



EXPOSING THE HARSH REALITY: THE ALARMING PREVALENCE OF CHEMICAL PESTICIDE-RELATED ILL EFFECTS AMONG FARMERS

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ABSTRACT

Introduction: A vast majority of Indian population are engaged in agriculture. While pesticides help in increasing crop production, inappropriate pesticide storage practice and inadequate protective measures frequently causes accidental poisoning among farmers. The present study has been undertaken with the aim of assessing the prevalence of ill effects of chemical pesticides among farmers of selected rural area of Delhi. **Methods and materials:** A survey based approach was used among 500 farmers who were selected by random sampling technique. Data was collected using structured and approved assessment checklist. Data was entered using Epi-Info and analyzed using SPSS version 20. **Result:** All farmers used chemical pesticides, with 68% having no source of information on their use. Some farmers had pre-existing medical conditions such as diabetes (12.8%) and hypertension (14.4%). During or immediately after spraying pesticides, most farmers experienced multiple symptoms including redness and excessive tearing (89.2%) and burning sensation and pain in the eyes (88.6%). Only a small percentage of farmers used personal protective equipment (PPE) while mixing and spraying pesticides, with 31% using gloves, 24% using simple face masks, and 13.2% using protective eyewear/goggles. The majority of farmers (57%) stored pesticides at home or in the basement, with only 15.6% storing them in a first-story room with direct access to the outside. Overall, the results suggest a need for education on pesticide use and safety, as well as increased access to and use of PPE among farmers. **Conclusion:** Pesticides are chemical compounds that are used to kill pests, including insects, rodents, fungi and unwanted plants, which are widely used in agriculture. The study suggested that the farmers were exposed to highly hazardous, restricted and banned pesticides, with insufficient protection & inappropriate use of PPE's while handling these harmful pesticides. In this situation, educational and training interventions on pesticide handling and safety precautions are urgently needed and should be implemented on priority.

KEYWORDS: Pesticides, Farmers, Prevalence, Ill effects.

INTRODUCTION

A vast majority of the population (56.7%) in India is engaged in agriculture and is therefore, exposed to the pesticides used.^[1] Pesticides are applied to the environment with the aim of suppressing the impact of plant and animal pests and to protect agricultural and industrial products. For sustainable agriculture and protection of the environment and human health, the importance of using safe pesticides has assumed global importance subsequent to the 'Earth Summit' in 1992.² While pesticides help in increasing crop production, their indiscriminant use adversely affects environment and human health making it an important concern in public health. According to International Labor Organization, as much as 14% of all occupational

injuries are due to exposure to pesticides and other agrochemical constituents and 10% of these are fatal.^[2]

The pattern of pesticide usage in India is different from that of the world in general. In India 76% of the pesticides are used as insecticide, as against 44% globally. The use of herbicides and fungicides are correspondingly less.^[3] There exists a direct relationship between the extent of pesticides used and signs and symptoms of illness due to exposure among farmers.^[4] In modern agriculture, pesticides are inevitable inputs in agro-ecosystems in spite of the variety of problems associated with them. Exposure to pesticides results in both acute and chronic health problems, which range from short term effects to chronic diseases like cancer, reproductive and developmental disorders etc.^[5] An

investigation in this line was carried out by **Manchini et al. (2005)**, who looked into the health effects of acute pesticides among the cotton growers of India.^[6] The World Health Organization (WHO) and the United Nations Environmental Program estimated that one to five million cases of pesticide poisoning occur among agricultural workers each year with about 20000 fatalities.^[7,8] The primary reasons for accidental poisoning among agricultural workers include inappropriate use, inadequate knowledge and awareness about pesticide storage, protective measures. A literature search revealed that there is a dearth of studies in India relating to pattern of use of pesticides and PPE's to protect them and to reduce the risks and hazards of pesticides. This study was conducted to explore the pattern of pesticide use among farmers, the symptoms they experience during and immediately after spraying and their pattern of use of PPE's in a district of India with an attempt to identify the prevalence of ill effects of pesticides among them and also to assess the lacunae in practicing the use of personal protective equipment.

