 µl |

| | | |
|-------------|--------------|--------------|
| Monoreagent | 1000 μ l | 1000 μ l |
|-------------|--------------|--------------|

Mix and incubate for 60 sec.at 25°C, then read absorbance A1. After exactly further 60 sec. read absorbance A2 at 340 nm.

$$\Delta A = (A1-A2) \text{ sample or standered}$$

Calculation

$$\text{Creatinine concentration [mg/dl]} = \frac{(\Delta A \text{ sample})}{(\Delta A \text{ standard})} \times \text{Conc. Std [mg/dl]}$$

$$\Delta A = [(A2 - A1) \text{ sample or standard}] - [(A2 - A1) \text{ Blank}]$$

3. 11.4 Determination of creatinine

Serum creatinine was determined by using kinetic test without deproteinization according to Newman and Price method (Newman and Price, 1999) using DiaSys reagent kits.

Principle

Creatinine form a colored orange-red complex in an alkaline picrate solution. The different in absorbance at fixed time during conversion is proportional to the concentration of creatinine in the sample.



Reagents

| Component | Concentration |
|-------------------------------|---------------|
| Reagent 1 Sodium hydroxide | 0.16 mol/l |
| Reagent 2 Picric acid | 4.0 mmol/l |

| | |
|----------|------------------------------|
| Standard | 2 mg /dl (177 μ mol /l) |
|----------|------------------------------|

Monoreagent preparation

Four parts of R1 were mixed with 1 part of R2

(e.g.20 ml R1+ 5 ml R2)= Monoreagent

Procedure

| | Blank | Std./Cal. | Sample |
|-------------|--------------|--------------|--------------|
| Monoreagent | 1000 μ l | 1000 μ l | 1000 μ l |
| Sample | - | - | 50 μ l |
| Std./Cal. | - | 50 μ l | - |
| Dist. water | 50 μ l | - | - |

Mix and read absorbance A1 after 60 sec against reagent blank at 492 nm, read absorbance A2 after further 120 sec.

Calculation

$$\text{Creatinine concentration [mg/dl]} = \frac{(\Delta A \text{ sample})}{(\Delta A \text{ standard})} \times \text{Conc. Std [mg/dl]}$$

$$\Delta A = [(A2 - A1) \text{ sample or standard}] - [(A2 - A1) \text{ Blank}]$$

3.12 Hematological analysis

A complete system of reagents of control and calibrator, Cell-Dyn 1700 was used to determine complete blood count (CBC) of pesticides sellers and controls in the laboratories of Al-TtawbaMedicalCenter, Jabalia Camp, in Gaza Strip.

3.13 Statistical Analysis

Data were computer analyzed using SPSS/ PC (Statistical Package for the Social Science Inc. Chicago, Illinois USA, version 18.0) statistical package. Simple distributions of the study variables and cross tabulation were applied. The independent-sample t-test procedure was used to compare means of quantitative variables including liver enzymes, kidney parameters and complete blood count of pesticides sellers and controls. Chi-square (χ^2) was used to identify the significance of the relations and associations among various variables. Yates's continuity correction test, χ^2 (corrected), was used when not more than 20% of the cells and expected frequency of less than five and when the expected number were small. The one-way ANOVA test was used for analysis of variance for average liver enzymes, kidney parameters and complete blood count as quantitative variables. The results in all the above mentioned procedures were accepted as statistically significant when the p-value was less than 5% ($p < 0.05$).

Percentage difference was calculated according to the following formula:

$$\% \text{ Difference} = \frac{\text{Mean of pesticides sellers} - \text{Mean of control}}{\text{Mean of control}} \times 100$$

3.14 Limitations of the study

The most important limitations of the present study could be:

- Budget
- Limited local and regional literature
- Recurrent cutting of electricity.

Chapter 4

Results

4.1 Personal characteristics of the study population

Table 4.1 illustrates the personal profile of the study population (pesticides' sellers in Gaza Governorate). The age frequency showed that 19 (73.1%) of pesticide sellers were 21-40 years old. The average age was 34.1 ± 9.7 years with range of 18-63 years. A total of 22 (84.6%) were married; only one (4.5%) had no children. Analysis of the educational status of the pesticide sellers (n=26) showed that 2 (7.7%) had a university degree, 17 (65.4%) had finished secondary school, 7 (26.9%) had finished preparatory school. It is worth mentioning that none of the pesticide sellers were illiterate. In addition, 4 (15.4%) were smokers.

Table 4.1 Personal characters of the pesticides sellers (n=26)

| Character | No. | % |
|--------------------------|----------|------|
| Age (Year) | | |
| ≤20 | 2 | 7.7 |
| 21-30 | 11 | 42.3 |
| 31-40 | 8 | 30.8 |
| 41-50 | 3 | 11.5 |
| >50 | 2 | 7.7 |
| Mean±SD | 34.3±9.7 | |
| Range (<i>min-max</i>) | 18-63 | |
| Marital Status | | |
| Single | 4 | 15.4 |
| Married | 22 | 84.6 |
| Have children | 21 | 95.5 |
| Have no children | 1 | 4.5 |
| Education | | |

| | | |
|--------------------|----|------|
| Preparatory school | 7 | 26.9 |
| Secondary school | 17 | 65.4 |
| University | 2 | 7.7 |
| Smoking | | |
| Yes | 4 | 15.4 |
| No | 22 | 84.6 |

4.2 Pesticide shop facilities

Owing of pesticide shop, pesticide supplier and shop facilities are summarized in Table 4.2. Fifteen (57.7%) of pesticides sellers are owners of the shop and 11 (42.3%) are employee. The main pesticides supplier was reported to be Wholesaler 17 (56.4%). Concerning shop facilities, most pesticides sellers 23 (88.8%) mentioned that the shop is ventilated. However, 18 (69.2%) pesticides sellers admitted that there is no special place for eating and drinking in the shop. Twenty two (84.6%) of pesticides sellers reported the presence of WC and water sink in the shop. The availability of first aid box in the shop was stated by 12 (46.6%). On the other hand, 21 (80.8%) of pesticides sellers admitted the availability of fire extinguisher. Pesticides shop inspection by Department of Health in Gaza Municipality and Ministry of Agriculture was reported by 23 (88.5%) sellers.

Tabl 4. 2 owing of pesticide shop, pesticide supplier and shop facilities.

| Shop facilities | No. | % |
|--|------------|----------|
| Are you owner or employee | | |
| Owner | 15 | 57.7 |
| Employee | 11 | 42.3 |
| Pesticide supplier | | |
| Wholesaler | 17 | 56.4 |
| Distributor | 1 | 3.9 |
| Other sources* | 8 | 38.8 |
| Shop ventilation | | |
| Yes | 23 | 88.5 |
| No | 3 | 11.5 |
| Special place for eating and drinking in the shop | | |
| Yes | 8 | 30.8 |
| No | 18 | 69.2 |
| WC and water sink in the shop | | |
| Yes | 22 | 84.6 |

| | | |
|--------------------------------------|----|------|
| No | 4 | 15.4 |
| Firstaid box in the shop | | |
| Yes | 12 | 46.2 |
| No | 14 | 53.8 |
| Fire extinguisher in the shop | | |
| Yes | 21 | 80.8 |
| No | 5 | 19.2 |
| Shop inspection | | |
| Yes | 23 | 88.5 |
| No | 3 | 11.5 |

* Israeli or Egyptian sources

4.3 Knowledge of pesticides sellers about pesticides

Table 4.3 illustrates the knowledge of the pesticides sellers (n=26) regarding the type of pesticide sold, way of pesticides use, alternatives of pest control, adverse health effects of pesticides, and route of their exposure. All pesticides sellers 26 (100%) had knowledge about the types and the way of pesticides use. A total of 13 (50.0%) pesticides sellers had knowledge about alternatives of pest control. When those pesticides sellers were further questioned about types of alternatives, a total of 9 (69.2%) and 4 (30.8) of them knew biological and natural control as alternatives to pesticides for pest control, respectively. All pesticides sellers knew that pesticides have adverse effect on health. Regarding knowledge about the routes of pesticides exposure; 19 (73.1%) pesticides sellers claimed that the mouth is the route of entry, followed by 18 (69.2%) who reported that inhalation is the route of entry, and 17 (65.4%) who claimed that the skin is the route of entry of pesticides into the body.

