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Assessment on knowledge and perception regarding health risks of pesticide usage among farmers

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ABSTRACT

Globally, pesticides are essential substances that have significant importance in increasing food production and pest management. Although, the serious concern about the health risk of pesticide toxicity should be investigated. The aim of the study is to assess the knowledge and perception of health risks of pesticide usage among farmers. This online-based descriptive cross-sectional study was conducted among farmers in Namakkal district, Tamil Nadu, India. A validated questionnaire was prepared, assessing the sociodemographic and analyzing the level of awareness, perception of pesticide usage among farmers. There were 412 farmers participated, in which 98.5% use pesticides and among them, 72.4% of farmers do not use personal protective equipment (PPE) on pesticide application. Hence, 68% are not aware of the harmful effects of pesticides even though 94.5% experienced health related problems while using them. Therefore, 95.4% of farmers think it is necessary to create awareness about safe handling practices and health risks regarding the usage of pesticides. Our study revealed that farmers do not have adequate knowledge about safe pesticide handling and are not aware of pesticide toxicity levels along with the risk associated with the degree of toxicity which is essential for implementing strategies regarding pesticide safety education and training.

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1. INTRODUCTION

As the world's population is predicted to reach over 10 billion by 2050, increasing food production is the top priority for all countries. According to evidence, the global population is growing at a rate of 97 million people each year [1]. Herbicides, insecticides, fungicides, nematicides, fertilisers, and soil amendments are currently employed in greater quantities than in the past to increase crop yield [2]. Pesticides can thus be viewed as a cost-effective, labor-saving, and effective pest management technique that is widely used in most agricultural production sectors [1].

Despite their widespread usage and popularity, pesticides have prompted severe concerns about health risks coming from farmer exposure when mixing and applying pesticides or working in treated fields, as well as residues on food and drinking water for the general public [3]. These actions have resulted in some unintentional poisonings, and even routine pesticide use can endanger farmers' health in the short and long term, as well as impair the ecosystem [3].

Pesticide poisoning and death are more common in developing nations due to lax workplace safety standards, a lack of personal protective equipment (PPE), poor hygiene, illiteracy, and a lack of understanding

of pesticide dangers. Pesticide use causes 3.5 to 5 million acute poisonings every year, with around 20,000 workers dying from exposure each year, according to the WHO, with the majority of these deaths occurring in developing nations. Many impoverished nations lack efficient pesticide poisoning monitoring systems, and the majority of cases go unreported [4]. High exposure to these chemicals results in neurotoxicity and decreased acetylcholinesterase (AChE) activity [5]–[7]. Hormonal changes, abnormal sperm, ovaries and eggs production, neurological, gastrointestinal, dermatological, and respiratory manifestations among many other effects are associated with acetylcholine inhibition due to organophosphorus pesticides exposure [8], [9].

Farmers' awareness of pesticide use and handling, behavioural responses, and health impact perceptions may not be sufficient. As a result, it's critical to comprehend farmers' knowledge and perceptions of the health concerns associated with fertilizer and pesticide use. These findings could aid in the development and implementation of measures to promote health risk awareness, safe pesticide handling, usage, and disposal, and a reduction in the prevalence of acute pesticide poisoning among farmers. Thus, the study aimed to: i) determine the pesticides usage among farmers, ii) evaluate the protective measures taken by farmers to reduce occupational pesticide exposure, iii) assess farmers practices and attitude regarding storage, handling and disposal of pesticides and explore the reasons for barriers, iv) identify the experiences of health related problems and acute pesticide poisoning while using pesticides, v) understand the knowledge and awareness about the health risks associated with the pesticide usage among the farmers and their family.

2. RESEARCH METHOD

This online-based descriptive cross-sectional study was conducted among farmers in and around Namakkal district, Tamil Nadu, to assess the knowledge and perception of the health risks regarding pesticide usage. The study's inclusion criteria were farmers more than 18 years old, both genders and those who use pesticides in their field. Exclusion criteria included farmers who follow organic farming and those who are not willing to respond. The study was conducted on six months (April-September 2020) with prior permission from the Institutional ethics committee (JKKNCP/Ethics_Practice/020PDS02).

