ORIGINAL ARTICLE

Practices and Knowledge about Safe Pesticide use- a Cross sectional Study amongst Farmers of a district in Odisha, India

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ABSTRACT

Background: With agriculture being the second largest workforce sector in the world, the knowledge and practices on safe pesticide use among farmers is of paramount importance. **Aim & Objectives:** The study aimed to investigate the farmers' knowledge and practices on safe use of pesticides. **Methodology**: A community based cross-sectional study was conducted among 421 farmers from December 2020 to September 2022 in the second populous district of the state. Data was collected using a semi structured questionnaire using demographic and occupational data, knowledge & practices on safe pesticide use. Data was entered into Microsoft excel and analysed using Epi Info statistical software. All categorical data was presented using frequency and percentages & continuous data in mean±SD. **Results**: The mean age was 40.53±6.7 years (18 to 65 years). Maximum (62.94%) were in the age-group of 40-60 years; 83.37 % were males and 79.33% literate. All the farmers used pesticides, 47.50% of them had an experience of >15 years in farming and 68.65% were using pesticides since 5-15 years. The overall knowledge was poor (68.4%).**Conclusion**: The overall knowledge on safe use of pesticides was poor, their practices still poorer. Most of them had not attended any training on integrated pest management.

KEYWORDS

Pesticide; Farmers; Practice; Level of Knowledge; Safe Pesticide Use; Occupational Exposure

INTRODUCTION

India is primarily an agricultural country with agriculture accounting for more than 49% of the working population involved in agriculture. (1) In the year 1966, green revolution was adopted in India with a target of increasing the agricultural yield by introducing pesticides. (2) Misuse of pesticide can harm environment and human health. (3) India is the fifth largest producer of pesticides in the world with a total production of 93 thousand metric tonnes in 2019–20. (4) The first case of pesticide mass poisoning was reported in Kerala where about 100 people died of pesticide contaminated foods. Thus, to regulate pesticide use, the Indian government introduced the Insecticide Act, 1971.(5) Occupational exposure to pesticides and pesticide poisoning is routine among farmers due to lack of education, lack of knowledge and unintentional application errors.(6) The World Health Organization and the United Nations Environment Program estimated maximum death from developing countries.(7) Unsafe handling, mixing pesticides with bare hands, minimal use of PPE during application, unsound disposal of empty pesticide containers, cocktails applications are the major concerns of pesticide misuse. (8)

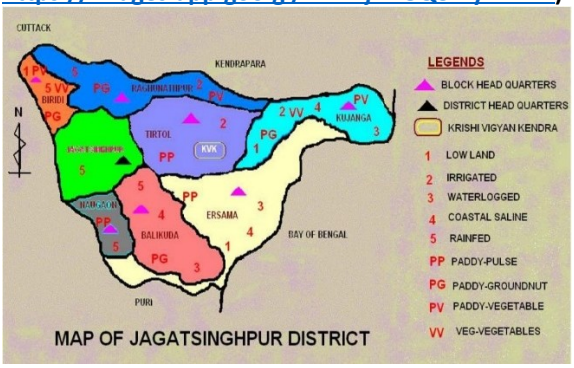
This proposed study has aimed to investigate on the farmers' knowledge and practices on safe pesticide use.

MATERIAL & METHODS

Study type & Study design: Community based & Cross sectional study

Study Area: The study was conducted among farmers who worked in agricultural lands that yielded crops and resided in the rural villages of Jagatsinghpur district of Odisha, India. The district has 1292 villages (including 69 un-inhabited villages) covering eight blocks, eight tehsils and one Sub-division and 194 Gram Panchayats (GPs) (Figure: 1). As per interim information of "Census India", the population of Jagatsinghpur district in 2011 was 11.37 lakhs, out of which 5, 78,000 were males and 5,59,000 females. The sex ratio was 967 per 1000. Considering the labour force in the district, out of 11.37 lakh population, the main workers constituted of 2, 90,170 agricultural labourers.

Figure 1: Agriculture Map of Odisha (source: https://images.app.goo.gl/E2m1j1AGQ8myAKFY7)



Study setting: Department of Community Medicine, KIMS, Bhubaneswar

Study population: Farmers who worked in agricultural lands that yielded crops and resided in the rural villages of Jagatsinghpur district of Odisha, India.