Table 4.3 Knowledge of pesticides sellers regarding type and way of pesticides use, alternatives of pest control, adverse health effects of pesticides and route of their exposure

| Knowledge about | No. | % |
|-------------------------------------|-----|------|
| Type of pesticide you sell | | |
| Yes | 26 | 100 |
| No | 0 | 0.0 |
| Way of pesticides use | | |
| Yes | 26 | 100 |
| No | 0 | 0.0 |
| Alternatives of pest control | | |
| Yes | 13 | 50.0 |
| No | 13 | 50.0 |
| Biological | 9 | 69.2 |

| | | |
|---|----|-------|
| Natural | 4 | 30.8 |
| Adverse health effects of pesticides on humans | | |
| Yes | 26 | 100.0 |
| No | 0 | 0.0 |
| Route of pesticides exposure | | |
| Inhalation | 18 | 69.2 |
| Skin | 17 | 65.4 |
| Oral | 19 | 73.1 |

4.4 Attitudes of pesticides sellers towards pesticides

Attitudes of pesticides sellers towards pesticides are pointed out in Table 4.4. When they questioned "are you with the use of pesticides?", 23 (88.5%) pesticides sellers agreed. They justified the use of pesticides by the absence of other successful alternatives for pest control. Most of pesticides sellers 21 (80.8%) believed that wearing gloves and putting a nasal masks protect from hazards of pesticides. In term of body resistance to pesticides, a total of 9 (34.6%) pesticides sellers (n=26) believed that their body has developed resistance against pesticides.

Table 4.4 Attitude of the pesticides' sellers towards use of pesticides, protective tools and resistance development against pesticides

| Attitude question | No. | % |
|--|------------|----------|
| Are you with the use of pesticides? | | |
| Yes | 23 | 88.5 |
| No | 3 | 11.5 |
| Do you think that the following tools can protect from hazards of pesticides? | | |
| Wearing gloves | 21 | 80.8 |
| Using goggles | 10 | 38.5 |
| Wearing wide brimmed hat | 5 | 19.2 |
| Putting on nasal masks | 21 | 80.8 |
| Wearing special boot | 5 | 19.2 |
| Wearing overall | 4 | 15.4 |
| Do you believe that your body has developed resistance against pesticides? | | |
| Yes | 9 | 34.6 |
| No | 17 | 65.4 |

4.5 Practices of pesticides sellers towards pesticides

Table 4.5 presents pesticides handling, type of pesticides sold, providing instructions and fate of empty pesticides containers as reported by pesticides sellers. All interviewed pesticides sellers 26 (100%) mentioned that they handled pesticides. The most common types of pesticides sold was insecticides 25 (96.2%) followed by rodenticides 24 (92.3%) and then by fungicides and herbicides 16 (61.5%) each. All pesticides sellers claimed that they provide

instructions on pesticides use to customers. The sources of their instructions were label on bottle 18 (69.2%), self-experience 14 (53.8%) and others including brochures of pesticides companies and Ministry of Agriculture 11 (42.3%). Thirteen (50.0%) threw the empty pesticide containers on the garbage site or along the street. In addition, 8 (30.8%) pesticides sellers used empty pesticides bottles or cans for other pesticides types, while 8 (30.8%) buried or burned them.

Table 4.5. Handling pesticides type of pesticides sold providing instructions and fate of empty containers as reported by pesticides sellers

| Practice aspect | No. | % |
|--|-----|------|
| Handling pesticides | | |
| Yes | 26 | 100 |
| No | 0 | 0.0 |
| The type of pesticide frequently sold | | |
| Insecticide | 25 | 96.2 |
| Fungicide | 16 | 61.5 |
| Herbicide | 16 | 61.5 |
| Rodenticide | 24 | 92.3 |
| Provide instructions on pesticide use to customers? | | |
| Yes | 26 | 100 |
| No | 0 | 0.0 |
| If yes, source of instruction | | |
| Label on bottle | 18 | 69.2 |
| Self-experience | 14 | 53.8 |
| Others* | 11 | 42.3 |
| Fate of empty pesticides bottles or cans | | |
| Use for other pesticides types | 8 | 30.8 |
| Throw on garbage site or along the street | 13 | 50.0 |
| Burning or burying | 8 | 30.8 |

* Brochures of pesticides companies and Ministry of Agriculture

4.6. Protective measures in use

Table 4.6 lists the different protective measures regularly used by pesticides sellers (n=26) during handling pesticides. Regarding protective gear, the highest number 19 (43.2 %) wore gloves and the lowest number 1 (2.3%) wore hat or special boot during handling pesticides.

The numbers of pesticides sellers who mentioned not drinking and not eating were 2 (4.5%) and 9 (34.6), respectively. In addition, 25 (96.2%) had a water bath after work.

Table 4.6. The use of protective measures as reported by pesticides sellers

| Protective measures in use | No. | % |
|-----------------------------------|------------|----------|
| Wear gloves | 19 | 43.2 |
| Wear goggles | 3 | 6.8 |
| Wear hat | 1 | 2.3 |
| Wear mask | 18 | 40.9 |
| Wear special boot | 1 | 2.3 |
| Wear overall | 2 | 4.5 |
| Not drinking | 2 | 4.5 |
| Not eating | 9 | 34.6 |
| Take shower after work | 25 | 96.2 |

4.7 Health impact of pesticides

Health impact and health care of pesticides, and attending training courses related to awareness as reported by pesticides sellers are illustrated in Table 4.7. Eleven (42.3%) and 6 (23.1%) of pesticides sellers claimed that they saw or informed about pesticides poisoning and death cases, respectively. Three of the death cases were neighbors and 3 were others including farmworkers, relatives and friends. Most of pesticides sellers 24 (92.3%) reported the presence of medical center in their areas to care about them. Less than half 12 (46.2%) of pesticide sellers participated in training courses related to health impact of pesticides. Organizations which conducted these training courses included the Association of Development 4 (33.3%) and the Ministry of Agriculture 8 (66.7%).

Table 4.7. Health impact and health care of pesticides, and attending training courses as reported by pesticides sellers

| Health impact | No. | % |
|--|------------|----------|
| Have you seen any pesticides poisoning cases or informed about it? | | |
| Yes | 11 | 42.3 |
| No | 15 | 57.7 |
| Have you seen any death cases from pesticides use or informed about it? | | |
| Yes | 6 | 23.1 |
| No | 20 | 76.9 |
| Neighbor | 3 | 50.0 |
| Others* | 3 | 50.0 |
| Is there any medical center in your area? | | |
| Yes | 24 | 92.3 |
| No | 2 | 07.7 |
| Training courses related to awareness and health impact of pesticides | | |
| Yes | 12 | 46.2 |
| No | 14 | 53.8 |
| If yes Association of Development | 4 | 33.3 |
| Ministry of Agriculture | 8 | 66.7 |

* Others including farmworkers, relatives and friends

4.8 Work aspects

Descriptions of the work aspect of the study population (n=26) is provided in Table 4.8. The average weekly work hours were 56.7 ± 13.7 hr/week. Ten (38.5%) of pesticides sellers worked 48hr/week or less and 16 (61.5%) worked more than 48hr/week. The number of years being engaged in their job as pesticides sellers ranged between 0.3 and 24 years (mean = 9.0 ± 6.8 years): 10 (38.5%), 12 (46.2%) and 4 (15.4%) of pesticides sellers has been engaged in their work for <5, 5-15 and >15 years, respectively.

Table 4.8 Work aspect of the study population (n=26).

| Work aspect | No. | % |
|-----------------------------|-----------|------|
| Weekly work hours | | |
| ≤48 | 10 | 38.5 |
| >48 | 16 | 61.5 |
| Mean | 56.7±13.7 | |
| Range | 24-90 | |
| Work duration (Year) | | |
| <5 | 10 | 38.5 |
| 5-15 | 12 | 46.2 |
| >15 | 4 | 15.4 |
| Mean | 9.0±6.8 | |
| Range | 0.3-24 | |

4.9 Liver function

The mean activities of some liver enzymes in the controls and the cases are shown in table 4.9. The average levels of serum ALT and AST in the cases (20.7±7.4 and 20.6±5.1 U/L, respectively) were higher than those in the controls (15.4±4.8 and 17.4±4.3 U/L, respectively) with percentage differences of 34.4% and 18.3%, respectively. The elevation in ALT activity was statistically significant (t=2.261, P=0.032).