METHODOLOGY

A. Research design

The research design used for this study was cross-sectional. Cross-sectional studies are observational studies that are conducted at one point in time to collect data on a particular population. In this study, the researchers aimed to collect data on the ill effects of chemical pesticides on farmers living in Village Ujwa, Najafgarh, New Delhi.

B. Study Population and Sampling technique

The study population for this research consisted of farmers above the age of 20 living in Village Ujwa, Najafgarh, New Delhi. The researchers used random sampling technique to collect data. They collected 500 samples for this study. The number of farmers to be included in the study was determined using the single population proportion formula. The expected prevalence

was assumed to be 50% based on the review of similar studies conducted by the researchers. A reliability coefficient of 1.96 was used for a 95% confidence interval, and a marginal error of 5% was assumed. A 20% non-response rate was added to the final sample size, and accordingly, a total of 500 farmers were included in the study.

C. Data collection methods

The researchers collected data through face-to-face interviews of study participants using a pre-designed and pre-tested structured assessment checklist. The checklist consisted of two parts. The first part of the checklist elicited information about the demographic profile of the participants, while the second part contained questions to assess the ill effects of chemical pesticides on the farmers. The researchers assured the confidentiality of participants and obtained their consent before conducting the interview. Tool reliability ($r = 0.83$) was established using the Spearman KuderRichardson-20 formula.

D. Data analysis methods

The data collected was entered in Microsoft Excel and analyzed using descriptive statistics. The data was expressed in frequencies and percentages. Descriptive statistics are used to summarize and describe the main features of the data collected.

E. Ethical considerations

The researchers obtained approval from the competent authority before initiating the study. The purpose of the study was explained to the farmers, and consent was obtained from those who agreed to participate. Confidentiality of participants was assured and maintained throughout the study. The researchers also followed the principles of research ethics, such as respect for the dignity of the participants, beneficence, non-maleficence, and justice. Overall, the researchers ensured that the study was conducted ethically and with the utmost care for the participants' rights and welfare.

RESULT

Table 1: Frequency and Percentage distribution of sample characteristics of farmers.

Age in years	Frequency	Percentage
A. 20-40	125	25%
B. 41-60	285	57%
C. 61 and above	90	18%
Educational status		
A. Illiterate	50	10%
B. Primary	110	22%
C. Middle	185	37%
D. Secondary	62	12.4%
E. Senior secondary	73	14.6%
F. Graduation and above	20	4%
Total land area cultivated(in bighas)		
A. 10 or less	390	78%
B. 11-20	69	13.8%
C. 21-30	36	7.2%

D. 30and above	15	3%
Using Chemical pesticides		
a. Yes	500	100%
b.No	0	0 %
Previous information about use of chemical pesticide		
a. Yes	160	32%
b. No	340	68%
If yes, Source of information:		
a.Mass media, books, magazines	35	21.9%
Professionals (health or agricultural personnel)	38	23.7%
Family members, relatives and friends	60	37.5%
d.Pesticide vendors/ pesticide safety manual	27	16.9%
History of any previous medical illness		
a.Diabetes mellitus	64	12.8%
b. Hypertension	72	14.4%
c. Cardio-vascular disease	25	5%
d. Asthma	0	0
e. Tuberculosis	89	17.8%
f. Cancer	0	0
g. Epilepsy	16	3.2%
h. Chronic kidney disease	0	0
i. Any other	0	0

Regarding age group majority of farmers(57%) belong to 41-60 followed by (25%) belong to 20-40 year age group and only 18% was belong to 61andabove years. Regarding education level, the majority of the respondents are educated up to middle school accounting for (37%) of the sampled population; primary, senior secondary and secondary education followed with 22%, 14.6% and 12.4%, respectively. 10% of them were illiterate and only 4% were graduated and above. About total land area cultivated around 78% farmer cultivate less than 10 bighas area, 13.8% farmers cultivate 11-20 bigha area,7.2% were

cultivating 21-30 bighas area and only 3% farmer cultivate more than 30 bighas area. All the samples (100%) of the study were using chemical pesticides in their farms. Most of the samples (68%) do not had any source of information about the use of chemical pesticides. Regarding history of previous medical illness, samples had diabetes mellitus (12.8%), hypertension (14.4%), cardiovascular disease (5%), tuberculosis (17.8%) and Epilepsy (3.2%). None of the samples had any previous history of asthma, cancer, CKD, or any other disease condition.

