

Original Article

IMPACT OF PESTICIDES ON LIVER ENZYMES IN WORKERS OF PESTICIDE FORMULATION & PACKING PLANTS IN PAKISTAN

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Objective: To evaluate the impact of pesticides on Gamma Glutamyl Transferase (GGT), Alkaline Phosphatase (ALP), Alanine Transaminase (ALT) and Aspartate Transaminase (AST) in workers of pesticide formulation & packing plants in Pakistan.

Material & Methods: One hundred workers in the age group of 20-50 years working at different pesticide formulation and packing units for at least one year were included in this study. One hundred healthy workers from other than pesticides industry, with no history of exposure to pesticides and matching age, sex and social status were taken as controls. Biochemical tests for GGT, ALP, ALT, and AST, were carried out employing Chemistry Auto analyzer.

Results: In current study, serum of one hundred control subjects indicated mean GGT value 37.19 ± 8.07 U/L. Mean GGT value for one hundred pesticide industrial workers was found to be 30.08 ± 10.63 U/L. These results revealed that all the hundred pesticide industrial workers had normal GGT levels, but on the lower side as compared to control subjects. P value was significant. Data of hundred pesticides industrial workers was taken and it was found that ALP, ALT, AST of eighty workers was within the normal range whereas the remaining twenty workers had raised level of ALP, ALT, & AST. Data of the control group showed that ALP, ALT, & AST of all one hundred workers were within the normal range.

Conclusions: All Pesticide industrial workers had normal GGT levels. High or upper normal levels of ALP, ALT, and AST were observed in serum of pesticide industrial workers.

Key Words: Pesticide industrial workers, Gamma Glutamyl Transferase, Alkaline Phosphatase Alanine Transaminase and Aspartate Transaminase.

Introduction

Pesticide is defined as any substance intended for preventing, destroying, attracting, repelling or controlling any pest including unwanted species of plants or animals during production, storage, transport, distribution and processing of food, agricultural commodities or animal feed.¹ Pesticides are used throughout the world to minimize the losses through pest infestations for obtaining maximum crop yields.

Exposure to pesticides is either oral, through inhalation, ocular or dermal. In oral exposure pesticides are swallowed due to unwashed hands after handling pesticides or mistaking pesticide as food or drink. In inhalation exposure, prolonged contact occurs in poorly ventilated spaces or inhaling vapors immediately after application due to lack of wearing masks. Ocular exposure occurs due to accidentally rubbing eyes with contaminated hands or gloves during working at formulation and packing plants. Lastly dermal exposure is due to applying pesticides without gloves, not washing hands after working, wearing of contaminated clothes, application of pesticides in windy weather or touching pesticide treated surfaces.

Liver is one of the most important organs in human body. One crucial function of liver in the human body is detoxification through altering or breaking down different toxins like alcohol, metals, pollutants, pharmaceutical agents for protecting rest of the body.² Liver functioning is evaluated on the basis of levels of different enzymes in the blood. i.e. Alkaline Phosphatase (ALP), Alanine Transaminase (ALT), Aspartate Transaminase (AST) & Gamma Glutamyl Transferase (GGT).

Significant negative impact of pesticides exposure on liver functions in human beings has been reported by many researchers. Azmi *et.al.* (2005), at Baqai University, Karachi studied the effect of pesticide residues on general health and different enzyme levels, in the blood of farmers from Gadap (rural area) Karachi. Fifty five farmers from different stations were examined for the presence of pesticide residues and liver enzyme levels in the blood samples. A significant increase in ALP, ALT and AST levels was reported.³ In addition, remarkably high levels of ALT and AST in the blood of occupational workers chronically exposed to organophosphate pesticides was observed by different researchers.^{4,5} It is intriguing to note that wide ranging pesticides severely disrupt

the enzymatic levels in persons exposed to them.^{6,7,8} The increasing and injudicious use of chemical pesticides is recognized to be one of the important sources of pollution and a potential hazard to both humans and animals.⁹ The acute effects of exposure to such agrochemicals in the environment have been proven to be health hazardous.¹⁰ Presently on an average, fifty thousand tons of pesticides are used in Pakistan annually.¹¹ A large number of workers are directly exposed to pesticides at formulation or repacking plants. Safety standards for workers at pesticides formulation and repacking plants in Pakistan generally do not meet with the international standards. Now when the pesticide formulation industry is expanding at rapid pace, health of the workers must be safeguarded. Assessment of different liver function tests is an important tool to assess the impact of exposure of workers to pesticides. Review of literature has shown that in Pakistan, a number of studies have previously been conducted regarding the effect of pesticides on farmers but not in the workers of pesticides industry who are continuously exposed to the pesticides. Keeping in view the importance of the subject, present study was designed to evaluate impact of exposure to pesticides on Gamma Glutamyl Transferase (GTT), Alkaline Phosphatase (ALP), Alanine Transaminase (ALT) and Aspartate Transaminase (AST) in workers of pesticide formulation and packing plants of Pakistan.

