

## RESEARCH ARTICLE

## IMPACT OF PESTICIDES EXPOSURE ON HEALTH OF PESTICIDE RETAILERS IN SOME AREAS OF AL- DHALA GOVERNORATE - YEMEN

Bassam Mohammed Mothanna Rashed<sup>1,\*</sup> and Galal Mohammed Salem Assakaf<sup>2</sup><sup>1</sup> Dept. of Biology, Faculty of Education, University of Aden, Aden, Yemen<sup>2</sup> Dept. of Physiological Science Faculty of Medicine and Health Science University of Aden, Yemen

\*Corresponding author: Bassam Mohammed Mothanna Rashed; E-mail: bsammhmdrashd@gmail.com

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## Abstract

Exposure to pesticides may result in some health effects on human. This study aims to investigate the effects of pesticide exposure on the liver functions among pesticide retailers who are persistent exposure to pesticides in some areas of AL- Dhala Governorate – Yemen in period Aug. 2020 to Feb. 2021. A number of 56 males who are pesticide retailers were selected randomly considered as exposed group with average exposure 11 years compared with 56 males who are not exposed or dealt with pesticides considered as control, have approximately same age and same area of study. Blood samples were collected and history was taken from both groups. the level of alanine aminotransferase (ALT), aspartate aminotransferase (AST) and alkaline phosphatase (ALP) showed significant increased activities in retailers compared with control. A significant increase in bilirubin levels in retailers ( $P<0.05$ ) compared with control. A decrease in levels of total protein and albumin of retailers ( $P<0.05$ ) compared with control. These findings provide evidence at first sight of medical manifestation due to chronic exposure to pesticides with absence of safety measures in pesticides shop.

**Keywords:** Pesticides, Liver functions, Pesticide retailers.

## Introduction

Pesticides are extensively used in cultivation practices to kill pests that harm crops, and are used for the eradication of rodents, insects, fungi and weeds [1,2]. It covers a wide range of compounds like insecticides, fungicides, herbicides, rodenticides, molluscicides, nematocides and plant growth regulators [3]. Due to the continuous rise in the worldwide population, there has been an increasing in demand for agricultural products such as pesticides [4].

Globally, about 2 million tons of pesticides are being utilized each year, China is the largest pesticide-producing nation, followed by the United States and Argentina [5]. Although pesticides are widely used as a crop protection product, they can have significant adverse effects on “non-target” species, including humans [6]. Pesticides may cause serious human health risks not only for users but also for the retailers. Many retail establishments sell pesticides such as insecticides, herbicides, acaricides, fungicides, and disinfectants for

home, gardens, and agricultural purposes. Therefore, pesticide retailers are exposed to a complex mixture of organophosphates, organochlorines, carbamates, pyrethroids, and other kinds of toxic agents in the stores [7].

The World Health Organization (WHO) has estimated that about 3 million workers in developing countries experience severe poisoning from pesticides each year. Furthermore, approximately 18,000 of them eventually die [8].

Individuals who apply pesticides in agricultural and occupational settings are at a high risk of direct contact and exposure to pesticides. Exposure for long-term could be harmful to human health and which may affect spermatogenesis [9,10,11]. It also has an effect on reproduction, nervous, immune, endocrine, blood coagulation, hematology, cardiovascular, respiration, metabolisms, fluid and electrolyte balance. So, considered an important cause of morbidity and mortality

in developing countries the liver is most susceptible and have carcinogenic and mutagenic potential [12,13,14].

Pesticides uptake occurs mainly by inhalation and ingestion or through the skin and eyes [14]. Occupational exposure to pesticides is common during production, storage, transportation, retailing and application of these compounds [15]. Pollution of the environment plays a crucial role in the occurrence of many diseases affecting plants, animals and man. One of the main factors causing pollution of the environment is the irrational use of organophosphorus insecticides [16].

Recently, it has been reported that there was a critical increase in the number of people suffering of various liver and kidney diseases as well as diabetic mellitus [17]. However, the risk increases by increasing periods of exposing time to pesticides [18], Chronic exposure to pesticides also produce changes in blood parameters [19] and cause liver and kidney dysfunction [20].

Like all countries the use of pesticides in Yemen is spreading widely in growing agricultural crops, but the first crop, which regaining consumption of a wide is the plant of khat, used in its cultivation a lot of imported types of pesticides some are prohibited world wide [16]. Unwise and random application of pesticides in the cultivation of khat [21].

To our knowledge, there is no any attempt to study the adverse effects of pesticides on health of pesticide retailers in areas of Al-Dhala Governorate. Recently been observed an increase health problems of workers in the field of pesticides in these areas such as inflammation and sensitivity and other.

