Human health risks and domestic water contamination through pesticides

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Research Article

Keywords: Blood, human, pesticides, water

Posted Date: April 6th, 2021

DOI: https://doi.org/10.21203/rs.3.rs-386845/v1

Abstract

The monitoring of pesticide pollution may be a substantial source of data describing the current state of environmental pollution. This study sought to evaluate the pollution of domestic water by the pesticides related to health risks and are assessing potential regarding effects on human health. Fifty blood and fifty faucet domestic water samples were collected consecutively from patients' diagnosed with pesticides poisoning once having consent. Additionally, ten blood, and water samples from healthy participants as control group. This study recruited in two periods, 2019 in several cities from Dakahlia region. Sampling regions designated consistent with the locations of major agricultural and industrial activities. The concentrations were determined once extraction of the samples and sequent gas chromatography mass spectrum (GC–MS) analysis of the extracts. The results revealed presence of Organophosphorus (Malathion) and organochlorine (Lindane) insecticides. Presence of an organophosphorus and organochlorine insecticide focused to posses serious effects on human health. Authorities to regulate the indiscriminate use of pesticides should implement strict enforcement.

Introduction

Pollution of waters with every kind of organic and inorganic substances is one of the most serious challenges for the healthy and property development of the environment (He et al. 2020; Ji et al. 2020). Previous studies show that agricultural activities that have discharged hazardous and toxic constituents in thereby, led to contamination of water in these areas. The physical and environmental health of billions of individuals could threaten by water pollution (Javier et al. 2017). Pesticides may be important sources of exposure to the public whenever they will enter the water supply and used domestically as household insecticides. Current-use pesticides often contacting with individuals whenever they will migrate everywhere with rainwater or farmland irrigation waters, getting into urbanized rivers (Li et al. 2019). Pesticides have detected in several aquifers, and surface waters worldwide, as a result of agricultural practices (Carazo et al. 2018). Immunological diseases, neurodegenerative diseases, hematological malignancies and solid tumors could result as detrimental effects of pesticides on human health (Fenga et al. 2017; Polo et al. 2017). Pesticides particularity organophosphates and carbamates are of great concern due to worldwide use, and harmful public health effects (Cotton et al. 2018). Organophosphate pesticides are considered as a large group of pesticides, which have replaced organochlorine pesticides due to their lower toxicity and accumulation in the environment, and comparatively higher decomposition rates. All the detected organophosphorus pesticides associated with a minimum of one health result because of national potable standards and health criteria (Kegley et al. 2014). Several studies in Egypt showed the presence of organochlorine in water (Abu-Arab et al. 2008; APHA 2012). Studies on predicted environmental concentrations in the risk assessment of pesticide use are limited in literature.

The aim of the present work was to check and evaluate the pollution of domestic water by these pesticides associated with health risks. In addition, assess a potential regarding the effects on human health.

Participants And Methods

Study area

The Study area lies between latitudes, 30^{0} 30^{-}–31^{0} 30^{-} N and longitudes 31^{0} 15^{-}–32^{0} 00^{-} E (Fig. 1). The water resources comprise surface and ground waters.

Study participants

This study was performed within two periods, 2019. A history was taken from the patients, and their relatives through respondent a form. Participants were from different ten districts of Dakahlia region (Fig. 1), and classified into two groups:

Group 1: Patients' group of (50) patients diagnosed with pesticides poisoning based on

Physical and clinical examination (Table 1) and confirmed by laboratory investigations.

Group 2: Control group of (10) healthy participants randomly chosen. They were clinically free from pesticides poisoning and of the same age and sex as the patients' group.

Table 1
Degree of poisoning in the total significant cases according to clinical picture

Clinical picture	Mild	Moderate	Severe
	Abdominal colic	Abdominal colic	Abdominal colic
	Salivation	Salivation	Salivation
	Vomiting	Vomiting	Vomiting
	Meiosis	Meiosis	Meiosis
		Chest crepitating	Chest crepitating,
			Sweating
			Bradycardia
			Arrhythmias,
			Pulmonary edema

Sampling

Sixty blood samples (ten ml of each) were collected from all participants once having consent and before the commencement of the study. Also, sixty faucet potable samples (500 ml of each) were collected from similar patients in two, different dates; in the summer after the application of pesticides in the agricultural lands, and the autumn during the first, seasonal rainfall. To assess the spatial variation of contamination by the pesticides, surface water (seven districts, Table 2) the samples were collected from homes of the

patients, situated with few meters to agricultural fields. Also, to assess potential groundwater contamination, samples were taken from wells (three districts, Table 2) near the drainage system.