Study duration: December 2020 to September 2022

Sample size calculation: Sample size was calculated- based on earlier reported prevalence of knowledge regarding pesticides among farmers, to be 52.63%, taking 5% of absolute precision and 95% of desired confidence level. (9) The sample size was calculated by utilizing the equation $n=z^2pq/d^2$, thus number of required sample was 383, additional 10%(of 383) of total sample was taken for prevention of losses thus the overall 421 farmers were considered as final sample for current study

Inclusion criteria: The study population comprised of all farmers, of both the sexes, aged more than 18 years, who were permanent residents of the village, and gave informed written consent.

Exclusion criteria: Uncooperative farmers not completing the interview and those diagnosed with mental illness or on anti-psychotic medications were excluded.

Strategy for data collection: Study sample were enrolled by multi-stage stratified cluster sampling. Five blocks under Jagatsinghpur district with high coverage of cultivation were selected for the study. From each block five gram panchayats (GPs) were randomly selected (5X5= 25 GPs); from each panchayat four villages were chosen randomly (25X4=100), thus a total 100 villages were selected for the study. The eligible farmers from each village were stratified by age and gender and randomly selected in proportion to the aggregate number of farmers registered in each village for reaching the final sample size.

Study Tools: Study tool used to collect data was a pre-designed, pre-tested, semi structured, researcher-made interview schedule with three sections. The tool was validated by three subject experts and piloted amongst 30 farmers in another district (Ganjam) of the state. The questionnaire comprised of three sections. The first section had the demographic data (age, gender, educational level, marital status) and occupational data (nature of work, duration and frequency of pesticide exposure).The second section assessed the knowledge of farmers about safe pesticide use. It had eight questions viz., ways of pesticide entrance into the body, how to store pesticides, ways of destroying pesticide residue, protecting themselves against pesticides, correct use of pesticides, ways to know about dangerous pesticides, attention on buying pesticides, how to use pesticides; that could be answered as either-"yes" or "no". One point was given for each correct answer; no mark has been given to wrong answer. The "Knowledge level" on safe pesticide use was graded as "poor" (if score was <four, i.e. 50% of a total score of eight) or "satisfactory" (if score was ≥ four i.e. 50% of a total score of eight). The third section had 16 questions pertaining to their practice on safety measures during pesticide use. These questions could be answered either- "never" or "sometimes" or "almost" or "always". No points for "never', one point for "sometimes", and two points for "almost" and three points for "always, were assigned and practice score calculated accordingly. A score of <16 was taken as poor practice, and ≥16 as satisfactory.

Ethical issues & informed consent: The study protocol was given ethical clearance by the Institutional Ethical Committee of the institute (letter no. KIIT/KIMS/IEC/497/2020, dated 3.11.2020). Prior to the initiation of the primary investigation, certified list of all the villages of Jagatsinghpur district was obtained. Informed

written consent was taken from all the farmers, prior to the interview being conducted.

Data analysis: All data were coded and entered into Microsoft excel spreadsheet. Descriptive statistics was used to represent the results as frequencies, percentages and means. Between groups percentages was compared with Chi square or F-test as appropriate, with a p-value less than 0.05 considered to be statistically significant.

RESULTS

Demographic characteristics

In the study conducted among 421 farmers engaged in agriculture practices, their mean age was 40.53±6.7 years, with a range of 18 to 65 years. 79.33% farmers were literate (Table 1).

