How to Cite:
Meenakshi, M., & Saini, V. (2022). Risk assessment and health hazards in vegetable growers of Haryana (India) based on their knowledge and attitudes towards pesticide uses. *International Journal of Health Sciences*, *6*(S1), 7443–7455. https://doi.org/10.53730/ijhs.v6nS1.6593

Risk assessment and health hazards in vegetable growers of Haryana (India) based on their knowledge and attitudes towards pesticide uses

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Abstract*---Objectives:*** India is an agricultural country, with agriculture employing the majority of the population. Pesticides are broadly and indiscriminately used in agricultural production, posing a serious threat to both the environment and public health. So, the objective of the current study was to assess the risk assessment of pesticide uses in vegetable growers in based on their knowledge and practices in Jhajjar district of Haryana. *Methodology:* The study included 110 vegetable and fruit farmers in Jhajjar District of Haryana. A standardized questionnaire was administered to gather the primary data from farmers after their consent. The collected data was entered in the excel sheet and analyzed using inbuilt programme. *Results:* We observed that more than 77% farmers were aware of the adverse health effects of the pesticides, but most of them were unable to understand the colour code and instructions present on the label. They do not follow safety practices regarding pesticide application and due to this 70% of them reported at least one symptom of acute pesticide poisoning. Headaches (54.54%), runny nose (45.45), coughing (44.54%), watery eyes (43.63) were the most common symptoms followed by itchy eyes/irritation (31.81%), skin irritation (30%), fatigue (29.09%), nausea (18.18%), and dizziness (7.27%). *Conclusions:* Despite of knowing hazardous effects of pesticides on their heath, farmers do it for the protection of crops, on the cost of their own safety. In this situation we recommend comprehensive prevention and intervention measures, such as pesticide safety

training programs, use of protective measures, pesticide poisoning or illness monitoring, strict regulation on the sale/purchase of hazardous pesticides along with integrated pest management.

***Keywords*---**Acute Poisoning, Health hazards, Pesticides uses, Risk assessment, Safety precautions.

Introduction

India is primarily an agrarian country, with agriculture employing the majority of the population. To enhance productivity, pesticides are widely used. In India, there are 293 pesticides registered, and it is reported that 104 pesticides are still produced/used in the country regardless of being prohibited in two or more countries around the world [(1)].

Pests and diseases significantly limit vegetable and fruit output in the tropical countries like India. Like other developing countries of the world, Indian farmers also heavily relied on different chemical pesticides to control weed growth, insect infestation, and diseases. Pesticides help farmers reduce the risk of crop output loss due to pests and illnesses. Pesticide exposure, both occupational and environmental, is hazardous to one's health. Vegetable and fruit growing farmers in developing countries face significant exposure risks as a result of the use of hazardous chemicals that are banned or restricted in developed countries, improper and excessive pesticide use, insufficient safety precautions, inaccurate application methods, a lack of maintenance or improper spraying equipment, insufficient storage practices, and the reuse of pesticide containers for domestic purposes (e.g. storing grains, water, and food) frequently result in negative health consequences and significant environmental harm.

Insecticide remains on fruits, vegetables and in drinking water also of great concern for the general community. Kumari and John investigated the hazardous effects of pesticide residues in fruits and vegetables collected from farms and markets of Himachal Pradesh (India) and found higher concentration of organophosphates, pyrethroid and phthalimide in farm samples [(2)].

The type of pesticides, the period and method of exposure, as well as the person's overall health all have a role in the potential health consequence. Pesticides can be digested, expelled, stored, or bioaccumulated in the body fat of humans and animals [(3)]. A variety of severe health impacts, including dermatological, gastrointestinal, neurological, carcinogenic, respiratory, reproductive, and endocrine disease may result from pesticide exposure. Furthermore, high levels of pesticide exposure to the farm-workers, whether accidental or purposeful, can lead to illness and death [(3)]. The chances also increased due to lack of education and awareness, the continued use of hazardous pesticides, insufficient training, and the inability to afford protective gear [(2-6)]. Also, farmers who used pesticides had higher suicide rates than the normal community [(7)]. Indirect exposure due to consumption of pesticide residue in food and drinking items may also affect the non agrarian population of adults, newborn or even fetus with serious health issues [(3)]. Pesticide exposure can occur in some cases as a result of chemical

spills, leaks, or defective spraying equipment which affect the soil, water and air of that particular area [8]. The current study aims to understand the vegetable and fruit growing farmer's ongoing application practices, knowledge and perceptions regarding pesticide uses in Jhajjar district of Haryana and to evaluate the associated health problems in them.