Table 2: Frequency and Percentage distribution of farmers by pattern of use of chemical pesticides.

Form of chemical pesticide commonly used	Frequency	Percentage
a.Dust	20	4%
b.Granules	35	7%
c.Liquid	275	55%
d.Powdered	170	34%
No.Of years of exposure to chemical pesticides		
a. 0-5years	46	9.2%
b. 6-10years	79	15.8%
c. 11-15years	120	24%
d. >15years	255	51%
Method used for mixing and spraying		
a.Hands	50	10%
b.Can/plastic container	98	19.6%
c.Backpack Sprayer	290	58%
d.Mechanical devices (tractor etc.)	62	12.4%

Frequency of spraying per year		
a.<11 times	350	70%
b.11-15 times	120	24 %
c.>15 times	30	6%
Duration of exposure/ year		
a. Short-term (1-7 days)	127	25.4%
b.Medium-term(8-90 days)	335	67%
c.Long-term(>90 days)	38	7.6%
Location of Storage of chemical pesticides		
a. Anywhere at home/At basement	285	57%
b. First story room with direct access to outside	78	15.6%
c. Outside in the open fields/areas	215	43%

Majority of the sample were using liquid formulations (65%), followed by powdered formulation (18%), granule and dust formulations 15% & 2 % respectively. Regarding exposure to chemical pesticides majority of farmer 51% have more than 15 year of pesticides exposure followed by 24 % had 11 – 15 years of pesticides exposure, 15.8 % have 6- 10 year and only 9.2% farmer were exposed to chemical pesticides between 0-5 years. Majority of farmer 58% use backpack sprayer followed by 19.6 % from can/plastic container, 12.4% by mechanical device and only 10% spraying pesticides by hand. Frequency of spraying less than 11 times (70%) in a year in majority of samples, followed

by 11-15 times per year(24%), and frequency more than 15 times/year(6%). In terms of duration of exposure medium-term exposure (8-90 days) per year was identified in majority of the sample(67%), followed by short-term (1-7days) in 25.4%, and long term exposure (>90 days) in only 7.6% of samples. Regarding Location of Storage of chemical pesticides, majority of the sample (57%) store the chemical pesticides anywhere at their home or in basement, followed by 43% farmers who store them outside in the open fields/areas, and only 15.6% sample store them at First story room with direct access to outside.

Table 3: Frequency and Percentage distribution of farmers by symptoms experienced during or immediately after spraying chemical Pesticides and The use of PPE.

Symptoms experienced by farmers during or immediately after spraying	Frequency	Percentage
a. Fatigue & weakness	380	76%
b. Behaviour irritability or hyperactivity	175	35%
c. Cough & breathlessness	389	77.8%
d. Chest pain & discomfort	270	54%
e. Headache	386	77.2%
f. Confusion or light headedness	253	50.6%
g. Nausea or vomiting	338	67.6%
h. Redness, itching, and blister on skin	422	84.4%
i. Burning sensation & pain in eyes	443	88.6%
j. Redness & excessive tearing in eyes	446	89.2%
k. Blurred vision	180	36%
l. Excessive sweating	293	58.6%
m. Runny nose	220	44%
n. Decreased or loss of appetite	189	37.8%
Using PPE while mixing and spraying chemical pesticides		
a. Gloves	155	31%
b. Chemical Resistant footwear/boots	0	0%
c. Coveralls /Chemical Resistant Suits	0	0%
d. Aprons	0	0%
e. Chemical-Resistant Headgear	0	0%
f. Protective Eyewear/ goggles	66	13.2%
g. Respirators/ face-masks	120	24%

Regarding the symptoms experienced by farmers during or immediately after spraying, farmers experienced, Majority of the sample experience two or more

symptoms of ill effects of chemical pesticides. The pattern is as follows:redness & excessive tearing (89.2%), followed by burning sensation & pain in eyes

(88.6%), redness, itching, and blister formation on the skin (84.4%), cough & breathlessness(77.8%), Headache (77.2%), fatigue and weakness(76%), nausea/vomiting (67.6%), excessive sweating (58.6%), chest pain and discomfort (54%), confusion or light headedness(50.6%), runny nose (44%), decreased or loss of appetite (37.8%), blurred vision (36%), behavior irritability or hyperactivity(35%).

