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Awareness of Protective Measures and Qualitative Analysis of Blood in Farmers with Chronic Exposure to Pesticides: A Cross Sectional Study

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ABSTRACT

India is the second most populous country in the world, with a majority of the adult population engaged in agriculture. Being the largest producer of pesticides in Asia, the availability and demand of these pesticides makes it a vulnerable country for its people to be exposed to the harmful effects of pesticides, directly or indirectly, especially with little or no protection used. Other aggravating factors include illiteracy, lack of awareness and improper handling of pesticides.

There is a dearth of studies relating to chronic poisoning from pesticide use and there are no exact data available with regard to the burden of morbidity. Hence a cross-sectional study of the farmers in some regions of rural Belgaum of Karnataka state, known for high usage of pesticides, was conducted aiming at detection of pesticide traces in the blood by Thin Layer Chromatography (TLC), and to assess the safety measures used.

The majority of the study group subjects were literate, i.e., 66%, and 94% had some exposure to pesticides for 10–20 years. Yet 50% were not aware of the health hazards caused by inappropriate handling of pesticides, 76% did not use any sort of protection, only 2% used proper personal protection equipment (PPE), and 54% tested positive for various pesticides in their blood, of which 32% tested positive for chlorpyriphos, 12% for DDT, and 10% for quinalphos.

There was strong correlation between the duration of exposure and pesticide traces present in the blood. The study also revealed that various factors, including lack of personal protective measures, and lack of awareness contributed to the morbidity from pesticide exposure to a great extent.

Key Words: Pesticide; Thin layer chromatography (TLC); Personal protection equipment (PPE); Chronic pesticide poisoning

Introduction

Pesticides comprise a broad range of substances widely used throughout the world to control infestation of crops with insects, weeds and fungi.[1] Poisoning due to pesticides is common in farmers and others who are closely associated with handling of pesticides. India being a developing country has more than 50% of productive population engaged in agriculture. India is the largest producer of pesticides in Asia and ranks twelfth in the world with regard to pesticide use, with an annual production of 90,000 tons.[2] Deliberate self-poisoning with pesticides is an important public health problem in rural regions of the developing world and kills an estimated 200,000 people every year, and the incidence of pesticide poisoning keeps rising.[3] Though unintentional chronic poisoning kills far fewer people, it is an apparent health problem in places where highly toxic pesticides are used,[4] especially with little or no protection,[6] thus risking a large number of agricultural workers including their family members to pesticide exposures directly and indirectly.[5]

In India there are no precise data available with respect to the burden of morbidity. There is thus, a need to determine the exact extent of the problem and to develop appropriate strategies to manage chronic cases with available resources in our country.[7]

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The rural setup of Belgaum which was selected for this study is a fertile land with very good water resources, and one of the sites of the study is located on the banks of a river. Hence because of the good yield, multiple crops are grown in a year in these areas, and thus the use of pesticides is quite extensive. This study was carried out to look into the pattern of protective practices employed, and analyse samples of blood for the presence of pesticides in chronically exposed farmers.

Materials and Methods

Study Design: Cross-sectional study of farmers chronically exposed to pesticides in rural Belgaum (Karnataka state) with randomised selection of sample size and control size each being 50 in number.

Study Material: Structured questionnaire (proforma) and blood samples of farmers chronically exposed to pesticides.

Consent: Written, informed consent was taken from both farmers and volunteers.

Selection Criteria:

Inclusion Criteria: Male farmers of all age groups chronically exposed to pesticides for a period of more than 10 years. The period of exposure was ascertained by interviewing and history taking.

Exclusion Criteria: Spraying done within one month of expected date of blood collection.

Procedure:

Sample Collection Procedure: Plain blood of 5 ml was collected in a glass tube with aseptic precautions, from the cubital region.

Analysis Plan: Blood sample was processed and analysed using Thin Layer Chromatography (TLC) at Poison Detection Centre, Department of Forensic Medicine and Toxicology, KLE University's JN Medical College, Belgaum.

Statistical Analysis: All required data were entered in the proforma and analysed using SPSS (trial) software. The percentage of persons with abnormal blood picture, their relation to different types of pesticides, and years of exposure were done by chi-square.

Results

A total number of 100 adult male subjects, with study group comprising 50 members and 50 being in the control group, were interviewed and blood samples were collected in field conditions.