For this study, we have developed a questionnaire based on previously published questionnaires [10]–[12]. It was circulated through the phone numbers collected from local farmers associations of Namakkal and through social media like WhatsApp, Facebook, E-mail. A pilot study was conducted on a finite population and based on the feedback received, and necessary changes were done. The renewed questionnaire was prepared and validated in two languages English and Tamil respectively with two sections. The first section consisted of seven questions to know about the respondent's socio-demographic factors like name, age, gender, literacy status, and the second section consisted of 21 questions to analyze the level of awareness of the respondents and to assess the knowledge and perception of the pesticide usage among the respondents. The responses were obtained from the farmers and farmworkers who work on daily wages. The minimum sample size was 385 and it was calculated using Rao Soft sample size calculator with a population size of 38, 11,110 approximately, the margin of error 5% and the confidence level 95%.

3. RESULTS AND DISCUSSION

To the best of our knowledge, this study is the first to examine the knowledge and perception regarding health risks of pesticide usage among farmers in Namakkal district, Tamil Nadu which is known for its cultivation and crop production in South India. The study was conducted in two languages for the convenience of the farmers that are English and Tamil. A total of 418 participants participated in the study. Among them, only 61(14.6%) chose English, and the majority of 351(85.4%) chose Tamil Nadu. Among them, only six participants (1.5%) do not use pesticides for their farming and 412(98.5%) use pesticides in their field and as pesticides have become an integral part of present-day farming and play a major role in increasing agricultural productivity. All individuals are confronted with some types of pesticide exposure, but farmers are particularly at high risk of pesticide exposure due to added risk of occupational exposure.

3.1. Sociodemographic details

The demographics from our study show that 266(64.5%) were males and 146(35.5%) were females as shown in Table 1, which is similar to a study conducted by Al-Haddad and Al-Sayyad [13]. Among them 95(23.1%) participants were under the age group of 18-30 years followed by 66(16.0%), 105(25.5%), 109(26.4%) 37(9.0%) participants were under age of 30-40 years, 40-50 years, 50-60 years and 60 years and above respectively as shown in Table 1. In a study conducted by Kapeleka *et al*. [14] 28.5% of participants were aged between 30 to 39 years old, 27.2% were aged between of 18 to 29 years, 21.2% was of 40 to 49 years and 17.2% was of 50 to 59 and only of 6% were from 60 years and above. Age is an important sociodemographic factor influences the knowledge on the prohibited and approved chemicals and awareness of safe handling practices while using pesticides.

When we examined the educational status of participants, 172(41.8%) were primary school 42(10.2%) were illiterate, 111(26.9%) were high school and 87(21.1%) college graduates, respectively, which shows the participants mostly could read and write as shown in Table 1. In a study conducted by Khan [15], over 71% of respondents had received an education of different levels, 7% of the farmers had also attended university, whereas 29% of respondents never had the school not read-write. The educational status of the famers also improves the awareness by which they could read publications, news, and information about pesticides [16], [17].

In our study, most 177(43%) farmers who participated had experience for farming for more than 12 years. The data indicates that many of them nowadays turn to farming and use pesticides as shown in Table 1. The usage and types of pesticides depends upon the type of crops, area, and land size. In this study, majority 189(45.8%) of them use the pesticides seasonally, followed by 161(39.1%) participants use weekly once or twice and 62(15.1%) use monthly once or twice the pesticides in their field during the cultivation of crops as shown in Table 1. The survey conducted by Khan [15] found that farmers often apply pesticides.

Table 1. Sociodemographic details

Characteristics	n=412(%)
Age	
18-30	95(23.1%)
30-40	66(16%)
40-50	105(25.5%)
50-60	109(26.4%)
60 and above	37(9%)
Sex	
Male	266(64.5%)
Female	146(35.5%)
Educational status	
Illiterate	42(10.2%)
Primary school	172(41.8%)
High school	111(26.9%)
College graduate	87(21.1%)
Years of using pesticides	
1-4	47(11.4%)
4-8	83(20.1%)
8-12	105(25.5%)
12 years and more	177(43%)
Duration of application of pesticides	
Seasonal	189(45.8%)
Monthly once or twice	62(15.5%)
Weekly once or twice	161(39.1%)

The major type of cultivation in Namakkal district, Tamil Nadu was plantain, sugarcane, paddy, coconut, corn, cereals, fruits and vegetables, and flowers, The farmers in our study mostly raised plantain 122(29.6%), coconut 89(21.6%), paddy 99(24.0%), sugarcane 109(26.5%), cereals 87(21.1%), fruits and vegetables 97(23.5%), flowers 25(6.1%) and others 8(02.0%). It was determined that all of the farmers who were included in the study used pesticides this year. In a study conducted by Öztaş *et al.* [10] mostly raised corn (55.9%) followed by wheat (55.9%), watermelon (47.1%), tomato (38.5%), pepper (34.3%), melon (28.0%), and eggplant (25.3%) consistent with the usual practice in Cukurova region. Different region has thus various types of cultivation.