Table 4.9 Serum liver enzymes (ALT and AST) activity in controls and cases

| Liver enzyme (U/L) | Control (n=14) mean±SD | Case (n=14) mean±SD | % Difference | t | P-value |
|--------------------------------------|------------------------|---------------------|--------------|-------|---------|
| ALT <i>Range (min-max)</i> | 15.4±4.8 (11-28) | 20.7±7.4 (15-36) | 34.4 | 2.261 | 0.032 |
| AST <i>Range (min-max)</i> | 17.4±4.3 (10-23) | 20.6±5.1 (14-29) | 18.3 | 1.931 | 0.064 |

ALT: Alanine Aminotransferase, AST: Aspartate Aminotransferase.

4.10 Kidney function

The mean levels of urea and creatinine (indicators of kidney function) of the controls and the cases are presented in Table 4.10. Urea and creatinine levels were increased in the cases compared to the controls (28.5±9.3 vs 20.4±4.2 mg/dl, % difference=39.7 and 0.81±0.12 vs 0.72±0.16 mg/dl, % difference=12.5, respectively). Such increase was statistically significant for urea (t=2.937, P=0.007).

Table 4.10 Serum urea and creatinine concentrations in the cases and the controls.

| Parameter (mg/dl) | Control (n=14) mean±SD | Case (n=14) mean±SD | % Difference | t | P-value |
|---|-------------------------------|----------------------------|---------------------|----------|----------------|
| Urea <i>Range (min-max)</i> | 20.4±4.2 (10-25) | 28.5±9.3 (42-11) | 39.7 | 2.937 | 0.007 |
| Creatinine <i>Range (min-max)</i> | 0.72±0.16 (0.32-0.97) | 0.81±0.12 (0.62-1.0) | 12.5 | 1.741 | 0.094 |

All values are expressed as mean ±SD.

4.11 Hematological parameters

4.11.1 White blood cells and blood platelets counts

Table 4.11 demonstrates total white blood cells count and blood platelets in the cases and the controls. White blood cell count was elevated in cases compared to the controls (8.4±1.1 vs 7.3±1.6 X10³ cell/μl, % difference=15.1, t=2.087, p=0.047). In contrast to white blood cells, blood platelets were significantly decreased in the cases compared to the controls (198.8±37.7 vs 252.4±46.2 X10³ cell/μl, % difference=-21.2, t=3.366, P=0.002).

Table 4.11 White blood cells and blood platelets of the cases and the controls

| Parameter | Control (n=14) mean±SD | Case (n=14) mean±SD | % Difference | t | P-value |
|---|-------------------------------|----------------------------|---------------------|----------|----------------|
| WBC ×10 ³ cell/μl <i>Range (min-max)</i> | 7.3±1.6 (5.1-9.7) | 8.4±1.1 (6.4-10.1) | 15.1 | 2.087 | 0.047 |
| PLT ×10 ³ cell/μl <i>Range (min-max)</i> | 252.4±46.2 (205-348) | 198.8±37.7 (168-290) | -21.2 | -3.366 | 0.002 |

All values are expressed as mean ±SD, WBC=white blood cell, PLT =No. of platelet.

4.11.2 Primary and secondary blood indices

Primary and secondary blood indices of the cases and the controls are demonstrated in Table 4.12. For the primary blood indices, the mean of red blood cell count was significantly decreased in cases compared to controls (4.6 ± 0.6 vs $5.0 \pm 0.4 \times 10^6$ cell/ μ l, % difference=8.0, $t=2.348$, $p=0.027$). In parallel, hemoglobin and hematocrit were decreased in the cases compared to the controls (14.2 ± 0.9 and 39.5 ± 4.5 vs 14.9 ± 1.0 and 41.9 ± 3.1 , respectively) recording % differences of 4.7 and 5.7, $t=1.865$, $p=0.073$ and $t=1.658$, $p=0.109$, respectively). Secondary blood indices including MCV, MCH and MCHC were found to be higher in cases compared to controls registering % differences of 2.5, 3.7 and 0.6, respectively (85.9 ± 3.3 fl, 30.9 ± 6.5 pg, and 35.9 ± 6.8 g/dl vs 83.8 ± 3.2 fl, 29.8 ± 1.5 pg and 35.7 ± 0.8 g/dl, $p=0.086$, $p=0.537$, and $p=0.951$, respectively).

Table 4.12 Primary and secondary blood indices of the cases and the controls

| Blood parameter | Control (n=14) mean \pm SD | Case (n=14) mean \pm SD | % Difference | t | P-value |
|--|---------------------------------|-------------------------------|--------------|--------|---------|
| RBC count $\times 10^6$ cell/ μ l <i>Range (min-max)</i> | 5.0 ± 0.4 (4.5-5.9) | 4.6 ± 0.6 (3.5-5.2) | -8.0 | -2.348 | 0.027 |
| HGB content (g/dl) <i>Range (min-max)</i> | 14.9 ± 1.0 (13.8-16.7) | 14.2 ± 0.9 (12.7-15.6) | -4.7 | -1.865 | 0.073 |
| Hematocrit (%) <i>Range (min-max)</i> | 41.9 ± 3.1 (36.9-47.7) | 39.5 ± 4.5 (30.6-44.7) | -5.7 | -1.658 | 0.109 |
| MCV fl <i>Range (min-max)</i> | 83.8 ± 3.2 (79.7-90.9) | 85.9 ± 3.3 (78.0-91.0) | 2.5 | 1.782 | 0.086 |
| MCH pg <i>Range (min-max)</i> | 29.8 ± 1.5 (26.9-31.8) | 30.9 ± 6.5 (23.6-44.8) | 3.7 | 0.626 | 0.537 |
| MCHC g/dl <i>Range (min-max)</i> | 35.7 ± 0.8 (34.0-36.8) | 35.9 ± 6.8 (29.3-50.4) | 0.6 | 0.062 | 0.951 |

RBC=Red blood cell; HGB=hemoglobin; MCV=mean corpuscular volume; MCH=mean corpuscular hemoglobin; MCHC=mean corpuscular hemoglobin concentration. All values are expressed as mean \pm SD.

4.12 Relations of seller's knowledge

4.12.1 Practice in relation to seller's knowledge

As indicated in table 4.13, 15 (78.9%), 15 (78.9%) and 17 (89.5%) pesticide sellers who wore gloves had knowledge that pesticides enter human body through inhalation, skin and mouth

compared to 3 (42.9%), 2 (28.6%) and 2 (28.6%) sellers who did not wear gloves P=0.197; P=0.052 and, P=0.009, respectively).

Table 4.13 Wearing gloves among pesticides sellers (n=26) in relation to their knowledge

| Knowledge about | Wear gloves (n=19) | | Not wear gloves (n=7) | | χ^2 | P value* |
|------------------------------------|-----------------------|------|--------------------------|------|----------|----------|
| | No. | % | No. | % | | |
| Route of pesticide exposure | | | | | | |
| Inhalation (n=18) | 15 | 78.9 | 3 | 42.9 | 1.663 | 0.197 |
| Skin (n=17) | 15 | 78.9 | 2 | 28.6 | 3.726 | 0.052 |
| Oral (n=19) | 17 | 89.5 | 2 | 28.6 | 6.797 | 0.009 |

*P value of χ^2 (corrected) test

Table 4.14 illustrates that 16 (88.9%), 14 (77.8%) and 16 (88.9%) pesticide sellers who wore masks had knowledge that pesticides enter human body through inhalation, skin and mouth compared to 2 (25.0%), 3 (37.5%) and 3 (37.5%) sellers who did not wear masks ($\chi^2=7.825$, P=0.005; P=0.122 and P=0.025, respectively).