The aim of our study was to evaluate the pesticides handling practices and the adverse health impact of exposure to pesticides among pesticide retailers in some areas of Al-Dhala Governorate, Yemen, to determine the pesticide possible effects on the liver functions.

## Materials and Population

### Data collection

In the study eleven villages (Al-Awabel, khalah, Al-Medsem, Shukua, Al-Hussien, Qataba, Al-Quraee, Al-Jalilah, Al-Dhala, Kharbaj and Al-Rubat) of Al-Dhala Governorate were selected, since there are Chat planting farms and spread of pesticides shops. A total 56 males of pesticide sellers were randomly selected and an equal number of 56 males were also selected as control from the same areas of study, they have never worked with pesticides, those having chronic diseases such as neurological disorder, diabetic, hepatitis or any other chronic disease were excluded from subjects of the study.

A brief questionnaire designed to record specific information regarding age, exposure time, personal

protective equipment (PPE) use and health status. All the subjects asked to answer the same questions.

### Blood collection

An equal amount of blood 5 ml were collected from all study subjects that are pesticide retailers from all the selected villages under study. Also an equal amount of 5 ml blood samples were obtained from the participants who live in the same areas of study but were not dealt with or exposed to pesticides and used as control.

The samples were marked precisely and transferred to the Central Health Laboratory at AL-Nasser Governorate Hospital at AL-Dhalea for further analysis of different biochemical parameters of liver functions.

The following biochemical tests were measured in order to study the effect of pesticides on the health of pesticide selling group as well as those who did not contact or dealt with any pesticides (control group).

Serum Alanine-amino transferase (ALT) serum aspartate aminotransferase (AST), serum alkaline phosphatase (ALP), serum total bilirubin and direct bilirubin, serum total protein and serum albumin. All samples were examined at the Central Health Laboratory at AL-Nasser Hospital.

## Ethical consideration

Ethical approval for the study was obtained from the Ethical Committee of Faculty of Medicine and Health Sciences, University of Aden, Yemen. Written informed consent was obtained from all participating pesticide retailers and controls. Data were treated in a confidential manner with access only to the investigators and the laboratory assistant (Research Code: REC-162 -2023).

## Statistical Analysis

The data were analyzed using statistical package for social science (SPSS) version 21. Significant differences between mean values of exposed and control groups were statistically analyzed using the independent t-test. Results were considered significant when p-value is <0.05.

## Results

This study was conducted to evaluate the risk of pesticides on health of human by examining some biochemical parameters of liver functions of the pesticide retailers. The general information on the retailers and control group is shown in Table 1. All exposed pesticide retailers were not using personal protective equipment (PPE) (Figure 1).

The pesticides available in retailer shops are shown in Table 2 and Figure 2. The retailers seem to be exposed to most extremely hazardous, moderately hazardous and

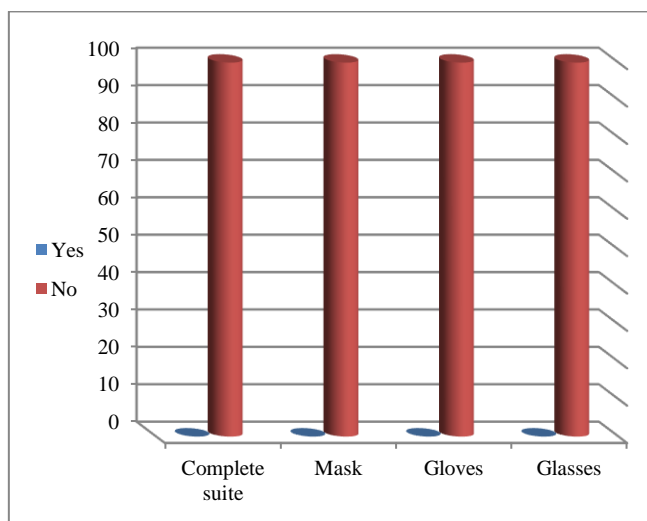
slightly hazardous according to WHO classification. The most abundant pesticide type was insecticides 59% then comes fungicides 34% and acaricides 7%.

The levels of biochemical parameters for liver functions for both studied groups are shown in Tables 3 and 4. Significantly high levels in some serum enzymes such as ALT, AST and ALP ( $P < 0.05$ ) of the retailers compared with control group was observed.