Table 2
Districts, type of water and number of samples

No	District name	Group	Type of water	No of water samples	No of blood samples
1	Mansoura	Group I	Surface	5	5
2	Talkha			5	5
3	Bilqas			5	5
4	Sherbin			5	5
5	Dekernis			5	5
6	Minyat el-nasr			5	5
7	El-Manzala			5	5
8	El-sinbillawin		Ground (Wells)	5	5
9	Aga			5	5
10	Mit-ghamr			5	5
Group II			Control	10	10
Total				60	60

Sample analysis

For water samples; field measurements of physiochemical parameters were taken at the time of sampling. The study followed the standard methods of APHA (2012) for gathering, preservation and analysis.

Blood samples were analyzed for plasma pseudo-cholinesterase level (P ChE) by spectrophotometer in keeping with (Ellman et al. 1961) using UNICO-UV 2100 spectrophotometer and kits of cholinesterase produced by Boehringer Mannheim GmbH Diagnostics, and red blood cells acetyl cholinesterase activity (A ChE) according to (Crane et al. 1970). Determination of aspartate Transaminases (AST) and alanine Transaminases (ALT) were done according to Burtis and Ashood (1994).

Blood and water samples were analyzed for pesticides by gas chromatography-mass selective detector (GC-MSD) and solid-phase micro-extraction were accustomed to sighting the presence of organophosphorus in human blood and water (Valente et al. 2015). Peaks identified by comparison of retention time value of samples with those of the corresponding pure standard compounds. Calibration standards and quality control samples were prepared freshly daily.

Privacy and confidentially of patients records and data was determined through coding system. The study used analytical grade chemicals of certified customary solutions for the aim of sample preparation, and its analysis.

Statistical analysis

The data coded, entered and processed on computer exploitation SPSS program. The results pictured in tabular and delineate forms then taken. The quantitative data was conferred as mean ± standard deviation, and the qualitative data were presented a number and a percentage. The analysis of the data was done to ascertain applied mathematics important distinction between groups.

Results And Discussion

The magnitude of pesticide poisoning based on hospital records during this study may under estimate the full impact of pesticide poisoning. As regards the degree of poisoning, the mean AST levels increased with increasing the severity of poisoning. On the other hand, the mean ALT levels were near to the levels of the control group in mild and moderate poisoning cases. It was significantly higher in severe poisoning. There was indirect correlation between the severity of poisoning and each of plasma pseudo-cholinesterase (P ChE) levels and acetyl cholinesterase (A ChE) activity %. The cholinesterase enzyme showed highly significant decrease ($P < 0.001$) in severe (26 %) poisoning compared to moderate (8 %) and mild (66 %) poisoning (Table 3). This could suggest that the pattern of poisoning severity may differ from country to country depending on the quality of life, circumstances of poisoning and amount of insecticides administered. The activity was calculated from the activity value of the control participants and represented as a percentage. Actual enzyme activities in severe cases were 9.18 %, 30.12 % in moderate and 47.52 % in mild poisoning cases (Table 3).

Table 3
Actual enzyme activity and mean serum Transaminases

Group Level Parameter	Control group	Patients group			P Value
	1900–3800 U/l n = 10	Mild > 1000 U/l n = 33 (66 %)	Moderate 1000 – 500 U/l n = 4 (8 %)	Severe < 500 U/l n = 13 (26 %)	
P chE Mean ± S.D*	2545.2 ± 477.3	1209.5 ± 245.6	766.8 ± 97.7	233.6 ± 39.5	P < 0.001
A chE Actual enzyme activity %	100 %	47.52 %	30.12 %	9.18 %	P < 0.001
AST (U/L)	25.8 ± 8.7	40.5 ± 1.5	44.4 ± 3.8	67.9 ± 2.2	
ALT (U/L)	23.9 ± 7.3	41.1 ± 2.7	45.7 ± 2.4	59.9 ± 5.9	
S.D*: Standard Deviation **(note: the average control value = 2545.2)** **AST: normal up to 40 units / ml**, **ALT: normal up to 45 units / ml** **P is significant if < or = 0.05**					**P** **highly significant**