Table 4.14 Wearing mask among pesticides sellers (n=26) in relation to their knowledge

| Knowledge about | Wear mask (n=18) | | Not wear mask (n=8) | | χ^2 | P value* |
|---|---------------------|------|------------------------|------|----------|----------|
| | No. | % | No. | % | | |
| Route of pesticide entry into body | | | | | | |
| Inhalation (n=18) | 16 | 88.9 | 2 | 25.0 | 7.825 | 0.005 |
| Skin (n=17) | 14 | 77.8 | 3 | 37.5 | 2.390 | 0.122 |
| Mouth (n=19) | 16 | 88.9 | 3 | 37.5 | 5.051 | 0.025 |

*P value of χ^2 (corrected) test

4.12.2 Training courses in relation to seller's knowledge

Table 4.15 showed that 9 (81.8%) of pesticide sellers who received training courses had knowledge about alternative of pest control compared to 4 (26.7%) who did not receive training courses. This relation was found to be significant (P=0.049). Regarding route of pesticide exposure, 10 (90.9%), 10 (90.9%) and 11 (100%) of pesticide sellers who received training courses knew that pesticides enter body through inhalation, skin and mouth compared to 8 (53.3%), 7 (46.7%) and 8 (53.3%) who did not receive such courses. The interaction of training courses with seller knowledge was significant for skin and mouth (P=0.054 and P=0.028, respectively).

Table 4.15 Training courses among pesticides sellers (n=26) in relation to their knowledge

| Knowledge about | Have training (n=11) | | Not havetraining (n=15) | | χ^2 | P value |
|---|-------------------------|------|-------------------------------|------|----------|---------|
| | No. | % | No. | % | | |
| Alternative of pest control (n=13) | 9 | 81.8 | 4 | 26.7 | 3.869 | 0.049 |
| Route of pesticide exposure | | | | | | |
| Inhalation (n=18) | 10 | 90.9 | 8 | 53.3 | 2.627 | 0.105 |
| Skin (n=17) | 10 | 90.9 | 7 | 46.7 | 3.708 | 0.054 |
| Oral (n=19) | 11 | 100 | 8 | 53.3 | 4.853 | 0.028 |

4.13 Relations of biochemical and hematological parameters of pesticides sellers to work duration

4.13.1 Liver enzymes of pesticides sellers in relation to their work duration

Table 4.16 showed a successive increase in the mean levels of ALT with increasing years of work (14.9±4.3, 22.6±9.9 and 23.3±16.3 mg/dl at <5, 5-15 and >15 years, respectively). This increase was not significant (P=0.456). Similar result was found for AST (14.8±2.1, 20.4±4.8 and 21.1±5.1 mg/dl (P=0.114).

Table 4.16 Liver enzymes (ALT and AST) activities of pesticides sellers (n=14) in relation to their work duration

| Liver enzyme (U/L) | Work duration (Year) | | | F | P value |
|-----------------------|----------------------|-----------------------|----------------------|-------|---------|
| | <5 (n=4) mean±SD | 5-15 (n=7) mean±SD | >15 (n=3) mean±SD | | |
| ALT | 14.9±4.3 | 22.6±9.9 | 23.3±16.3 | 0.843 | 0.456 |
| AST | 14.8±2.1 | 20.4±4.8 | 21.1±5.1 | 2.663 | 0.114 |

ALT: Alanine aminotransferase, AST: Aspartate aminotransferase. All values were expressed as mean±SD.

4.13.2 Urea and creatinine concentrations of pesticides sellers in relation to their work duration

Table 4.17 showed a successive increase in the mean levels of urea with increasing years of work (27.5±13.5, 28.2±7.2 and 30.4±11.2 mg/dl at <5, 5-15 and >15 years, respectively). This increase was not significant (P=0.928). The mean levels for creatinine at the same work intervals were 0.75±0.12, 0.87±0.11 and 0.76±0.12 mg/dl (P=0.225).

Table 4.17 Urea and creatinine concentrations of pesticides sellers (n=14) in relation to their work duration

| Parameter (mg/dl) | Work duration (Year) | | | F | P value |
|----------------------|----------------------|-----------------------|----------------------|-------|---------|
| | <5 (n=4) mean±SD | 5-15 (n=7) mean±SD | >15 (n=3) mean±SD | | |
| Urea | 27.5±13.5 | 28.2±7.2 | 30.4±11.2 | 0.076 | 0.928 |
| Creatinine | 0.75±0.12 | 0.87±0.11 | 0.76±0.12 | 1.712 | 0.225 |

All values are expressed as mean \pm SD, $p>0.05$ not significant.

4.13.3 Blood parameters of pesticides sellers in relation to their work duration

As presented in Table 4.18, blood platelet count showed a successive decrease with increasing years of work (215.0 \pm 52.0, 195.1 \pm 37.6 and 180.7 \pm 1.2 at <5, 5-15 and >15 years, respectively). This increase was not significant (P=0.517). White and red blood cell counts and hemoglobin were fluctuated with no significant differences (P=0.434; P=0.843 and P=0.428, respectively).

Table 4.18. Blood parameters of pesticides sellers (n=14) in relation to their work duration.

| Blood parameter | Work duration (Year) | | | F | P value |
|--------------------|---------------------------|-----------------------------|----------------------------|-------|---------|
| | <5 (n=4) mean \pm SD | 5-15 (n=7) mean \pm SD | >15 (n=3) mean \pm SD | | |
| WBC | 7.9 \pm 1.6 | 7.1 \pm 0.8 | 7.9 \pm 1.1 | 0.902 | 0.434 |
| RBC count | 4.6 \pm 0.4 | 4.6 \pm 0.6 | 4.4 \pm 0.9 | 0.174 | 0.843 |
| HGB content | 15.4 \pm 1.9 | 14.7 \pm 1.1 | 15.8 \pm 0.8 | 0.919 | 0.428 |
| PLT | 215.0 \pm 52.0 | 195.1 \pm 37.6 | 180.7 \pm 1.2 | 0.701 | 0.517 |

WBC = white blood cell ($\times 10^3$ cell/ μ l); PLT =No. of platelet ($\times 10^3$ cell/ μ l); RBC=Red blood cell ($\times 10^6$ cell/ μ l); HGB=hemoglobin (g/dl). All values are expressed as mean \pm SD. $P<0.05$: significant, $p>0.05$ not significant.

Chapter 5

Discussion

The present study was carried out in the Gaza Strip, which has several environmental problems. One of these problems in concern result from pesticides which was identified as a major environmental health problem in Gaza Strip (Safi 2000, Yassin et al.,2002 and El shanty 2009). Data on pesticides in the Gaza Strip are limited to few published studies on farm workers used such highly toxic compounds. However, till now no published data are available on pesticides handling among pesticides sellers in the Gaza Strip. Therefore, the present study is to assess awareness, biochemical and hematological parameters in pesticides' sellers in Gaza Governorate. This will be useful in awareness and prevention strategies applied to pesticides sellers.

The total response of pesticides sellers to questionnaire interview was high attention to participate in this study. The result of that none of the pesticides sellers found to be illiterate do reflect a well-educated community. This may give the impression that educated pesticides sellers is a result of them not getting another job because of the unemployment crisis in the Gaza Strip. Giacaman et al., (2009) reported that unemployment in Gaza Strip was around 33% of the active workforce in 2007, and rose to 37% in 2008. Such unemployment crisis is expected to exceed 50% in 2011 as a result of the continuous siege on economic conditions in Gaza Strip.

Concerning shop facilities, the present data showed that pesticides shops in Gaza Governorate have WC and water sinks, and well ventilated, a finding contradict with that found by Kesavachandran et al., (2009). WHO reported that pesticides shops in some urban

areas in Indian have poor ventilation. In addition, most pesticides sellers admitted shop inspection by Department of Health in Municipality and Ministry of Agriculture. Despite that, most pesticides shops in Gaza Strip have no special places for eating and drinking. This means that pesticides sellers eat and drink in the workplace, a practice which could put them at higher risk of pesticides poisoning. Similar result was obtained by Kesavachandran et al., (2009) in India. Therefore, providing special place for eating and drinking in each shop is highly needed. The broad suggested idea is to establish central canteen for all pesticides sellers, as pesticides shops are concentrated in a small area in Gaza Governorate.

The present results revealed that all pesticides sellers knew the types and the ways of pesticides use and knew that pesticides have adverse effect on health. Studies on knowledge, attitude and practice indicated that pesticides' users had little knowledge of the risk of pesticides in developing countries (Wesseling et al., 1997). However Salameh, (2004) found that Lebanese agricultural workers had low pesticide knowledge scales compared to pesticide distributors. On the other hand, knowledge on alternatives of pest control in the present study was moderate, where half of pesticides sellers had no knowledge on alternatives of pest control. Low level of knowledge among farm workers in the Gaza Strip on biological and natural control as alternatives to pesticides for pest control was reported (Yassin et al., 2002). Such results necessitate the launch of educational extension programs on pesticides alternatives among pesticides sellers.