The other biochemical markers such as total and direct bilirubin, total protein and albumin of both studied groups are shown in Table 4. There was significant increase in total bilirubin and bilirubin (direct) levels among retailers group ( $P < 0.05$ ). However, compare to control group, a significant decrease in total protein and albumin levels of retailers was recorded ( $P < 0.05$ ).

**Table 1:** General characteristics of the exposed pesticide retailers and control group as documented by questionnaire.

variable	Control	Retailers	p-value
Number of participants	56	56	-
Age (year)	31 ± 9.8	33 ± 10.1	0.214
Years of pesticides exposure	0	11 ± 8.23	-

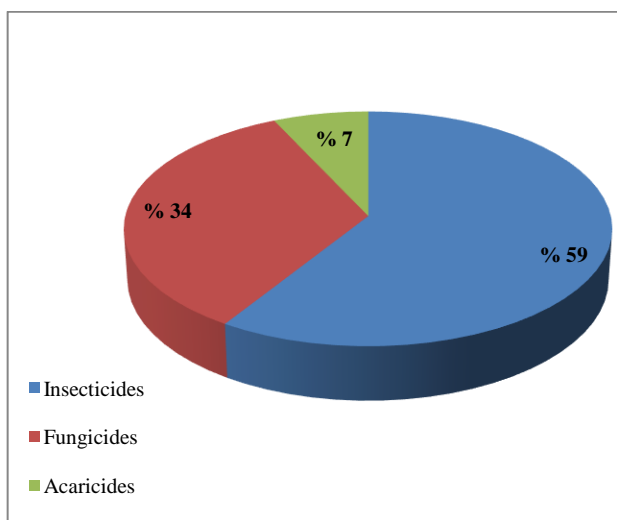


**Fig. 1:** Use of personal protective equipment (PPE) by pesticide retailers.

**Table 2:** The pesticides frequently contacted by pesticide retailers.

Type of pesticides	Active ingredients	Class (WHO)* <sup>[22]</sup>
Insecticides	<b>Methiocarb, Methidation, Triazophos, Abamectin, Methomyl,</b>	Ib
	Imidachloprid, <b>Bifenthrin, Dimethoate, Cypermethrin,</b> Enamectin Benzoate, Chlorpyriphos, Acetamipride, Indoxacarb, Deltamethrin, Lambda-Cyhalothrin, Thiamethoxam	II
	Sipronsad	III
Fungicides	Difniconazole, Copper oxychlorid, Metalaxyl, Triadimenol, Dinconazole	II
	Kresoxim-methyl, Bascalid, Penconazole	III
	Carbendazim, Azoxystrobin	U
Acaricides	Chlorfenapyer, Fenpyroximate	II

**Bold** = prohibited pesticides. WHO\* = classification of pesticides: Ib = Highly hazardous; II = Moderately hazardous; III = slightly hazardous; U = Unlikely to present acute hazard in normal use.



**Fig. 2:** The types of pesticides commonly exposed by pesticide retailers (%).

**Table 3:** ALT, AST and ALP activities in pesticides exposed retailers as compared to control.

Biochemical functions	Control (n = 56)		Retailers (n = 56)		p-value
	Mean	± SD	Mean	± SD	
ALT (IU/L)	23.00	5.59	39.25	24.28	0.001
AST (IU/L)	25.00	6.11	41.25	20.76	0.001
ALP (IU/L)	227.32	65.63	316.43	139.25	0.001

**Table 4:** Other biochemical markers in pesticides exposed retailers as compared to control.

Biochemical functions	Control (n = 56)		Retailers (n = 56)		p-value
	Mean	± SD	Mean	± SD	
Total bilirubin (mg/dl)	0.63	0.20	0.73	0.19	0.005
Direct bilirubin (mg/dl)	0.24	0.11	0.36	0.17	0.001
Total protein (g/dl)	7.61	0.54	7.17	0.68	0.001
Albumin (g/dl)	4.39	0.44	3.94	0.63	0.001

## Discussion

The present study was conducted to determine the impact of pesticide on health of people, who exposed to various kinds of pesticides without any type of protection measures during eleven years of time. Liver function tests of pesticide retailers showed elevation in values of ALT, AST and ALP ( $P < 0.05$ ). In a study carried out by [23] on pesticides sellers showed elevation in values of ALT, AST and ALP ( $P < 0.05$ ). Similar results were obtained by [24] in Malihabad and [25] in Pakistan.

In experimental studies it has also been shown that pesticides can elevate the enzyme activities of ALT and AST [26]. The increase in ALP might be due to an increased permeability of plasma membranes or cellular necrosis. Pesticide exposure causes leakage of cytosolic enzymes from hepatocytes and other body organs into the blood [27]. The present study revealed that the liver enzymes were high among pesticide retailers. This situations could be attributed to inappropriate protection equipment (PPE) during the contact with pesticides and long term exposure.