Table 1: Characteristics of study participants (N=421)

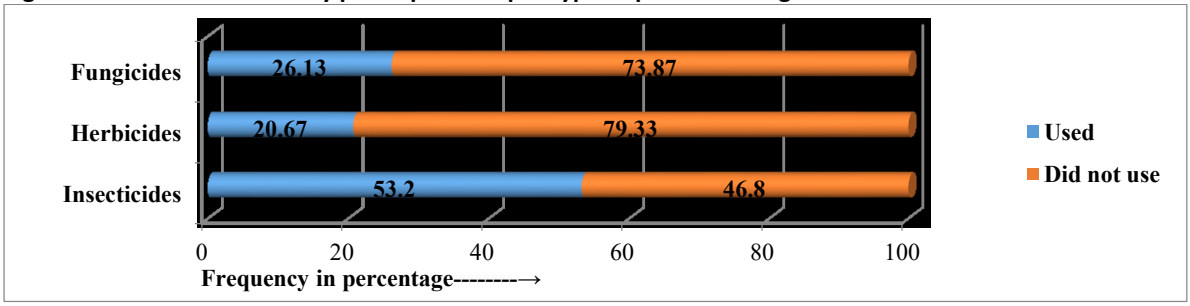
Characteristics	Number of participants(n)	Percentage (%)
Age group (in years)		
< 20	23	5.46
21-40	129	30.64
41-60	265	62.94
>60	4	0.95
Gender		
Male	351	83.37
Female	70	16.63
Educational level		
Professional	6	1.42
Graduate	17	4.04
Intermediate	26	6.18
High school	59	14.01
Middle class	67	15.91
Primary school	159	37.77
Illiterate	87	20.67
Marital status		
Married	364	86.46
Not married	57	13.54
Socio-economic class(according to Modified kuppuswamy scale, 2021		
Upper class	8	1.90
Upper middle class	31	7.36
Lower middle class	68	16.16
Upper lower class	221	52.49
Lower class	93	22.09
Working period in agricultural field (in years)		
1-5 years	69	16.39
>5-10 years	51	12.12
>10-15 years	101	23.99
>15 years	200	47.50
Duration of pesticide use (in years)		
<5	81	19.23
5-15	289	68.65
15-25	32	7.6
25-35	17	4.04
>35	02	0.48

Occupational characteristics

52.50% of the farmers had an experience of less than 15 years in farming (Table 1).

All the farmers reported using pesticides, although the type and frequency of use varied. About 53.20% of study subjects were using insecticides where as 20.67% of farmers admitted of using herbicides. (Figure 2) About 233 (55.34%) out of 421 study subjects were applying pesticides three times at particular stages of crop. 32.53% farmers were using pesticides two times at particular stages of crop followed by 11.64% who were applying pesticides only once.

Figure 2: Distribution of study participants as per type of pesticide usage



Knowledge about safe use of pesticides

The knowledge about safe use of pesticides was assessed using an eight item scale (Table 2). The knowledge score was calculated as a summary of responses. As described in the methods section. The overall knowledge was poor (68.4%), while satisfactory only in 31.6%. About 207 farmers (49.17%) reported to have got the information about pesticides from neighbours, followed by pesticide salesman (33.73%), community leader (4.52%), television (4.27%), and agricultural office (2.61%), and health volunteers (2.14%), articles in newspaper and magazine (1.67%) and public health office (1.42%).

About 390 (92.63%) farmers out of 421 had not attended any trainings on Integrated Pest Management (IPM); these trainings organized by the government, emphasizes on growth of healthy crops while keeping the natural pest control system intact, so that there is a reduction in the risks to farmers as well as the environment due to use of pesticides. Of the 7.37%(31) who had attended the IPM training held in Bhubaneswar (the state capital with government offices, where all trainings are conducted), 29 had a satisfactory knowledge on safe pesticide use; while only 104 had satisfactory knowledge among the 390 who received no training; this difference was also found to be statistically significant with a p-value of <0.0001. Only 8.79% had done their periodical health checkup at a nearest community health centre.

Table 2: Distribution of study participants according to their knowledge about safe use of pesticides (n=421)