Knowledge of pesticides sellers on the route of pesticides entry into the body through oral, inhalation and skin was relatively high. This finding is in agreement with that of Kesavachandran et al., (2009) who showed that the exposure of the retail shop keepers occurs through ingestion, inhalation and dermal contact. In addition, the knowledge of pesticides sellers regarding the mouth as a route of pesticides exposure was the highest. World Health Organization (1993) considered mouth as an important route for pesticides entry into the body.

The current investigation shows that the majority of the interviewed pesticides sellers were with the use of pesticides. Moderate knowledge about other alternatives for pest control and profits of selling pesticides may be the justification for such attitude. Most of pesticides sellers believed that gloves and masks do protect them from pesticides hazards. This attitude is reflected in their practice of being wearing gloves and masks rather than other protective

gears. In addition, one third of the interviewed pesticides sellers believed that their bodies could develop resistance against pesticides. This is not only the attitude of pesticides sellers in the Gaza Strip, but also the attitude of farm workers in the West Bank (Salheh et al., 1995; / Al Faris, 2007).

Regarding practice, the present results showed that all pesticides sellers handled pesticides and provided instructions about pesticides use to customers. The main sources of their instructions were labels on bottles and self-experience. Similar result was obtained by Kesavachandran et al., (2009). Insecticide was the most common type of pesticides sold. In addition, half of pesticides sellers threw the empty pesticide containers on the garbage site or along the street and around third of them burn pesticides bottles or cans. Such practice could put the general population at risk. Disposal of pesticides are one of the main special problems associated with pesticide use and its management in Gaza Strip (Safi, 1995). In order to reduce the effects on the environment, it is necessary to improve the management of pesticides' containers. Usually, users burn or bury empty containers. These methods, even though decreasing must be avoided or even forbidden. Their removal must follow a specific removal process by incineration at very high temperature ($> 1200\text{ }^{\circ}\text{C}$) with a specific filtration of the smoke (Huyghebaert et al., 2002).

As indicated in the present study, the use of protective measures among pesticides sellers was poor except for wearing gloves and masks and taking shower after work. This finding is in accordance with that obtained by other authors (Zhang & Lu, 2007; Singh & Gupte 2010; Jensen et al., 2011) who reported that most pesticide users took incomplete or inadequate protective measures. In this context, the majorities of pesticides sellers eat and drink in the shop. Kesavachandran et al., (2009) found that the workers in pesticides retail shops eat and drink in the work place.

When knowledge about pesticides entry into body was related to practice in term of gloves and masks, it was found that pesticides sellers who wore gloves and masks had more knowledge than who did not. This means that knowledge has positive influence on practice. The present finding is in consistent with the study from Lebanon (Salameh, 2004) who found that the lower the knowledge of pesticides users was, the lower were the preventive measures applied. Zhang and Lu, (2007) reported that most pesticide users in North of China took

incomplete preventive measures for lack of extensive pesticide knowledge and information. Therefore, pesticide safety education is necessary in order to induce protective behavior among agricultural workers.

Health impact of pesticides sellers showed that more than one third and about quarter of pesticides sellers saw or informed about pesticide poisoning and health cases, respectively. Previous reporting on pesticide poisoning and death cases was mentioned in Gaza Strip (Safi, 2002; El-shanty, 2009). Most of pesticides sellers reported the presence of medical center in their areas that revived and treated pesticide poisoning cases. More than half of pesticides sellers admitted that they did not received training courses related to awareness and health impact of pesticides. Similar results were documented (Zhang & Lu, 2007; Singh & Gupta, 2010). Consequently, there is a need to encourage pesticides sellers to participate in training courses related to awareness and health impact of pesticides.

When knowledge about alternative of pest control and pesticides entry into body was related to training courses related to awareness and health impact of pesticides, it was found that pesticides sellers who received training had more knowledge than who did not. This means that training has good impact on knowledge. Wesseling et al., (1997) reported that pesticides users in developing countries had little knowledge of the risk of pesticides as a result of receiving little training. In addition, Jensen (2011) showed that the higher educated pesticides users reduced their risk of poisoning for each extra personal protective measure they adapted. This support the previous idea that there is a need to encourage pesticides sellers to participate in training courses related to awareness and health impact of pesticides.

Although the actual weekly work hours were determined by the Palestinian labor law to be 45 hours (Palestinian Labor Law 2001), about two thirds of pesticides sellers worked more than 48 hours/week. This may be attributed to increasing life expenses, practically after the economic siege on the Gaza Strip (United Nation, Office for the Coordination of Humanitarian Affairs, 2008). In addition, around half of pesticides sellers worked in pesticides shop for 5-15 years. This may increase risk of pesticides on health of pesticides sellers.

Concerning liver function, the results showed that the average levels of serum ALT and AST of pesticides sellers were significantly higher than those in the controls. This effect is

expected to be as a result of pesticides exposure. However, ALT was more affected than AST which could be true as ALT is considered the most specific enzyme for liver function. Elevation of liver enzymes activities was previously documented in occupational setting of pesticides exposure (Yassin, 2003; Khan et al., 2008). Liver is the center of biotransformation and detoxification of foreign compounds and is the most vulnerable to the chemical assaults (Kulkarni and Hodgson, 1980). Pesticide exposure causes liver damage and leakage of cytosolic enzymes from hepatocytes and other body organs into blood (Dewan et al., 2004). When liver enzymes activities were related to work duration of pesticides sellers, there was a successive not significant increase in the mean levels of ALT and AST. Bhalli et al., (2006) reported that elevation of liver enzymes may be due to increased gene expression due to long term requirement of detoxification of pesticides.

Kidney function of pesticides sellers was assessed through the measurement of urea and creatinine. Urea and creatinine levels were increased in the pesticides sellers compared to the controls. Elevation of urea and creatinine concentrations was documented in occupational setting of pesticides exposure (Attia, 2006; Khan et al., 2008). In addition, nephrotoxic effect of pesticides have been reported (Kossmann et al., 1997; Poovala et al., 1999). Urea is formed by the liver as an end product of protein breakdown and is one marker of the kidney function (Debra Manzella, 2008). Increase in serum urea observed here may be due to 1) impairment in its synthesis as a result of impaired hepatic function as mentioned above, 2) disturbance in protein metabolism and 3) decrease in the filtration rate of the kidney. Creatinine is a waste product that is normally filtered from the blood and excreted with the urine. Increases in creatinine levels in response to pesticides exposuer are indicating renal diseases. However, this change may be not significant (Parron et al., 1996; Yassin, 2003). Consequently, it is difficult to determine the onset of such changes and this may lead to controversial results. Therefore, it must watch the creatinine levels carefully to determine how much function the kidneys have and this does vary slightly. When urea and creatinine concentrations were related to work duration of pesticides sellers, there was a general not significant increase in the mean levels of urea and creatinine. Therefore, like liver, kidney function was also affected in pesticides sellers with work duration.

Complete blood count showed that total white blood cell count was significantly elevated in the pesticides sellers compared to controls. In contrast to white blood cells, blood platelets were significantly decreased in pesticides sellers. Similar results were addressed as a result of exposure to pesticides in adults (Safi et al., 2005; Rastogi et al., 2008). The induction of white blood cell count indicates the activation of a defense mechanism and the immune system, which could be a positive response for survival (Wesseling et al., 1997). Leukocytosis has been recorded following the administration of pesticides (Brown et al., 1990; Sungur and Guven, 2001). Regarding primary blood indices, red blood cell count, hemoglobin and hematocrit were generally decreased in pesticides sellers compared to controls. On the other hand, secondary blood indices including MCV, MCH and MCHC were found to be higher in pesticides sellers. These results are consistent with those of other studies dealing with pesticides exposure in humans (Jyotsna et al., 2003; Leilanie and Prado-Lu, 2007). The observed decrease in hemoglobin content and hematocrit value in pesticides sellers could be attributed to the decreased size of red blood cells or the impaired biosynthesis of heme in bone marrow as a result of pesticide exposure (Isselbacher et al., 1992 ; Zayed et al., 1993). When blood parameters were related to work duration of pesticides sellers, blood platelet count showed a not significant successive decrease with increasing years of work. White and red blood cell counts and hemoglobin were fluctuated with no significant differences. This may imply that blood abnormalities in pesticides sellers could be attributed to their occupational exposure to pesticides.