Methodology

Study Design: The present work is a cross-sectional study. Primary data was collected using a pre-tested semi-structured questionnaire to provide the framework for the study. The survey covered the farmers' demographic characteristics, pesticide application methods, use of personal protective equipment (PPE), personal hygiene while handling pesticides, and acute/chronic symptoms experienced in the previous year.

The questionnaire was developed with closed and open-ended questions. The closed questions were in multiple-choice format, so participants had to choose only the suitable answers that best described their opinion or point of view on a specific issue. The standardized questionnaire was divided into three sections.

The first section was focused on gathering information on the farmers' personal characteristics, such as age, sex, and education. The second section collected data about farmers' awareness of pesticide rules and regulations, as well as their knowledge and understanding of pesticides' effects on the environment and human health. In addition, we gathered information on self-reported pesticide toxicity symptoms. Respondents were asked if they had experienced at least one health problem instantly after spraying or handling pesticides in the previous year or prior to the date of the interview. If respondents answered yes, they were asked to specify which symptoms they had experienced. Questions about pesticide handling and safety practices were asked in the third part, including the interpretation and reading label instructions, storage and disposal of pesticides and empty pesticide containers, and use of protective measures during and after pesticide handling.

Place and duration of study: The study was conducted from November 2020 to March 2021, in rural areas of selected blocks (a district sub-division for the purpose of rural development) of District Jhajjar, Haryana, India i.e. Jhajjar, Badli, and Bahadurgarh.

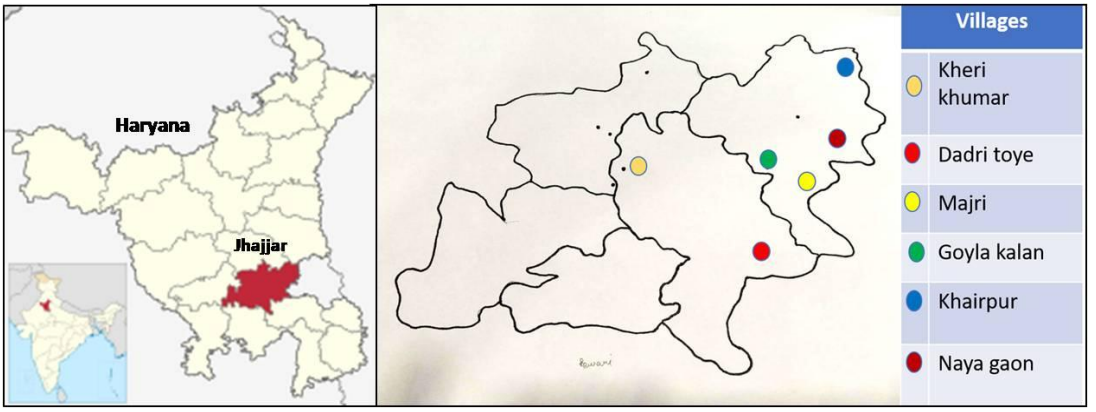

Figure 1 showing Haryana in Indian map and graphical representation of the villages selected from the Jhajjar District

Ethical approval and Patient consent: The verbal consent of farmers was obtained after explaining them the objectives of the study and prior to questioning. Inclusion and exclusion criteria: Farmers who had direct contact with pesticides for at least six months, regardless of gender or age, were included in the study. The survey excluded farmers who were not exposed to pesticides and administrative personnel.

Sample Size and sampling: A total of 110 vegetable and fruit growing farmers were selected using random sampling method.
Statistical analysis and software used: For the data analysis, Microsoft Office Excel was used. The results were represented as frequencies and percentages.

Results

The socioeconomic information of respondents in the selected area is provided in table 1.

Table 1
Showing the demographic profile of farmers

Variable	Frequency (N)	Percentage (%)
Gender		
Male	100	90.09
Female	10	9.91
Age group		
20-30	27	24.55
31-40	39	35.45
41-50	33	30
More than 50 yrs.	11	10

Males predominated (more than 90%) females in vegetable cultivation. The prominent age group was 31 to 40 years and majority of farmers had no formal education figure 2.