3.2. General knowledge about pesticides

Pesticides have chemical classes such as organophosphates, organochlorines, synthetic pyrethroids, carbamates, in which Organophosphates are said to have high lethal dose (LD)-50[18]. Most of the pesticides used on the farms belonged to the moderate risk (category II), followed by high risk (category I) and low risk (category III) groups as classified based on acute dermal LD50 for rabbits/rat. Over 98% of sprayed insecticides and pesticides reach a destination other than their target species, including non-target species, air, water and soil. Studies have shown that not all applied pesticides may actually reach targeted pests and the remaining have potential to get into the soil, water and the atmosphere [19]. From our study, we have observed that the major concern of pesticide usage was for better yield 156(37.9%), for preventing the attack of pests, insects and weeds 126(30.6%), replenishing the soil with key elements 109(26.5%), and to improve essential nutrients for growth 117(28.4%). In a past study conducted by Jallow *et al.* [11] they also indicated that pesticides were indispensable for high crop yield (80%).

From our study, we had observed that 135(32.8%) farmers get knowledge from retailers, 179(43.4%) from co-farmers, 52(12.6%) from consultancies and 46(11.2%) from the government sector, about pesticides, including the new products. Deng *et al.* [20] surveyed in Northern China and found that 34.5% of the respondents had received pesticide information from pesticide distributors, about 54.4% from co-workers, 41.1% from their own experience and 25.7%, 16.6% and 7.3% from TV, newspaper and internet respectively. Our study reports that only 98(23.7%) of the farmers will read the instructions given on the container or pamphlets but 314(76.3%) participants denied to read, as presented in Table 2 among them 124(39.4%) had the reason of small letter, 78(24.8%) was not interested to read the instructions, 57(18.1%) has no time to read, 27(8.5%) selected unknown language and 28(8.9%) don't know to read. A study conducted by Öztaş *et al.* [10] 11.4% did not read warnings and precautions on the labels of pesticides that confirm our study.

Table 2. Knowledge and perception among farmers (n=412)

Particulars	Yes (%)	No (%)
Do you read the instructions written on the container or pamphlets	98 (23.7%)	314 (76.3%)
Do you have the habit of eating, drinking or smoking while applying pesticide?	75 (18.2%)	337 (81.8%)
Do you use personal protection equipment (PPE) during the application of pesticide?	114 (27.6%)	298 (72.4%)
Do you dispose the used empty pesticide bottles or containers?	311 (75.5%)	101 (24.5%)
Are you aware of pesticide toxicity level by reading the signs or symbols on the label?	85 (20.6%)	327 (79.4%)
Do you think that pesticides have harmful effects to human health?	89 (21.6%)	323 (78.3%)
Have You Experienced Any Health-Related Problems?	389 (94.5%)	23 (5.5%)
Do you have knowledge of diseases that can be worsened by pesticide usage	258 (62.6%)	154 (37.4%)
Have you attended any training/workshops or seminars on pesticide use	146 (35.5%)	266 (64.5%)
Do you think it is necessary to create awareness about safe handling and health risks regarding the usage of pesticide?	393 (95.4%)	19 (4.6%)

3.3. Personal hygiene, handling and disposal practices

The type of conduct with the personal health and hygiene while handling the pesticide was found that a majority 337(81.8%) of participants generally did not eat, drink, or smoke while applying pesticides though 75(18.2%) have a habit of eating, drinking or smoking as shown in Table 2. Similarly, in a study conducted by Deng *et al.* [20], 78.6% do not eat, drink, or smoke during the pesticide application.

Our study found that 114(27.6%) of farmers and farm workers use either any one or all protection as shown in Table 2 that includes the least number of participants using masks, gloves, and shoes 02(1.7%). Still, a majority 28(24.5%) use shoes alone, 26(22.8%) participants use only mask, 13(11.4%) participants use only gloves, 22(19.2%) participants use both masks and gloves, 17(14.9%) participants use both mask and shoes and 06(5.2%) participants use gloves and shoes during the application of pesticide as shown in Figure 1. In comparison, 298(72.4%) of farmers don't use any protection as shown in Table 2 as 115(38.6%) are not comfortable with the PPE, 66(22.1%) makes them distracted from work, 98(32.9%) thinks that's protective equipment is not necessary and 19(6.4%) has experienced other reasons. In a dated analysis by Al-Haddad and Al-Sayyad [13] 86.5% use safety shoes, 57.7%use gloves, 59.6% use safety glasses, 51.3% use respirators and only 2.6% use aprons.