Chapter 6

Conclusions and Recommendations

6.1 Conclusions

- The mean age of pesticides' sellers was 34.1 ± 9.7 years with average range of 18-63 years. They are educated.
- Most of pesticides' sellers were shop owners and they admitted that there is no special place for eating and drinking in the shop.
- All pesticides sellers had knowledge about types, ways of pesticides use and their adverse health effects, and the majority of them knew that mouth, inhalation and skin are the routes of pesticides exposure.
- Attitude toward pesticides use and effectiveness of protective gear particularly gloves and mask was positive.
- Practice showed that half of pesticides sellers threw the empty pesticides containers on the garbage site or along the street. Protective measure in use was generally poor except for gloves 19 (73.1%) and mask 18 (69.2%).
- Pesticide sellers who wore gloves and masks had more knowledge on route of pesticides exposure through inhalation, skin and oral than those who did not with general significant difference ($P < 0.05$).

- About half of pesticides sellers reported that they see or informed about pesticides poisoning and death cases as well as having training courses related to awareness and health impact of pesticides. The interactions of training with knowledge on alternatives of pest control, and on skin and mouth as routes of pesticides exposure were significant.
- The average weekly work hours of pesticides sellers were 56.7 ± 13.7 hr/week and about half of them engaged in their work for 5-15 years.
- Serum alanine aminotransferase and aspartate aminotransferase were significantly increased in cases compared to controls (20.7 ± 7.4 vs 15.4 ± 4.8 U/L, % difference = 34.4, $p = 0.032$ and 20.6 ± 5.1 vs 17.4 ± 4.3 U/L, % difference = 18.3, $p = 0.064$).
- Serum urea and creatinine were also higher in the cases (28.5 ± 9.3 vs 20.4 ± 4.2 mg/dl, % difference = 39.7 and 0.81 ± 0.12 vs 0.72 ± 0.16 mg/dl, % difference = 12.5, respectively). Such increase was statistically significant for urea ($t = 2.937$, $P = 0.007$).
- White blood cell count was higher in cases (8.4 ± 1.1 vs $7.3 \pm 1.6 \times 10^3$ cell/ μ l, % difference = 15.1, $p = 0.047$). In contrast, blood platelets were significantly decreased in cases (198.8 ± 37.7 vs $252.4 \pm 46.2 \times 10^3$ cell/ μ l, % difference = 21.2, $p = 0.002$).
- Red blood cell count was significantly lower in cases compared to control (4.6 ± 0.6 vs $5.0 \pm 0.4 \times 10^6$ cell/ μ l, % difference = 8.0, $p = 0.027$). In parallel, hemoglobin and hematocrit showed not significant decrease in cases (14.2 ± 0.9 and 39.5 ± 4.5 vs 14.9 ± 1.0 and 41.9 ± 3.1 , respectively).
- Mean corpuscular volume, mean corpuscular hemoglobin and mean corpuscular hemoglobin concentration showed no significant changes ($P > 0.05$).
- ALT, AST, urea and creatinine showed successive increase with increasing years of work, whereas blood platelet exhibited successive decrease with increase work duration.

6.2 Recommendations

1. Conducting of educational extension programs on pesticides alternatives and training courses related to awareness and health impact of pesticides to pesticides sellers.
2. Encouragement of pesticides sellers to be committed to safety measures particularly during pesticides handling such as exposure.
3. Frequent monitoring of biochemical and hematological parameters of pesticides sellers.
4. Improvement of sellers practice to collect empty pesticides containers in safety bags instead of throwing them on the garbage site or along the street.
5. Limitation of work hours to be not more than 48/ hr/week.
6. Establishment of central canteen for all pesticides sellers, as pesticides shops are concentrated in a small area (Fras area) in central Gaza city.

Chapter 7

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Annex (1) English Questionnaire

QUESTIONNAIRE ABOUT PESTICIDES' SELLERS

Serial No.....

Date.....

Personal information

1. Name..... Tel. No.....

2. Age (year)

3. Education

| Illiterate | Primary | Preparatory | Sec. School | Dip, University |
|------------|---------|-------------|-------------|-----------------|
| | | | | |

4. Marital Status

| Married | Single | Widowed | Divorced |
|---------|--------|---------|----------|
| | | | |

4.1 In the case of being married, do you have children?

(1)Yes (0) No

5. Are you smoker?

(1)Yes (0) No

Work aspects

6. Are you? Owner Employee

7. How many hours per day do you work? hours

8. How many days per week do you work? days

9. How long have you been in the business of selling pesticides?
_____ years

10. Who are the suppliers of the pesticides you sell?

Wholesaler _____% Distributor _____%
Pesticide Company _____% Smugglers _____% Others _____%

11. Are ventilation good in shop? (1)Yes (0) No

12. Is there Special place for eating and drinking in the shop? (1)Yes (0) No

13. Is there WC and water sink in the shop? (1)Yes (0) No

14. Is there First aid box in the shop? (1)Yes (0) No

15. Is there Fire extinguisher in the shop? (1)Yes (0) No

16. Is there Shop inspection? (1)Yes (0) No

16.1. If yes whom

Knowledge questions

17. Do you know the types of pesticide you sell?
(1)Yes (0) No

17.1 If yes please specify:

| Rank | Name of the pesticide | uses |
|------|-----------------------|------|
| 1 | | |
| 2 | | |

| | | |
|---|--|--|
| 3 | | |
| 4 | | |
| 5 | | |

18. Do you know how the pesticides used?
 (1)Yes (0) No

19. Do you know any other ways for pest control rather than Pesticides use?
 (1)Yes (0) No

20. Do you know that exposure to pesticides has an adverse health effect on human health?
 (1)Yes (0) No

21. Do pesticides enter human body through the followings?

- Inhalation
- Skin
- Mouth

22. According to pesticide sell, please list the crops to which pesticides extensively applied (on order).

| Rank | Name of the crop | Number of spray |
|------|------------------|-----------------|
| 1 | | |
| 2 | | |
| 3 | | |
| 4 | | |

Attitude questions

23. Are you with the use of pesticides for pest control?
 (1) Yes (0) No

23.1 If no Why?

- To protect human health
- To keep good environment

- To increase my income
- Others

24. Do you think that the followings can protect you from hazards of pesticides?

- Wearing gloves
- Using goggles
- Wearing wide brimmed hat
- Putting on nasal masks
- Wearing special boot
- Wearing overall

25. As a pesticides' seller do you believe that your body has resistant against pesticides?

(1)Yes (0) No

Practice question

26. Are you handling pesticides?

(1)Yes (0) No

26.1 If the answer yes, for how long? ----- Years

27. Do you provide instructions on the use of pesticides to your customers?

(1)Yes (0) No

27.1 If yes source of instruction is

- Label on containers
- Self-experience
- Others

28. What are you doing with empty pesticides bottles or cans?

- Throw them in garbage
- Throw them alongside of streets

- Use for other pesticides types
- For home use
- Burning or burying the empty pesticides

29. Which the following do you wear during dealing with pesticides?

- Gloves (1) Yes (0) No
- Goggles (1) Yes (0) No
- Hat (1) Yes (0) No
- Mask (1) Yes (0) No
- Special boot (1) Yes (0) No
- Overall (1) Yes (0) No

30. during your work in the shop is you doing the followings?

- Smoking (1) Yes (0) No
- Drinking (1) Yes (0) No
- Eating (1) Yes (0) No
- Chewing gum (1) Yes (0) No

31. Do you wash your hands after handling pesticides?

(1)Yes (0) No

32. Do you take shower directly after work?

(1)Yes (0) No

32.1 If yes

- in the shop
- at home

33. According to the customers' request, please list the type of pesticide frequently sold

| | Insecticide | Herbicide | Fungicide | Rodenticide | Others |
|--------|-------------|-----------|-----------|-------------|--------|
| First | | | | | |
| Second | | | | | |
| Third | | | | | |
| Fourth | | | | | |

Health impact and attending training courses

34. Have you been participated in seminar or training courses related to health impact of pesticides?

(1)Yes (0) No

34.1 If yes please specifies the organization, the institute or any other sector which conducted such courses.....

35. Have you seen any pesticides poisoning cases or informed about it?

(1)Yes (0) No

36. Have you seen any death cases from pesticides use or informed about it?

(1)Yes (0) No

36.1 if yes there are

Neighbors

customer

Family

Others

37. Is there any toxicological or medical center in your area provides medical services to farm worker or sellers?

(1)Yes (0) No

Thank you

Annex (2) Arabic Questionnaire

استبيان حول باعة المبيدات

الرقم المسلسل:..... التاريخ:.....