Among the study group, the highest number of individuals belonged to the age group of 30–39 years and 50–59 years, both being 30%, followed marginally by 40–49 years (28%), while none were below 19 years of age. Sixty six percent of individuals were literate. Majority of the individuals, i.e., 78% in the study group had exposure to pesticides for 10–15 years, followed by 10% with 16–20 years of exposure (**Table 1**). With regard to the awareness pertaining to the harmful effects and handling pesticides, and protective measures to be adopted, 50% of the study group were aware. But only 2% in the study group were using proper protection (**Table 2** & **Fig 1**); 22% used just cloth to cover their face while spraying; while the rest, i.e, 76% from the group did not use any sort of protection. A total of 72% of the study subjects indulged in chewing tobacco, smoking, and eating food at the place of spraying (**Table 3**). The lab results and the type of compound present in the blood as tested by Thin Layer Chromatography (TLC) from the subject group showed 16 were positive for chlorpyriphos (an organophosphorus pesticide), 6 were positive for DDT (an organochlorine pesticide) and 5 for quinalphos (another organophosphorus pesticide). None of the control group members tested positive (**Table 4**). **Table 5** shows the prevalence of various factors precipitating symptoms among the positive subjects.

Of the total 27 study subjects who tested positive for various pesticides, 77.77% were exposed for more than 10–15 years; 62.96% were unaware of any knowledge of protective measures to be adopted while handling the pesticides, 70.37% of the subjects were not using any personal protective equipment/measures, and 29.63% used only cloth to cover their face while spraying. 59.25% of the subjects who tested positive indulged in chewing tobacco, smoking, and eating food while handling pesticides.

Discussion

The Food and Agriculture Organization (FAO) recommends that Ia (extremely hazardous) and Ib (highly hazardous) pesticides should not be used in developing countries.[7] It also suggests that class II (moderately hazardous) pesticides be avoided. But as per our study farmers

are using moderately hazardous pesticides regularly in the area of study.

All the study and control subjects in our study were male, and the age group ranged from 20–69 years; most belonged to the age group of 30–39 years and 50–59 years. The majority of the study group comprised literate individuals, i.e., 66%, unlike in an earlier study by Rastogi et al[4] wherein the majority were illiterates.

A significant number of the study group, i.e, 94% had exposure to pesticides for 10–20 years, which was far more than a study conducted by Sosan et al[8], where-in 50% of the study group had >20 years of exposure, but is similar to the study done by Chitra Grace et al,[2]in which majority had exposure to various pesticides for about a decade.

Table 1 Period of Exposure (in years) of Study Group

Exposure Period	Number	Percentage
10–15	39	78
16–20	05	10
21–25	03	06
26–30	03	06
31 & above	Nil	00
Total	**50**	**100**

Table 2 Protective Measures Used by Study Group

Protection	Number	Percentage
OP*	01	02
OC#	11	22
Nil	38	76
Total	**50**	**100**

OP* - Occasional proper protection; OC# - Occasional cloth protection

Half of the farmers in our study were not aware of the health hazards caused by the inappropriate handling of pesticides, while the rest had gained this knowledge mostly from their co-farmers, and a few gained it from the retail shop-keepers selling pesticides. But with respect to following precautionary measures, especially

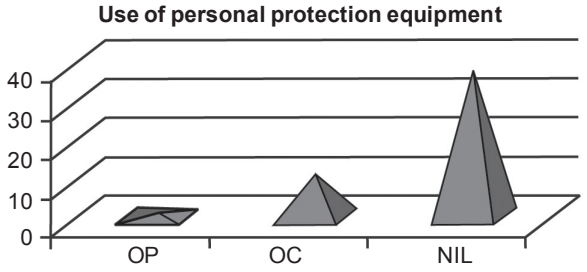

Fig 1: Protective Measures Used by Study Group

personal protective measures, only 2% in the study group were using proper protection; 22% used just cloth to cover their face while spraying, and the rest, i.e, 76% did not use any sort of protection, which is similar to the studies conducted by Singh and Gupta[3] and Chitra Grace et al,[2] wherein it was found that the majority of the farmers did not bother about safety measures at all.

Table 3 Hazardous Habits in the Study Subjects at the Workplace

Habit	Number	Percentage
Tobacco Chewing	05	10
Alcohol Consumption	00	00
Smoking	03	06
Eating Food	11	22
Tobacco Chewing & Eating Food	13	26
Smoking & Eating Food	03	06
All the Above	01	02
Nil	14	28
Total	**50**	**100**

More than 80% of the study subjects indulged in hazardous practices such as chewing tobacco, smoking, and consuming food at the place of spraying. This is in agreement with the study by Singh and Gupta,[3] in which a considerable proportion of the respondents (20%) were found to smoke, chew tobacco or consume eatables during pesticide application.