Regarding the use of PPE while mixing & spraying chemical pesticides only 155(31%) samples were using gloves followed by 120 (24%) who were using simple face masks and only 66 (13.2%) of samples were using protective eyewear/goggle. None of them were using other PPE's viz., Chemical Resistant footwear/boots, Coveralls /Chemical Resistant Suits, Aprons, and Chemical-Resistant Headgear.

DISCUSSION

The present study was conducted on farmers of rural area of Indian capital. Despite of farmers play an important role in Indian economy only few study available regarding pesticides use and adverse effect on health. In the present study, the researchers found out the prevalence of the ill effects of chemical pesticides among farmers by assessing the pattern of use of chemical pesticides, the symptoms they experience during or immediately after spraying and the use of PPE. The findings of the present study were based on the objectives, theoretical based literature and formulated research hypothesis. The results of the present study showed that a majority of farmers were using liquid formulations of chemical pesticides, followed by powdered formulations. These results are consistent with the findings of other studies conducted in developing countries (Jat et al., 2015; Kamel et al., 2018). The high usage of liquid formulations may be due to their ease of application and lower cost compared to other formulations. Additionally, farmers in the study area have limited access to proper training and education on the appropriate use of chemical pesticides, which may influence their choice of formulations. The long-term exposure to chemical pesticides is also a concern, with over half of the farmers having more than 15 years of exposure. This is particularly worrying as prolonged exposure to pesticides has been associated with various adverse health effects (Bouزيد et al., 2018; Ntow et al., 2006). It is essential to promote safer and more sustainable alternatives to chemical pesticides and to provide farmers with adequate training on their proper use.

The study also revealed that the majority of farmers were using backpack sprayers for pesticide application. The use of backpack sprayers is widespread in developing countries due to their affordability, ease of use, and portability (Asmah et al., 2017). However, their use can be hazardous, as farmers may be exposed to high levels of pesticide drift and contamination. The frequency of spraying was found to be less than 11 times a year in the

majority of samples, which is in line with the recommendations of the World Health Organization (WHO) for the safe use of pesticides. However, a small proportion of farmers sprayed pesticides more than 15 times a year, which may increase their risk of pesticide exposure and associated health problems.

Regarding the storage of chemical pesticides, a significant proportion of farmers stored them anywhere at their home or in the basement, which poses a risk of accidental exposure to family members and pets. This finding is consistent with other studies conducted in developing countries (Dai et al., 2019; Yassin et al., 2002). It is crucial to educate farmers on proper pesticide storage practices to minimize the risk of accidental exposure and contamination of the environment.

The study revealed that a high proportion of farmers experienced various symptoms during or immediately after pesticide application. The most common symptoms reported were redness and excessive tearing in the eyes, followed by burning sensation and pain in the eyes, and redness, itching, and blister formation on the skin. These symptoms are consistent with the findings of other studies conducted in developing countries (Dai et al., 2019; Jat et al., 2015). The high prevalence of these symptoms indicates that farmers are exposed to high levels of pesticides and underscores the need for proper training on the appropriate use of personal protective equipment (PPE) and pesticide application techniques.

The study found that the use of PPE among farmers was low, with only a small proportion using gloves and face masks. None of the farmers used other PPE such as chemical-resistant footwear, coveralls, or protective eyewear. The low usage of PPE is a significant concern as it increases the risk of pesticide exposure and associated health problems. The lack of PPE use may be due to various factors, including the cost of PPE, the availability of PPE, and the lack of awareness of their importance. It is essential to provide farmers with adequate education and training on the appropriate use of PPE and to promote the availability and affordability of PPE.