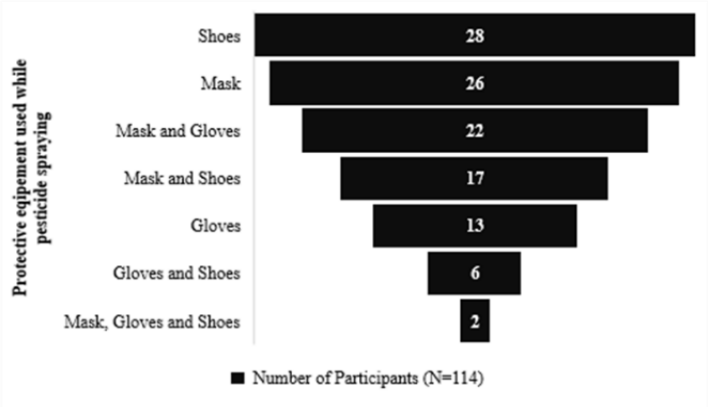

Figure 1. Protective equipment used while spraying pesticide

It is important to have proper disposal and storage practices of pesticide bottles as they may harm both humans and the environment. In our study, we had observed that 311(75.5%) of the participants dispose the

empty containers or bottles after use as shown in Table 2 among them, 106(34.1%) of participants return the empty bottles to the crap sellers or to the waste management sites, 86(27.7%) of participants throw in an open field, 80(25.7%) throw their used pesticide containers in the dustbin and 39(12.5%) do opt other methods for disposing of, but a proportion of 101(24.5%) do not dispose of the containers. With a non-significant interest in the current study 46(45.5%) participants re-use containers of pesticide for storing food items or water as shown in Table 2. According to the study conducted by Mustapha and Mubushar *et al.* [21], the common way of disposing of empty pesticide containers was placing them in garbage containers and/or dumpsters for disposal at the landfill (50%), incinerating them on the farm (43%), or delivering them to the municipality hazardous waste collection sites for disposal (39%) and the respondents (25%) [6], [20]–[30].

3.4. Awareness of toxicity and health risks of pesticides

Alas, 85(20.6%) of participants could only understand the toxicity level by reading the sign on the label and 327(79.4%) couldn't understand the toxicity level as shown in Table 2. Hence, scientific categorization based on colour code was rarely understood. This study significantly coincides with study and Ricco *et al.* [23] respectively. In our study, 89(21.6%) respondents knew that pesticides are mode of poisoning or harmful effect to human health, yet 323(78.3%) are not aware of pesticide poisoning as shown in Table 2.

Pesticides are harmful compounds for humans. Various studies have correlated the pesticide exposure with allergies, cancer, neuro abnormalities, endocrine dysfunctioning, abnormal physiology, developmental effects, headaches, stomachaches, vomiting, skin rash, coma and so on. Regular consumption of food from pesticide contaminated source has both in-short duration (acute) and long-duration (chronic) effects. Pesticides entering the human body can cause acute and chronic poisoning. The study found that most 389(94.5%) had experienced health-related problems and 23(5.5%) did not experience health-related issues while using pesticides as shown in Table 2. The prevalence of self-reported symptoms or health related problems by the participants while using pesticide include a majority of 169(41.0%) and 158(38.3%) experiences skin irritation and Eye irritation while using pesticide. Adding to health problems like Headache 137(33.2%), shortness of breath 123(29.8%), 45(10.9%) experienced convulsion and 63(15.2%) experienced other health problems as presented Figure 2. Our study concurs with a study conducted by Khan [15]. Health impacts like non carcinogenic and carcinogenc risk are never negligible by the pesticide residues.

A number of findings showing the importance of surveillance emerge in this study. In our consideration, we inspected that 40(9.7%) of participants doesn't make serious attention of health risk by pesticide usage and 141(34.3%) of participants take home remedies, but the majority 231(56.0%) of participants consult with a physician when they experience any health-related problems. These results indicate that there is a significant association between the past similar studies. In a past study conducted by Lekei *et al.* [28] 60% of poisoned respondents did nothing about their symptoms and 81% did not report going to a health care facility, which confirms to our study.