معلومات شخصية

1- الاسم رقم الموبايل:.....

2- العمر:..... سنة

3- المستوى العلمي:

| | | | | |
|-----------|---------|--------|-------|----------------|
| غير متعلم | ابتدائي | إعدادي | ثانوي | دبلوم أو جامعي |
| | | | | |

4- الحالة الاجتماعية

| | | | |
|-------|------|------|------|
| متزوج | أعزب | أرمل | مطلق |
| | | | |

4.1- هل لديك أبناء؟

(1) نعم (0) لا

5. هل أنت مدخن؟

(1) نعم (0) لا

جوانب العمل

6. هل أنت؟ مالك للمحل □ عامل في المحل □

7. كم ساعة تعمل يومياً؟ ساعة.

8. كم يوم تعمل في الأسبوع؟ يوم.

9. منذ متى و انت في الأعمال التجارية في مجال بيع المبيدات؟ سنة.

10. أي نوع من الموردين للمبيدات كنت تتعامل معه؟

تاجر جملة _____ % موزع _____ %
شركة المبيدات _____ % المهربين _____ % أخرى _____ %

11. هل التهوية جيدة في المحل

(1) نعم (0) لا

12. هل يوجد مكان منفصل وخاص بالطعام والشراب في المحل؟

(1) نعم (0) لا

13. هل يوجد دورة مياه ومغسلة في المحل؟

(1) نعم (0) لا

14. هل يوجد صندوق إسعافات أولية؟

(1) نعم (0) لا

15. هل يوجد مطفأة حريق؟

16. هل يوجد جهة رقابية على المحل ؟
(1) نعم (0) لا

1-16 إن كانت الإجابة نعم أذكرها.....

أسئلة المعرفة

17. هل تعرف نوع المبيدات التي تبيعها ؟
(1) نعم (0) لا

17.1 إذا كان نعم لو سمحت حددها واستعمالها حسب الأكثر بيعا :

| الرقم | اسم المبيد | استعمالات المبيد |
|--------|------------|------------------|
| First | | |
| Second | | |
| Third | | |
| Fourth | | |
| Fifth | | |

18. هل تعلم كيف تستخدم المبيدات؟
(1) نعم (0) لا

19. هل تعرف أي وسائل أخرى لمكافحة الآفات بدلا من استخدام المبيدات؟
(1) نعم (0) لا

20. هل تعرف أن التعرض للمبيدات لها تأثيرات صحية ضارة على صحة الإنسان؟
(1) نعم (0) لا

21. هل تعرف أن المبيدات تدخل إلى الجسم من خلال ؟

- الاستنشاق
- الجلد
- الفم

22. وفقا لبيع المبيدات الحشرية ، الرجاء إدراج قائمة المحاصيل التي طبق عليها استخدام المبيدات (على الترتيب).

| التصنيف | اسم المحصول | عدد مرات الرش /السنة |
|---------|-------------|----------------------|
| 1 | | |
| 2 | | |
| 3 | | |
| 4 | | |

أسئلة الأسلوب

23. هل أنت مع استخدام المبيدات لمكافحة الآفات؟

(1) نعم () لا (0)

إذا كانت الإجابة لا ما السبب؟

لحماية صحة الإنسان

للمحافظة على نظافة البيئة

لزيادة الدخل الخاص بي

أخرى.....

24. هل تعتقد أن ما يلي يمكن حمايتك من مخاطر مبيدات الآفات؟

ارتداء القفازات

استخدام النظارات الواقية

ارتداء قبعة واسعة الحواف

وضع كمامة على الأنف

ارتداء حذاء خاص

ارتداء المعطف الشامل

25. كما يقول بائعي المبيدات 'هل تعتقد إن جسمك طور مقاومة ضد المبيدات ؟

(1) نعم () لا (0)

أسئلة الممارسة

26. هل تتعامل مع المبيدات؟

(1) نعم () لا (0)

27. هل تزود زبائنك من مستخدمي المبيدات بالتعليمات الخاصة بالمبيد؟

(1) نعم () لا (0)

1-27 إذا كانت الإجابة نعم الإرشادات التي تعطيها اكتسبتها عن طريق :

الطابع الملصق على العبوة

الخبرة الشخصية

غير ذلك.....

28. ماذا تفعل بزجاجات و علب المبيدات الفارغة؟

- ترميها إلى القمامة
 ترمى بها على جانب الطريق
 تستخدمها لمبيدات أخرى
 تستخدمها في البيت
 تحرقها أو تدفنها
- (1) نعم) لا (0
 (1) نعم) لا (0
 (1) نعم) لا (0
 (1) نعم) لا (0

29. أي من هذه الأشياء تستخدمها خلال تعاملك مع المبيدات؟

- القفازات
 النظارات الواقية
 القبعة
 القناع
 حذاء خاص
 المعطف الشامل
- (1) نعم) لا (0
 (1) نعم) لا (0

30. خلال عملك في المتجر هل تستخدم التالي:

- التدخين
 الشرب
 الأكل
 تمضغ العلكة
- (1) نعم) لا (0
 (1) نعم) لا (0
 (1) نعم) لا (0
 (1) نعم) لا (0

31. هل تغسل يديك بعد التعامل مع المبيدات؟

- (1) نعم) لا (0

32. هل تأخذ حمام مياه (دش) بعد انتهائك العمل مباشرة؟

- (1) نعم) لا (0

32.1 إذا كان نعم في البيت في المتجر

33. بناءً على طلب الزبائن، من فضلك أدرج المبيدات التي تباع باستمرار:

| مبيدات حشرية | مبيدات الأعشاب | مبيدات الفطريات | مبيدات للقوارض | أخرى | |
|--------------|----------------|-----------------|----------------|------|--------|
| | | | | | الأول |
| | | | | | الثاني |
| | | | | | الثالث |
| | | | | | الرابع |

التأثير الصحي وحضور الدورات التدريبية

34 هلشاركتفي دورة أو ورشة عمل أو تدريب تتعلق بالأثر الصحي للمبيدات؟
(1) نعم (0) لا

34. 1 إذا كان نعم من فضلك حدد المؤسسة أو المنظمة التي أجرت هذه الدورات.....

35. هل رأيت حالة تسمم بالمبيدات أو أخبرت بها؟

(1) نعم () لا (0)

36. هل رأيت حالة وفاة ناتجة عن المبيدات أو أخبرت بها؟

() نعم () لا (0)

36-1 إذا كانت الإجابة نعم هل كانت حالة الوفاة من؟:

من الأقارب

من الزيون

من الجيران

غير ذلك.....

37. هل يوجد في منطقتك مركز طبي أو مركز سموم لتقديم الخدمة العلاجية للمزارعين أو بانعي المبيدات؟
(1) نعم (0) لا

Thank you

Annex (3) Approval of Administrator hospitals Ministry of health

Al-Quds University

Jerusalem

School of Public Health

2010/9/28



جامعة القدس

القدس

كلية الصحة العامة

الأخ/د. محمد الكاشف المحترم

مدير عام المستشفيات - وزارة الصحة

تحية طيبة وبعد،،،

الموضوع: مساعدة الطالب إبراهيم حسن ليد

يقوم الطالب المذكور أعلاه بإجراء بحث بعنوان:

"Assessment of Awareness, Biochemical and Hematological Parameters among Pesticides Sellers in Gaza governorates"

كمطلب للحصول على درجة الماجستير في الصحة العامة-مسار صحة البيئة. و عليه نرجو التكرم للإيعاز لمن ترونه مناسب

لتسهيل مهمة الطالب باستخدام مختبرات مستشفى الشفاء لعمل التحاليل اللازمة وهي :

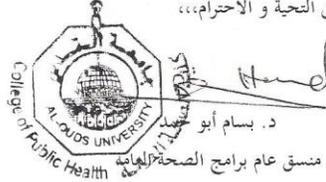
CBC .3

Colein straz .2

Blood chemistry -1

علماً بأن المعلومات ستكون متوفرة لدى الباحث و الجامعة فقط.