Material & Methods

In this cross-sectional study, one hundred workers in the age group of 20-50 years working at different pesticide formulation and packing units of Pakistan for at least one year were included.

One hundred healthy workers from other than pesticides industry, with no history of exposure to pesticides and matching age, sex and social status were taken as controls. Individuals, who were known diabetic, hypertensive, smokers, obese, or having previous history of jaundice or positive cases of Hepatitis B or C were excluded from the study.

Collection of Blood Samples:

6-8 ml of blood was collected from individuals of both study and control groups and allowed to clot for 20-30 minutes to obtain serum. All the blood samples were brought to the laboratory and serum was immediately separated by centrifugation at 3000 rpm for five minutes. Serum was transferred to Eppendorf tubes and kept frozen at -2 to -4°C for later analysis.

A detailed performa on demographical data

inquiring about their general health and also about the safety measures they practiced was filled out by each worker included in this study.

Biochemical Analysis:

Biochemical tests for Gamma Glutamyl Transferase, ALP, ALT, and AST were estimated on Dade Dimension RxL (Siemens Healthcare Diagnostic Inc. Delaware, USA). Screening for Hapatitis B & C virus was done by immuno-chromatographic technique to confirm that all the samples included in current study were negative for Hepatitis B and C virus.

Statistical Analysis:

Results of, GGT, were expressed as mean SD. Data were analyzed according to the unpaired student's t test. ANOVA technique was applied for the comparison of the groups i.e., controls and workers of pesticides industry having normal and abnormal ALP, ALT, and AST level. 'p' value of less than 0.05 was considered statistically significant.

Results

Working on the data of the study group, it was found that ALP, ALT and AST of eighty workers were within the normal range whereas the remaining twenty workers had raised levels of ALP, ALT and AST. Data of the control group showed that ALP, ALT and AST of all one hundred workers were within the normal range. In current study, serum of one hundred control subjects indicated mean GGT value 37.19 ± 8.07 U/L (**Table 1**). Mean GGT value for one hundred pesticide industrial workers was found to be 30.08 ± 10.63 U/L. From amongst these one hundred workers, eighty pesticide industrial workers (having normal ALP, ALT & AST levels) showed mean GGT value of 30.58 ± 10.14 U/L, falling within normal limits (**Table 2**). Mean GGT value for the rest of twenty industrial workers was 28.10 ± 12.51 U/L, also falling within normal limits though lower (**Table 2**). These results revealed that all the one hundred pesticide industrial workers had normal GGT level, but on the lower side as compared to control subjects. P value was significant. (**Table 1**)

General Health Problem:

Data on health problems and safety measures of both groups were obtained through history Performa (**Table 3**). Chi-square test was applied and p value was significant for "itching" and might be attributed to exposure of pesticides.

Cross tabulation of safety measures by pesticide industrial workers are shown in **Table 4**. Chi-Square test was applied and p value was significant for those pesticide industrial workers who were not using safety

measures.

Discussion

Significant negative impact of pesticides exposure on various liver functions amongst pesticide handlers has been reported by many researchers. In 1980, a

study was carried out in Bulgaria to observe the impact of pesticide exposure on levels of different liver enzymes in seventy four workers exposed to professional chronic combined pesticide effect. A significant increase in levels of ALT and AST was recorded whereas no impact was observed on ALP

Table-1: Means, Standard Deviations, 95% Confidence Interval and 't'-test of LFT's for Control Subjects and Pesticide Industrial Workers having normal and abnormal LFT's jointly.

LFT's (u/l)	Control Subjects (n=100) Mean±SD	Pesticide industrial workers (n=100) Mean±SD	95%C-I	Patients vs Control 95%C-I OR	p-value
GGT	37.19±8.07	30.08±10.63	8.81-51.35	C-I=0.88-0.95 OR=0.92	<0.000***
ALP	67.48±12.30	124.27±43.18	37.91-210.63	C-I=0.1.12-1.25 OR=1.18	<0.000***
ALT	29.39±5.86	54.47±32.29	-10.11-119.05	C-I=1.11-1.23 OR=1.16	<0.000***
AST	24.12±16.34	35.67±16.34	2.99-68.35	C-I=1.24-1.53 OR=1.38	<0.000***

***p<0.001 highly highly significantly higher/lower as compared to controls

Table-2: Means, Standard Deviations, 95% Confidence Interval of LFT's for Control Subjects and Pesticide Industrial Workers having normal LFT's .