In the study bilirubin levels of both indirect and direct of humans exposed to pesticides used to evaluate the effect of those pesticides on the liver function. The control group showed normal levels of both direct and indirect bilirubin in blood. While, there was elevation levels of both direct and indirect bilirubin in blood of retailers. These results supports previous studies in Erbil, Iraq [28], in Egypt [29]. The elevation of plasma bilirubin level in retailers after exposure to pesticides could be indicating malfunction in the liver or it might be attributed to long term exposure to pesticides which disturbed the normal red blood cell metabolism,

Synthesis of plasma protein is one of the main functions of the liver. The results of the present study demonstrated a significant decrease in the level of total protein and albumin among retailers compared with control, this indicating a possible damage in the liver. According to [30] hypoproteinemia or reduction of total protein levels occur as a result of liver damage since plasma proteins are synthesized in the liver. Our results were consistent with [31] in a study conducted on exposed humans in India, [32] in Egypt and [33] in India.

Serum protein levels may be altered due to the toxic effects of pesticides through impairment of protein synthesis by hepatocytes [34, 35]. In the same context, the present results do confirm impairments in protein metabolism as a result of pesticide exposure. Insecticides are one type of chemicals used to control insects. However, when used incorrectly, these substances can have a negative impact on retailer's health and natural environment.

## Conclusion

The present study revealed that most of pesticide retailers did not use necessary personal protective equipment (PPE) to avoid the hazards associated with pesticides marketing. present study demonstrated that pesticide retailers is more likely liver affected compared to controls in associations with increase in ALT, AST, ALP and bilirubin levels, also decreased level of albumin and total protein.

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## مقالة بحثية

## تأثير التعرض للمبيدات على صحة تجار التجزئة في بعض مناطق محافظة الضالع – اليمن

بسام محمد منثى راشد<sup>1\*</sup>، و جلال محمد سالم السقاف<sup>2</sup><sup>1</sup> قسم الأحياء، كلية التربية عدن، جامعة عدن، اليمن  
<sup>2</sup> قسم العلوم الفسيولوجية، كلية الطب والعلوم الصحية، جامعة عدن، اليمن\* الباحث الممثل: بسام محمد منثى راشد؛ البريد الإلكتروني: [bsammhmdrashed@gmail.com](mailto:bsammhmdrashed@gmail.com)

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## المُلخَص

التعرض للمبيدات يؤدي إلى بعض الآثار الضارة على صحة الإنسان، هدفت هذه الدراسة إلى معرفة تأثير التعرض للمبيدات على بعض وظائف الكبد لدى تجار المبيدات بالتجزئة الذين يتعرضون للمبيدات بشكل مستمر في بعض مناطق محافظة الضالع – اليمن خلال الفترة من أغسطس 2020 إلى فبراير 2021، تم اختيار 56 متطوعاً من تجار المبيدات بالتجزئة بشكل عشوائي كمجموعة متعرضة للمبيدات بمتوسط 11 عاماً، وتم مقارنتهم بـ 56 متطوعاً لم يتعرضوا أو يتعاملوا مع المبيدات كمجموعة ضابطة وكان المتطوعون في المجموعتين تقريباً بنفس العمر ومن نفس منطقة الدراسة. تم أخذ عينات الدم وكذلك المعلومات المتعلقة بالدراسة من جميع المتطوعين. أظهرت النتائج أن متوسط قيم كل من إنزيم الأئين أمينو ترانسفيراز ALT، الأسيرتات أمينو ترانسفيراز AST، الفوسفاتيز القلوي ALP كان مرتفعاً بدلالة إحصائية ( $P<0.05$ ) في تجار التجزئة، كما ظهر ارتفاع ذو دلالة إحصائية ( $P<0.05$ ) في مستوى البيليروبين في مجموعة تجار المبيدات مقارنة بالمجموعة الضابطة، وظهر انخفاض ذو دلالة إحصائية ( $P<0.05$ ) في متوسط قيم كل من البروتين الكلي والألبومين في تجار التجزئة بالمقارنة مع المجموعة الضابطة. أظهرت النتائج من الوهلة الأولى تأثيرات صحية ضارة بسبب التعرض المزمن للمبيدات مع عدم التقيد باستخدام معدات الحماية الشخصية في محلات بيع المبيدات.

الكلمات المفتاحية: المبيدات، تجار التجزئة، وظائف الكبد.

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