Analysis of the blood of the study subjects revealed that 54% tested positive for various pesticides, the majority, i.e., 32% testing positive for chlorpyriphos (an organophosphorus compound), while 12% tested positive for

Table 4 Results of Blood Analysis for Pesticide Residues in Study and Control Groups

Type of Pesticide Compound	Study Group		Control
	Positive Cases	*Percentage*	
Quinalphos	05	10	None
Chlorpyriphos	16	32	
DDT	06	12	
Monocrotophos	00	00	
Triazophos	00	00	
Dimethoate	00	00	
Dichlorvos	00	00	
Carbosulfan	00	00	
Diclofol	00	00	
Profenphos	00	00	
Total	**27**	**54**	

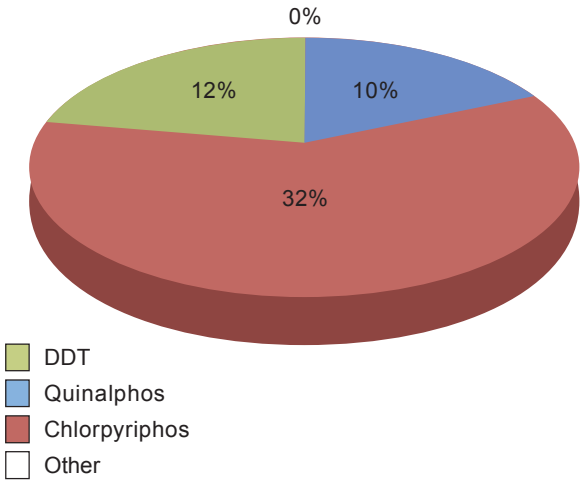

Fig 2 Results of Blood Analysis for Pesticide Residues in Study and Control Groups

DDT (dichlorodiphenyltrichloroethane, an organochlorine compound) and 10% for quinalphos (another organophosphorus compound), which gives an idea about the commonest types of pesticides used in this region. Though some these pesticides are banned, their use is still rampant in many rural areas of India. Among the positive cases, majority of the farmers though literate, were unaware of any protective measures to be used while handling the pesticides; most of them did not use any sort of protective equipment, but instead indulged in various habits which could accelerate pesticide absorption, and were exposed to pesticides for more than a decade.

Table 5 Predisposing Factors in Positive Cases

Total Positive Cases	27	
Period of Exposure 10–15 yrs	21	77.77
Unaware of Protective Measures	17	62.96
Used No PPE	19	70.37
Used Cloth Occasionally	08	29.63
Hazardous Habits at Workplace	16	59.25

Limitations of the study:

- The study group being very small, conclusions cannot be taken as confirmatory of the scenario.
- Only direct exposure to pesticides of male farmers have been addressed in the study.
- The site of the study does not exactly represent the whole population of that area.

- There are possible selection biases, as we were able to recruit only a minority of the exposed target population.

Despite these limitations, this study reveals that agricultural workers are prone to health concerns related to the use of pesticides over a period of time. Since national-level official data focusing on agricultural worker's health are scarce, it is important that intervention programs such as surveillance systems are undertaken to investigate the exact impact of pesticide exposure.

Conclusion

Laboratory markers are useful in both raising suspicion as well as confirming the diagnosis of alcohol abuse. They are also helpful in follow-up of patients undergoing treatment, and monitoring abstinence. However, sensitivities and specificities vary considerably, and depend on the nature of population concerned. A judicious combination of reliable history, questionnaires, and use of biochemical markers can help in diagnosing heavy consumption of alcohol with near-certainty.

REFERENCES

1. Sailaja N, Chandrasekhar M, Rekhadevi PV, Mahboob M, Rahman MF, Vuyyuri SB, *et al*. Genotoxic evaluation of workers employed in pesticide production. *Mutat Res* 2006;609(1):74–80.
2. Chitra Grace A, Muraleedharan VR, Swaminathan T, Veeraraghavan D. Use of pesticides and its impact on human health: a case of farmers in South India. *Int J Occup Environ* Health 2006.
3. Bhoopendra Singh, Gupta MK. Pattern of use of personal protective equipment and measures during application of pesticides by agricultural workers in a rural area of Ahmednagar district, India. *Indian J Occup Environ Med* 2009;13(3):127–130.
4. Rastogi SK, Tripathi S, Ravishanker D. A study of neurologic symptoms on exposure to organophosphate pesticides in the children of agricultural workers. *Indian J Occup Environ Med* 2010;14(2):54–57.
5. Kaiser Jamil, Prabhavathy Das G, Abjal Pasha Shaik, Dharmi SS, Sudha Murthy. Epidemiological studies of pesticide exposed individuals and their clinical implications. *Current Sci* 2007;92(3): 10–11.
6. Singh S, Sharma N. Neurological syndromes following organophosphate poisoning. *Neurol India* 2000;48(4):308–313.
7. Yassi A, Kjellstrom T, Kok TK, Gudotli TL. Basic Environmental Health. 2001. Geneva: World Health Organozation.
8. Sosan MB, Akingbohungbe AE, Ojo IA, Durosinmi MA. Insecticide residues in the blood serum and domestic water source of cacao farmers in Southwestern Nigeria. *Chemosphere* 2008; 72(5):781–784.