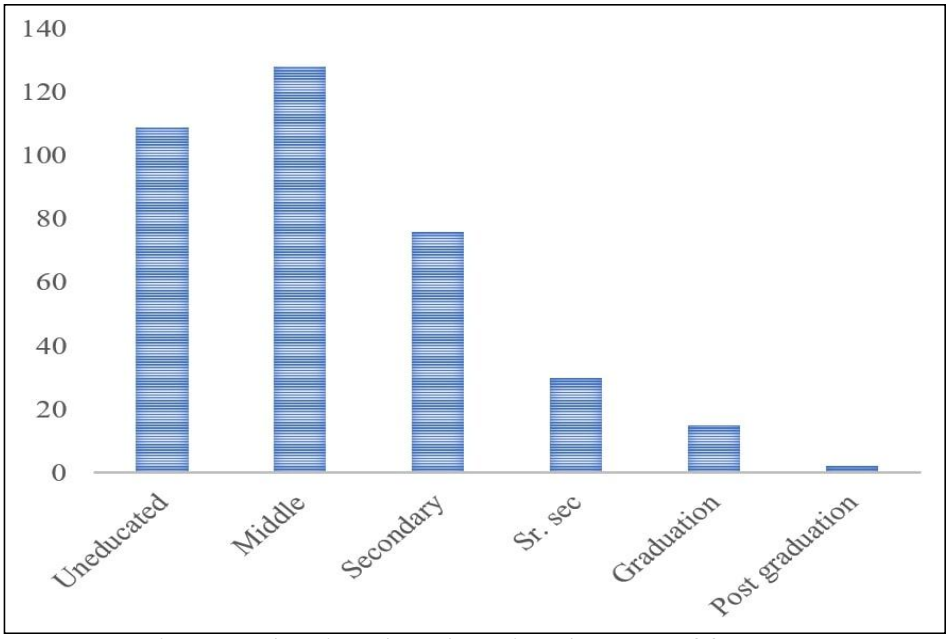

Figure 2 showing the educational status of farmers

Awareness regarding the pesticide handling was given in table 2 which indicated that 90% farmers didn't have formal training for pesticide handling and more than 3/4th of them were unable to identify the toxicity colour codes.

Table 2
Shows the farmers awareness regarding pesticide handling

Variable	Frequency (N)	Percentage (%)
Whether they took training for safe handling		
Yes	11	10
No	99	90
Whether able to identify toxicity color codes		
Yes	20	18.18
No	90	81.82
Whether able to read or follow instructions on the label of pesticide container		
Yes	29	26.37
No	81	73.63
Whether take bath after application of pesticides		
Yes	103	93.63
No	7	6.36
Whether they wash their hand after application of pesticides		
Yes	93	84.54
No	17	15.45

Most of the farmers (81) couldn't read or follow the instruction given on the container of pesticide. But they bath and wash their hand after pesticides application.

Information about storing and disposal of pesticide residue solutions and empty pesticide containers was provided in table 3.

Table 3
Shows the pesticide handling practices of farmers

Variable	Frequency (N)	Percentage (%)
Storage of pesticides		
Home	32	29.10
Field	43	39.09
Animal house	14	12.72
Specific Store	15	13.64
Buy & immediately use	6	5.45
Disposal of empty container		
Dumped in the field	60	54.53
Put in to local garbage	19	17.27
Domestic use	25	22.72
Burning	6	5.45
What they do with leftover pesticides		
Stored for next spray	16	14.54
Disposed of in the field	34	30.90
Mix only the required quantity of pesticides	60	54.56

Most of the farm workers didn't store pesticides at safe place and at many occasions we observed that pesticides were placed along with food preparation items (Figure 3).

Figure 3 showing the storage of pesticides along with food preparation place

One of most prevalent disposal method for empty pesticide containers was to dump/dispose of them on the field followed by throwing containers in the local garbage or burning them on the farms (Figure 4).

Figure 4 showing the disposal of empty containers of pesticides on the field

Alarmingly, 22.72% of the farmers stated that re-using pesticide containers for domestic use such as water storage, storing seeds, grains, household items, and so on. Use of the personal protective equipment (PPE) by farmers during spraying is given in Table 4

Table 4
Shows the personal protective equipment (PPE) used by farmers during spraying

Variable	Frequency (N)	Percentage (%)
Complete PPE (without gloves & goggles)	10	9.09
Partial PPE	40	36.36
Not using PPE	60	54.54
Whether using mask/cloth on face during mixing & spraying		
Yes	46	41.82
No	64	58.18

Majority of farmers didn't use complete PPE and even more than 58% farm workers didn't apply face mask or cloth on face during spraying. Acute toxicity symptoms experienced by farmers during or after handling pesticides are provided in table 5.