LFT's (u/l)	Control Subjects (n=100)	Pesticide industrial works with normal LFT's (n=80)	p-value
GGT	37.19±8.07	30.58±10.14	<0.000***
ALP	67.48±12.30	107.18±22.76	<0.000***
ALT	29.39±5.86	40.767±11.51	<0.000***
AST	24.12±16.34	28.64±4.26	<0.000***

***p<0.001 highly highly significantly higher as compared to Controls

Table-3: Means, Standard Deviations, 95% Confidence Interval of LFT's for Control Subjects and Pesticide Industrial Workers having abnormal LFT's .

LFT's (u/l)	Control Subjects (n=100)	Pesticide industrial works with abnormal LFT's (n=20)	p-value
GGT	37.19±8.07	28.10±12.51	<0.000***
ALP	67.48±12.30	192.60±37.63	<0.000***
ALT	29.39±5.86	109.30±30.44	<0.000***
AST	24.12±16.34	63.80±16.56	<0.000***

***p<0.001 highly highly significantly higher as compared to controls

Table-4: Means, Standard Deviations, 95% Confidence Interval of LFT's for Pesticide Industrial Workers having normal and abnormal LFT's.

LFT's (u/l)	Pesticide industrial workers with normal LFT's (n=80)	Pesticide industrial workers with abnormal LFT's (n=20)	p-value
GGT	30.58±10.14	28.10±12.51	0.3535
ALP	107.18±22.76	192.60±37.63	<0.000***
ALT	40.76±11.76	109.30±30.44	<0.000***
AST	28.64±4.26	63.80±16.56	<0.000***

***p<0.001 highly highly significantly higher as compared to normal LFT's

Table-5: Prevalence (%) of health problems among pesticides workers and control subjects and results of chi-square test.

Health Problems	Pesticide industrial workers (n=100)	Control Subjects (n=100)	p-value
Backache	10	07	0.467
Cough	09	10	0.819
Itching	17	05	0.011*
Joint pain	03	01	0.317
Weakness	40	34	0.485
No Pain	21	43	0.006**

* $p < .05$ significantly higher as compared to control subjects

and GGT due to pesticide exposure.¹³

High ALP levels in serum have also been reported by previous researchers such as Srivastava *et. al.* (1991)¹⁴, Paulino *et. al.* (1996)¹⁵, Srivastava and Malik (2000)¹⁶, Mani *et. al.* (2001)¹⁷, Altuntas *et. al.* (2002)¹⁸ and Kaur and Dhanju (2004)¹⁹ in persons involved in spraying. High levels of ALT and AST has also been noted in the serum of the persons exposed to pesticides by different research scientists; Misra *et. al.* (1985)²⁰, Carvalho (1991)²¹, Kossmann and Magner (1992)²², Paulino *et. al.* (1996)¹⁵, Katoh *et. al.* (1998)²³, Kacker *et. al.* (1999)²⁴, Venkaterswarlu *et. al.* (2000)²⁵, Goel *et. al.* (2000)¹⁷, El-Sakka *et. al.* (2002)²⁶, Sahin *et. al.* (2002)²⁷, Rahman and Siddiqui (2003)²⁸, Choudary *et. al.* (2003)²⁹, Kaur and Dhanju (2004).¹⁹

In Pakistan, studies have been conducted by SNH Naqvi *et. al.* (2007)³⁰ in Karachi on workers involved in spraying of pesticides in fields and reported significant increase in their liver enzyme levels.

Many researchers also correlated different pesticides with enzyme gamma-glutamyl transferase (GGT). Desi *et. al.* (1996) recorded decrease in level of GGT during biological monitoring and health surveillance of group of green house pesticide sprayers.³¹ Low levels of GGT were also reported by Ranjbar *et. al.* (2002) in various persons exposed to different pesticides or involved in pesticide spraying.³² Dahamana *et. al.* (2004) also correlated the enzyme activity of GGT with different pesticides exposure such as chlorpyrifos, triazophos that can cause structural and functional changes in man as well as beneficial organisms and reported low levels of GGT.³³ High levels of GGT were not observed in any pesticide industry worker.

In the current study, blood samples of eighty workers showed normal levels of ALP, ALT and AST, although, slightly on the higher side except GGT which was slightly on the lower side as compared to the control subjects. Other twenty pesticide industry workers had raised levels of ALP, ALT and AST whereas GGT level was slightly on the lower side but within normal range. Above results are in conformity with the findings of Enan *et. al.* (1992)³⁴, Garcia and Mourelle (1984)³⁵ and Ranjbar *et. al.* (2002)³² who reported low levels of GGT in various persons exposed to different pesticides or involved in pesticide spraying.

Conclusions

Following conclusions were drawn from this study.

- High or upper normal levels of ALP, ALT, and AST and lower though normal GGT levels were observed in serum of pesticide industrial workers.
- Pesticide industrial workers had more general health problems like generalized weakness, itching, backache, cough etc. as compared to control subjects.

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Picture Quiz

WHAT IS THE DIAGNOSIS?



See answer on page 195