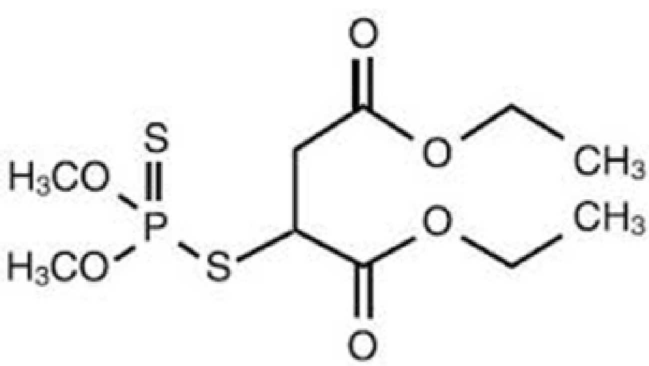
Drinking water and blood samples contained organophosphorus insecticides (Malathion) and organochlorine insecticides (Lindane) by GC - MS. Ghanem et al. (2011) reported that the concentration of pesticides in groundwater in Jenin was found to be beyond those in Tulkarem. The contamination of the tested wells was due to pesticides and not due to sewer water disposal, since most of the samples were free from infective indicators. The results unconcealed that using these wells for drinking purposes had a potentially high health risk. The drinking polluted water wells were due to the uncontrolled industrial and agricultural activity as well as the lack of monitoring of drinking water treatment efficiency. This explained the clinically variant degree of severity among the poisoned patients that’s confirmed by cholinesterase enzyme assay. Human health directly affected by the consumption of polluted water. Legislative measures to limit the foremost toxic pesticides might thus be additional helpful for low and medium income countries (Gunnell et al. 2017). This was mainly due to the uncontrolled industrial and agricultural activity as well as the lack of monitoring of drinking water treatment efficiency. In environmental correction, chemical removal from potable water is also a heavy concern (Agarwal et al. 2016; Stefan 2018). Rai et al. (2019) reported that acetic acid expressed a powerful perspective towards removal of pesticide residue and that sodium carbonate exhibited a lot of reductions power. Concern regarding the environmental impact of repeated pesticide use has prompted research into the environmental fate of these agents, which can emigrate from treated fields to water bodies.

Malathion

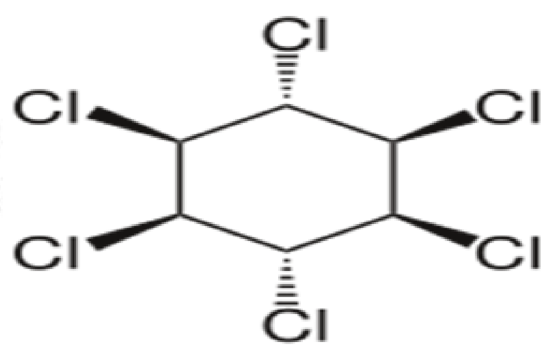
It's one in all the foremost commonly used Organophosphorus in many countries in conjunction with Egypt (Al-Naggar et al. 2015). It acts as associate degree ethanol group enzyme substance inflicting nervous and biological process damages which are able to in all probability finish in death (Ojha A and Srivastava, 2014).

Lindane

Its associate degree organochlorine chemical variant of hexachlorocyclohexane that has been used each as associate degree of agricultural pesticide, and as a pharmaceutical treatment for lice and infection (CEC 2005). Insecticide in soil can leach to surface, and even water, and might bio-accumulate within the organic phenomenon (EPA 2007). In 2015, the international agency for research on cancer classified lindane as a well known human carcinogen (IARC 2015). It affects the nervous system, liver, and kidneys, and can otherwise to be a carcinogen (ATSDR 2005). These findings indicated that though associate degree in Egyptian Ministerial Decree prohibited the import and use of organochlorine in 1996. A number of these cytotoxic pesticides are still illicitly applied creating exposure to those compounds unavoidable (Barakat 2004 & Lucenta et al. 2007).



Malathion



Lindane

Chemical formula	$C_{10}H_{19}O_6PS_2$	$C_6H_6Cl_6$
Molar mass	330.358021	290.83 g/mol

Conclusions

Pesticides found in water are due to natural processes or human activities. Presence of associate degree of organophosphorus and organochlorine insecticides in water and blood samples targeted to their serious effects on human health and aquatic life. Presence of those pollutants in domestic water of the studied areas has serious effects on human health and surroundings. Authorities to manage the indiscriminate use of pesticides need to implement strict social control. There's want of encapsulated medical protection for people who get directly exposed or unintentionally on intense of the contaminated water.