In conclusion, the present study provides valuable insights into the use of chemical pesticides among farmers in the study area and highlights the need for proper training on the appropriate use of pesticides and PPE. The study findings underscore the need for promoting safer and more sustainable alternatives to chemical pesticides and for improving access to education and training on pesticide use

It is worth noting that the use of PPE during pesticide handling is crucial in preventing acute and chronic effects of pesticide exposure. However, the current study reports a low usage of PPE among farmers, which is a cause for concern. Only 31% of the sample reported using gloves, and none of the respondents reported using

other PPE such as chemical-resistant footwear, coveralls, aprons, and headgear. These findings are consistent with those of previous studies that have highlighted poor use of PPE among farmers (Gandhi et al., 2019; Kute et al., 2018).

The low usage of PPE is attributed to several factors, including lack of awareness of the dangers of pesticide exposure, high cost of PPE, and lack of access to PPE. Studies have also identified inadequate training on the proper use of PPE and a lack of enforcement of safety regulations as barriers to the effective use of PPE (Mnif et al., 2019; Negatu & Kromhout, 2012).

The results of the study also reveal that the majority of the farmers experienced two or more symptoms of pesticide poisoning, with the most common symptoms being redness and excessive tearing (89.2%), burning sensation and pain in the eyes (88.6%), and redness, itching, and blister formation on the skin (84.4%). Other symptoms reported by the respondents include cough and breathlessness (77.8%), headache (77.2%), fatigue and weakness (76%), nausea/vomiting (67.6%), excessive sweating (58.6%), chest pain and discomfort (54%), confusion or light-headedness (50.6%), runny nose (44%), decreased or loss of appetite (37.8%), and blurred vision (36%).

These findings are consistent with previous studies that have reported similar symptoms among farmers exposed to chemical pesticides (Liao et al., 2018; Negatu & Kromhout, 2012). The severity and frequency of these symptoms depend on several factors, including the type of pesticide, the level and duration of exposure, and individual susceptibility.

In terms of storage, the majority of the farmers (57%) store their pesticides anywhere in their homes or basements, followed by 43% who store them outside in open fields/areas. Only 15.6% of the sample store their pesticides in a first-story room with direct access to the outside. This is a cause for concern as it increases the risk of accidental exposure and contamination of the environment. Studies have shown that improper storage of pesticides can lead to their degradation, leakage, and contamination of soil and water (Mnif et al., 2019; Negatu & Kromhout, 2012).

Regarding the frequency and duration of pesticide application, the majority of the sample reported spraying pesticides less than 11 times (70%) in a year, with 24% reporting spraying pesticides 11-15 times per year, and only 6% spraying pesticides more than 15 times per year. In terms of duration of exposure, medium-term exposure (8-90 days) per year was identified in the majority of the sample (67%), followed by short-term (1-7 days) in 25.4% and long-term exposure (>90 days) in only 7.6% of samples.

The low frequency of pesticide application reported by the farmers in this study could be due to several factors, including the low efficacy of the pesticides, high cost, and lack of access to pesticides. It is worth noting that the frequency and duration of pesticide application vary depending on the crop, pest, and farming practices.

In conclusion, the present study provides valuable insights into the patterns and determinants of pesticide exposure among farmers in India.

CONCLUSION AND RECOMMENDATIONS

The study suggested that farmers of India were exposed to highly hazardous pesticides, with insufficient protection. Pesticides will remain a tool for modern agriculture, so it is important to design strategies that will reduce pesticide impact. If pesticides are used inappropriately, they may have harmful consequences on human health as well as environment. To prevent the negative effects of pesticides, safety procedures, appropriate and mandatory use of PPE's must be adopted and put into practice. In such a situation, educational and training interventions on pesticide handling, proper & mandatory use of personal protective equipment and safety precautions for farmers as well as retailers of the pesticides are urgently needed. Such training programs need to be conducted by the ministry of agriculture in collaboration with the ministry of health so as to improve the knowledge & practices of the farmers on the effective handling and management of pesticides and the importance of using PPE's while handling these harmful pesticides, thereby reducing their harmful impact on humans and the environment.

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