Table 5
Shows the acute toxicity symptoms experienced by farmers during or after handling pesticides

Symptoms	Frequency (N)	Percentage (%)
Headache	60	54.54
Runny nose	50	45.45
Coughing	49	44.54
Watery eyes	48	43.63
Itchy eyes/irritation	35	31.81
Skin irritation	33	30.00
Fatigue	32	29.09
Rough skin of hands & feet	30	27.27
Nausea	20	18.18
Dry throat	16	14.54
Excessive sweating	15	13.63
Shortness of breath	15	13.63
Dizziness	8	7.27
Poor vision	6	5.45
Stomach ache	5	4.54
Vomiting	5	4.54
No health effect	31	28.18

Headache, coughing, runny nose, watery and Itchy eyes/irritation and fatigue were the most common symptoms followed by rough hands & feet, nausea, dry throat, shortness of breath and excessive sweating, while 28% farm workers reported no symptoms.

Discussion

The present study was undertaken to understand the knowledge, attitudes and practices of pesticide application by vegetable and fruit growing farmers of Jhajjar district of Haryana.

Socioeconomic characteristics of the farmers in the selected area

In socio-demographics we have considered sex, age group and educational status of the farm workers. The survey indicated that males dominated (90%) vegetable cultivation while females were only involved in weeding, plucking vegetables, flowers, and fruits. During spray they do other work at farm or the next day of pesticide spray. Same scenario was also observed Tamil Nadu [9], and West Bengal [10]. The male-female ratio in the current study is parallel to the previous studies in Nigeria, Ghana, Ethiopia, and the Southern Philippines respectively [6,11-14]. The majority of the farmers (44.54%) had no formal education followed by 36.36% of the farmers educated up to middle level, while the percentage of illiterate farmers was 71.4% and 39.5% in California and Pakistan [15,16] respectively.

Farmer's awareness and understanding of pesticides

Pesticide safety precautions can be better understood through training activities and programs. Pesticide labels were not interpreted or followed by more than 73% of farmers. This can be directly related to the educational status as they were unable to interpret and understand the label's language, the label information is written in English and in very small font size. The remaining 26.37% of farmers only read the manufacturing and expiration dates (table 2). Farmers who have been educated and well informed on pesticide safety are better able to read, interpret, and follow risk alerts on labels, and as well as comprehend the consequences of improper pesticide use [5]. More than half of Tanzanian farmers were able to interpret and comprehend pesticide labels [17].

When asked if they had received any pesticide handling training, 90% of respondents stated that they had not received any pesticide handling or application training. The vast majority of farmers stated that they learn from their elders. In Kuwait, the vast majority (64%) of farmers received no pesticide safety training [5]. In Uganda, the findings were completely opposite, where 71% of farmers were well trained in pesticide handling and application [18].

The majority of farmers (81.82%) were unable to interpret the toxicity color codes on pesticide container labels. Only 18.18% of the respondents were able to decipher the toxicity color codes, with many only recognizing red as the "color of danger". This is most likely owing to the poor educational level of the majority of our study's interviewees. In Uganda, 37% of farmers were able to understand the toxicity color codes on pesticide container labels [18].

Pesticide handling attitude of farmers

Over 94% of respondents took bath after applying pesticides, and 84.54% said they wash their hands with water and soap afterward. The remaining farmers (15.45%) were washing their hands with soil and water as shown in Table 2. This demonstrates that respondents are aware of the potential risk of pesticide exposure on humans. These findings are consistent with hand-washing practices by farmworkers in Nigeria, Kenya and Pakistan where 100%, 98% and 71% used to wash their hands after pesticide application respectively [11,19,20].

Storage and disposal practices of pesticides

The vast majority of farmers (39.09%) kept pesticides in the open field followed by living areas in home (29.10%) and their animal areas (12.72%). Only a few of them (13.64%) kept the pesticides locked away in pesticide-specific stores thus limiting pesticide access to minimize potential self-harm or accidental poisoning. But on many occasions, we observed that pesticides were placed along with food preparation items (Figure 3). In Karnataka, only 12.28% stored pesticides inside the house [21]. In West Bengal, 48.4% of farmers stored pesticides in the cowshed, which was quite an unsafe place for the storage of pesticides [10].

In other parts of the world, the storage practices are more or less the same as in India. Some studies show similar finding which represents the careless nature of

farmers. The percentage of farmers varies from country to country, as in Tanzania, 9.2% of farmers stored pesticides in a specific pesticide store [17], in Pakistan 10.8% stored in home [15], in Uganda 60% stored pesticides in their houses [18].