Declarations

ACKNOWLEDGMENT

The author wishes to thank the study participants for their contribution to the current research and expresses his appreciation to all people facilitate for their cooperation, and help throughout this study.

Authors Contributions: I'm solely author for this paper.

Funding: Not applicable

Availability of Data and Materials: All data are given in the manuscript.

Conflict of interest: None declared.

Consent to participate: Free and informed consent of the participants obtained prior enrolling this stud.

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Figures

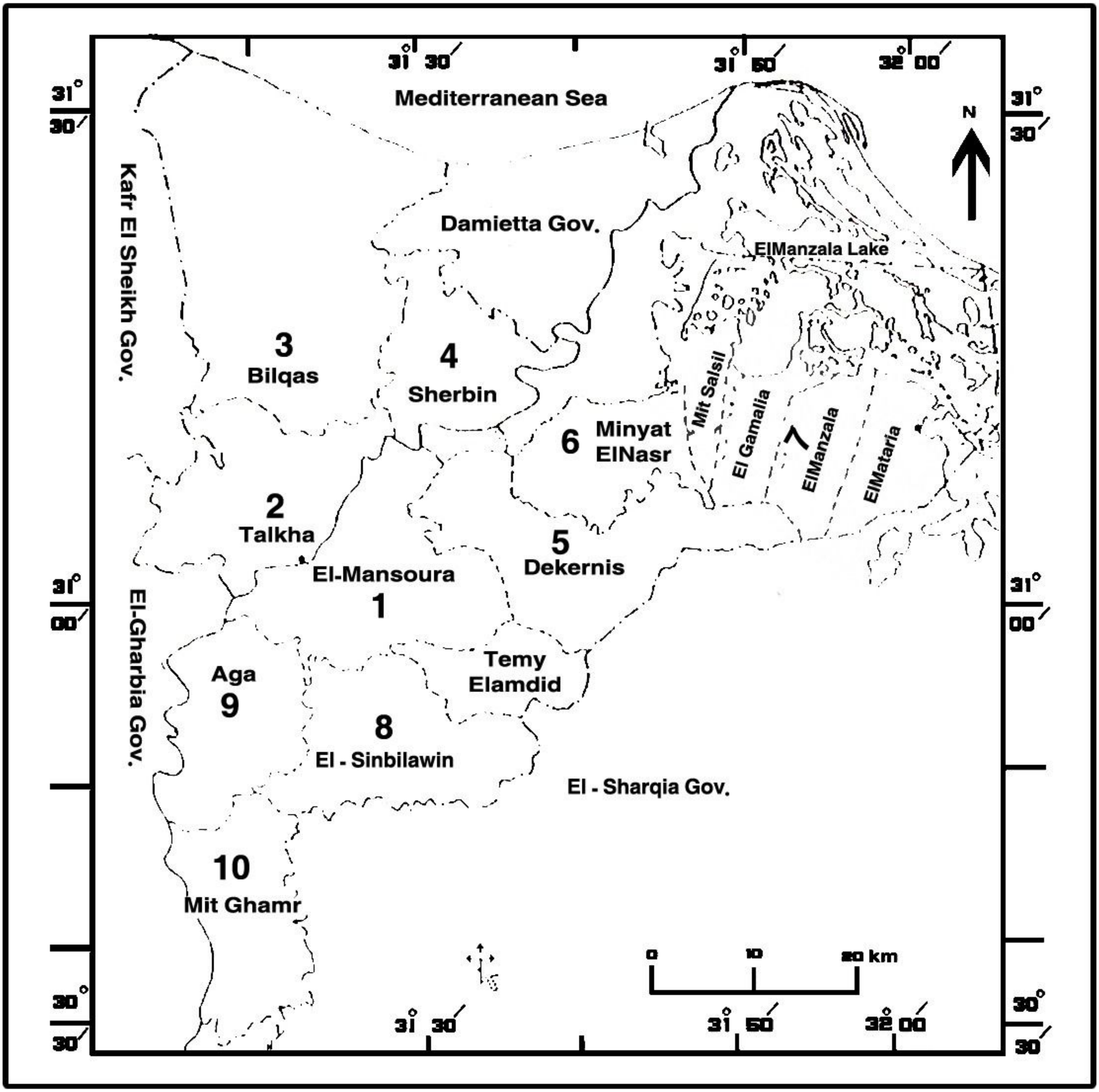

Figure 1

Location map