Our study declares that 258(62.6%) of farmers know about diseases that can be worsened by pesticide and a minimum of 154(37.4%) don't know about the disease that is worsened by pesticide usage as shown in Table 2. Among the 258 participants who have knowledge thinks that diseases like asthma 228(55.3%), skin diseases and cancer 176(42.7%), kidney problems 101(26.9%), hypertension 100(24.2%), diabetes mellitus 87(21.1%) and 24(5.8%) other diseases.

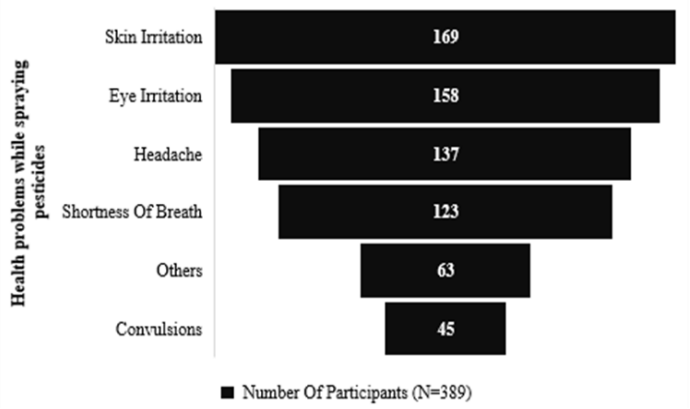

Figure 2. Health problems experienced by farmers while using pesticides

From the current study we found that only 146(35.5%) of the participants had attended training/workshops/discussions on pesticide use and care on pest control aspects and the majority of 266(64.5%) have not attended any supportive pesticide programs as shown in Table 2. In a study conducted by Singh *et al.* [6] reported that about 90% of the farmers had not received any pesticide use training, which confirms our study. A past study conducted by Okonya and Kroschel [29] also shows that the lack of knowledge or training in safe pesticide-handling practices exposes both the environment and farmers to the negative effects of pesticides. There is a need to set up policies and programs to promote the safe use of pesticides. It is appreciable that we have observed that the majority of the participants that is 393(95.4%) thinks that it is necessary to know about safe pesticide handling and to have awareness for using pesticides and only 19(4.6%) thinks it's not required to have an understanding about pesticide usage as shown in Table 2. Hence, implementing strategies to create awareness about safe handling and health risks is much needed.

This study is timely, providing updated information about the knowledge gaps and perception of pesticide usage. The reasons for each barrier the farmers look into were also clearly evaluated in this study. This information may help determine the efficient and age-appropriate strategies for farmers' health promotional activities, thus preventing harmful effects on their health. The research is based mainly on self-reported data, relying on the honesty of respondents subjected to bias. The sample size was relatively small. A large population could have been included in this study. Another limitation relates to the inability to link health symptoms experienced by respondents to pesticide exposure directly. The health symptoms experienced by respondents, such as headaches and fatigue, were not specific. In some cases, these symptoms might have been due to causes other than exposure to pesticides, such as long exposure to the sun. Based on the number of respondents (412 farmers), we cannot claim that the results are representative for all farmers in Namakkal, Tamil Nadu. It was not feasible to interview all farmers in Namakkal, Tamil Nadu. However, our intention is not to generalize but to explore and highlight important occupational health and pesticide safety issues for the individual farmer. The inherent weakness of a cross-sectional study that fails to establish cause and effect relationships results in difficulty in identifying the true determinants of practice.

4. CONCLUSION

In a nutshell, this study looked into farmers' knowledge and perceptions of the health concerns associated with pesticide use. Farmers lack adequate understanding about safe pesticide handling and are unaware of pesticide toxicity levels and the risk connected with the degree of toxicity, according to our research. In many ways, our research backs up previous studies and publications that have documented the harmful impacts of pesticides. The positive attitude of agreement towards the importance of apprehension over the safe handling and health risks of pesticide usage is acknowledged, despite farmers' lack of knowledge.

This study, as well as others on pesticide handling techniques, highlighted a critical need for pesticide safety education and training, which appears to be a worldwide issue. As a result, it is critical to establish measures for raising knowledge about the detrimental health impacts of pesticide use, which should begin at the federal level and be carried out in collaboration with organizations by holding seminars and training programmes for farmers. Our findings aid future study and development of effective public health strategies relating to the health implications of pesticide use by farmers and integrated pest management.

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