When questioned about the leftover pesticides, more than 14% of farmers stored for next spray and around 31% disposed on the field. About 54.56% of farmers mix only the quantity of pesticides required for the application. One of most prevalent disposal method for empty pesticide containers was to dump/dispose of them on the field (54.54%), throwing containers in the local garbage (17.27%) or burning them on the farms (5.45%). Alarmingly, 22.73% of the farmers stated that re-using pesticide containers for domestic use such as water storage, storing seeds, grains, household items, and so on (as shown in table 3). Farmers reuse empty containers because they believe there is no risk to their health after thoroughly washing the containers with water. The re-use of empty containers is a significant resource of short-term exposure. Similar widespread reuse of pesticide containers for other household activities has been reported in other studies [5,22].

Improper disposal of empty containers of pesticides may be a chief source of pesticide exposure and environmental contamination. Farmers usually dumped empty containers in unsafe ways. The very same practice was observed in other studies conducted in Ethiopia [13] and Western Ghana [22].

Use of personal protective equipment to avoid pesticides exposure

To reduce occupational pesticide exposure, proper PPE, as well as other safety measures and behavior during pesticide solution mixing and application, are essential. Over 36.36% of farmers said they used at least one protective measure while spraying pesticides, but only 9.09% of respondents stated using PPE as recommended (protective shoes, cloth on face/mask, cloth on head, full sleeve shirt, and full-length pants). A significant proportion of respondents stated that they did not wear a mask or cloth on their faces (58.18%). In the present study, there is a low level of employment of PPE to decrease work-related exposure to pesticides as farmers stated that they do not use PPE during pesticide mixing and application/spraying.

Some reasons that have been mentioned include being very expensive, not being comfortable in the weather, not being available when needed, and PPE slowing down work because farmers in the selected area are not used to wearing PPE. Negatu et al found that none of the small-scale farm workers used PPE [23]. Jallow and associates, found that education level, agrochemical use, and protective practices are highly predictive of the adequate use of PPE among pesticide-using farmers [5].

Symptoms of pesticide toxicity

Annually, 3 billion kilograms of pesticides are used globally, but only 1% of total pesticides are proficiently used to regulate insect pests on target plants [24]. The remaining pesticides affect the non-target plants and environment in large

quantities. As a result, pesticide contamination has affected the environment and negatively impact human health [25]. Exposure to pesticides obviously poses a prolonged health risk, particularly for workers who handle or apply pesticides, which are usually considered to be the group that will receive the most exposure due to their work and is thus at greatest risk of acute intoxications. Recent studies have found that prolonged moderate pesticide exposure may be connected with impaired neurodevelopment activity or other neurological effects [4] and farmers who used pesticides had higher suicide rates than the normal community [7].

Unsafe practices raise the risk of acute poisoning, which includes the possibility of symptomatic adverse health effects [26]. The most common symptoms experienced by farmers during or just after application of pesticides were headaches, skin irritation, coughing, runny nose, itchy eyes/irritation, fatigue and dizziness. Respondents also informed other symptoms vomiting, nausea, stomach-ache, blurring of vision, and excessive sweating immediately after pesticide application. Almost same symptoms were noted in other studies also with more or less variation [27-31]. Variations in symptom patterns in these studies could be attributed to differences in farmers' pesticide knowledge about safety precautions and use as well as the temperature and humidity conditions at the time of spraying. Surprisingly 28.18% workers did not experience any health effects as a result of pesticide exposure. This can be attributed to a kind of resistance due to long exposure.

Conclusions

The study provides an outline of the perceptions and awareness about pesticide applications and safety measures and health effects in vegetable and fruit growing farmers' in Jhajjar district. The findings revealed that farmers have a very low understanding of the importance of safeguarding themselves and the surroundings from the consequences due to pesticide handling. We recommend that farmers should have episodic training and awareness initiatives on pesticide handling, storage, labeling, and the safe disposal of empty containers. There would also be practical demonstrations of the benefits of wearing appropriate PPE when handling pesticides.

One drawback of the current study is that it is primarily grounded on self-reported information, which depends on respondents' honesty. Farmers' health symptoms, such as headache and fatigue, were not linked to pesticide exposure, and in some cases, these symptoms may have been caused by factors such as prolonged exposure to sunlight, especially if head protection was not worn. Nevertheless, the respondents' symptoms appeared during or shortly after applying or handling pesticides.

Conflict(s) of interest- None

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