و اقبلوا فائق التحية و الاحترام،،،



نسخة:

- الملف

Jerusalem Branch/Telefax 02-24799234
Gaza Branch/telefax 08-2884422-2884411

Sphealth@admin.alquds.edu

فرع القدس/تلفاكس 02-2799234
فرع غزة/تلفاكس 08-2884422-2884411
ص ب/51000-القدس



التاريخ 7/6/2010

Name:

الإسم: إبراهيم حسن ليد

I would like to inform you that the committee has discussed your application about:

نفيدكم علماً بأن اللجنة قد ناقشت مقترح دراستكم حول:-

Assessment of awareness, biochemical and hematological parameters among pesticides sellers in Gaza Governorates .

In its meeting on June 2010 and decided the Following:-

و ذلك في جلستها المنعقدة لشهر 6 2010

To approve the above mention research study.

و قد قررت ما يلي:-

الموافقة على البحث المذكور عاليه.



Signature

توقيع

Member

Member

Chairperson

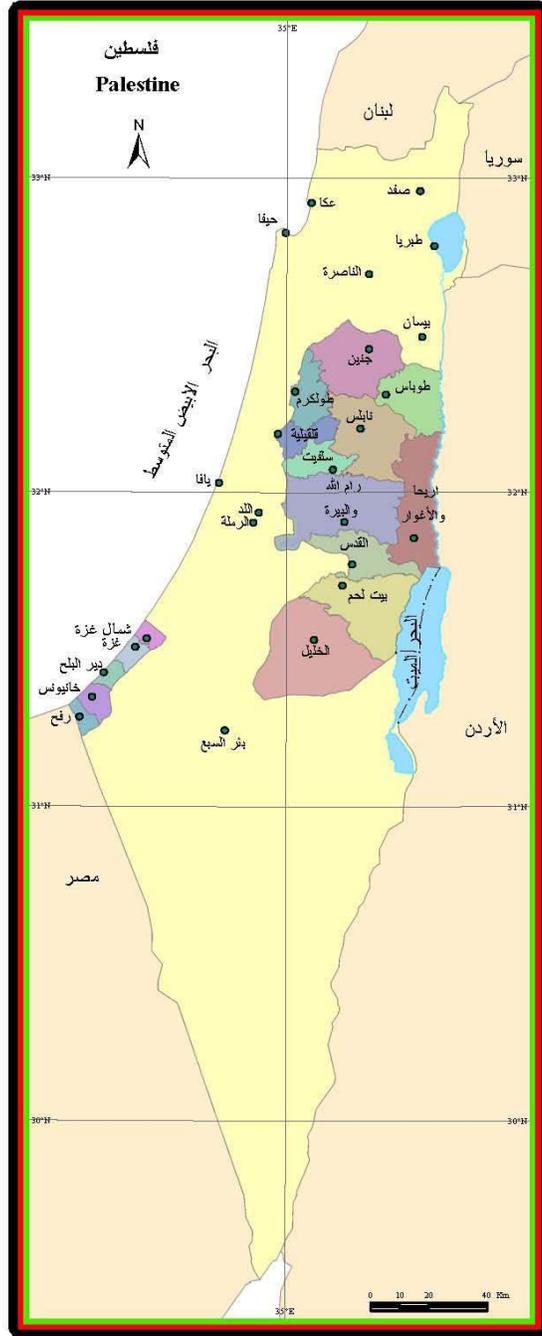
عضو

عضو

Conditions:-

- ❖ Valid for 2 years from the date of approval to start.
- ❖ It is necessary to notify the committee in any change in the admitted study protocol.
- ❖ The committee appreciate receiving one copy of your final research when it is completed.

Annex (5) Map of Palestine



Annex (6) Map of Gaza Governorate

| Name of experts | | Place of work |
|------------------------|--------------------------|----------------------|
| 1. | Prof Dr .Majed M. Yassin | Islamic University |
| 2. | Prof Dr . Yehia Abed | AlQudsUniversity |
| 3. | Dr. Yasser el-Nahal | Special center |
| 4. | Dr. Yousef Abu Safieh | AlQudsUniversity |
| 5. | Dr Ashraf el-Jedy | Islamic University |

ملخص الرسالة

تقييم الوعي والمعايير الحيوية و الدموية لدى بائعي المبيدات 'في محافظة غزة

يتعرض بائعي المبيدات لأنواع متعددة من المبيدات بما في ذلك مبيدات الحشرات، مبيدات الأعشاب ومبيدات الفطريات. أجريت هذه الدراسة لتقييم الوعي الصحي لدى بائعي المبيدات الآفات في محافظة غزة وقياس مدى خطورة المبيدات على صحتهم من خلال اجراء التحاليل الكيميائية الحيوية والدموية.

أجريت دراسة مقطعية عرضية لبائعي المبيدات الآفات وهم ستة وعشرون بائع تم تعبئة الاستبانة من خلال المقابلة مع كل بائع وكانت الأسئلة تتعلق بالمعرفة والمواقف والممارسات تجاه التعامل مع مبيدات الآفات. وكما درست أيضا المعايير الكيميائية الحيوية والدموية لدأربعة عشر بائعاً أربعة عشر شخص لم ليس لهم علاقة بالمبيدات كحالات ضابطة. المعلومات التي جمعت تم تحليلها احصائياً (T-test, ANOVA test Frequency,) بواسطة البرنامج الاحصائي SPSS. النتائج: معدل أعمار البائعين هو (34.3±9.7). نسبة المالكين للمحلات ويعملون فيها هي (57.7%) و نسبة العمال هي (42.3%). المحلات جيدة التهوية. نسبة (69.2%) من البائعين أفادوا انه لا يوجد مكاناً خاصاً للأكل والشرب في المحل. جميع بائعي مبيدات الآفات لديهم معرفة حول أنواع المبيدات وطرق استخدامها وآثرها على الصحة.

نصف عدد البائعين لديهم معرفة حول بدائل مكافحة الآفات بالمبيدات. البائعين يعرفون أن طرق دخول المبيدات إلى الجسم عن طريق الفم والاستنشاق والجلد على التوالي. البائعين لديهم قناعات وتوجهات ايجابية باتجاه أن استخدام القفازات والأقنعة لها فعالية لحمايتهم من مخاطر المبيدات.

نصف البائعين يلقون زجاجات المبيدات الفارغة في سلة القمامة أو في الشارع. استخدام وسائل الحماية من مخاطر المبيدات عموماً ضعيفاً عدا القفازات بنسبة (73.1%) والأقنعة بنسبة (69.2%). البائعين الذين كانوا يرتدون القفازات والأقنعة الواقية لديهم معرفة حول طرق دخول المبيدات من خلال الاستنشاق والجلد والفم أكثر من أولئك الذين لم يرتدون (P<0.05). إنزيمات (ALT) و (AST) نتائجها زادت في تحاليل بائعي المبيدات مقارنة بالعينات الضابطة. إنزيمات اليوريا والكريتينين كانت أعلى في تحاليل البائعين من وكانت هذه الزيادة ذات دلالة إحصائية لليوريا (t=2.937, P=0.007). عدد خلايا الدم البيضاء كان أعلى في بائعي المبيدات في المقابل، الصفائح الدموية قد تتناقص بصورة كبيرة مقارنة بالعينات الضابطة. عدد خلايا الدم الحمراء كان أقل بكثير في تحاليل البائعين. وبالتوازي مع ذلك نقص الهيموغلوبين (HGB) ظهرت ولكن ليس بشكل كبير في الحالات. تركيز (MCV) و (MCH) و (MCHC) لم تظهر أي تغييرات كبيرة (P>0.05). انزيمات (ALT) و (AST) واليوريا والكريتينين ظهرت زيادة مطردة مع زيادة سنوات العمل، بينما أظهرت الصفائح الدموية انخفاضاً مع زيادة سنوات العمل. و من أهم التوصيات التي خرجت بها الدراسة التأكيد على عمل دورات علمية تدريبية حول بدائل المبيدات و مخاطر المبيدات وتأثيرها على الصحة وضرورة عمل مطعم لتناول الوجبة الغذائية خارج مكان العمل.