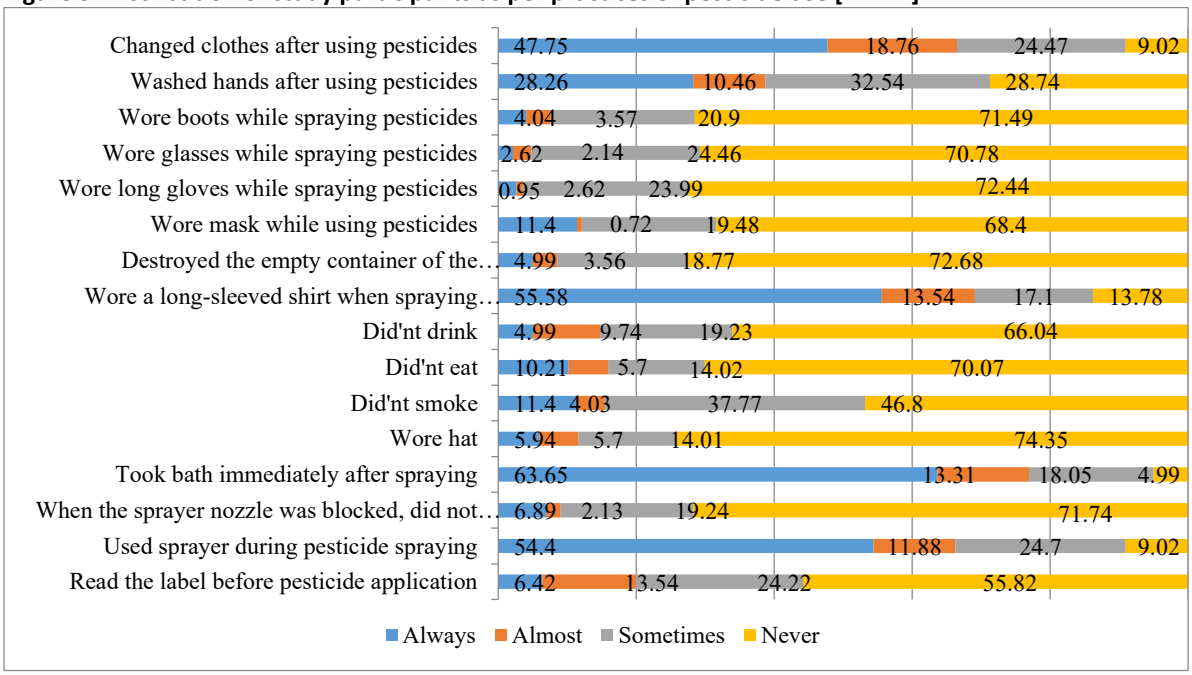
Statement on safe pesticide use	Response	Number of participants (n)	Percentage (%)
Route of pesticide entry into the body	Correct(Yes)	276	65.56
	Wrong(No)	145	34.44
Storage of pesticide	Correct(Yes)	257	61.04
	Wrong(No)	164	38.96
Ways of destroying pesticide residues	Correct(Yes)	271	64.37
	Wrong(No)	150	35.63
Protection against pesticides	Correct(Yes)	124	29.46
	Wrong(No)	297	70.54
Correct use of pesticides	Correct(Yes)	37	8.79
	Wrong(No)	384	91.21
Ways to know dangerous pesticides	Correct(Yes)	69	16.38
	Wrong(No)	352	83.62
Attention to buy pesticides	Correct(Yes)	281	66.74
	Wrong(No)	140	33.26
How to use pesticides	Correct(Yes)	71	16.86
	Wrong(No)	350	83.14

Practices during pesticide use

The practices during pesticide use were assessed using a 16 item likert scale and scores assigned as mentioned in the methods section. Majority (55.82%) "never" read the label before pesticide application whereas about 24.22%, 13.54% and 6.42% study participants read the label "sometimes", "almost" and "always" respectively, before applying pesticides (Figure 3).

The overall practices of farmers were poor (61.53%) in this study.

Figure 3: Distribution of study participants as per practices of pesticide use [n=421]



DISCUSSION

In the study among 421 farmers of Jagathsingpur district of Odisha, the mean age of the study participants was found to be 40.53 + 6.7 years, with maximum in the age group of 40-50 years. A similar pattern of age was seen in a study done in south India by Sai MVS etal, where the participants reported a mean age of 40 years. (9) A lower mean age was reported in study done in another state -in a study by Pandher S etal, among farmers in Punjab (33 years), with maximum in the age group of 21-30 years (4); and countries-a study done in Bangladesh by Dasgupta S etal, the mean age was 35 years. (7) These differences in age group can be because of the proportion of population engaged in agriculture in the different areas.

In the current study there was a male predominance (83.37%); study by Vijay Kautilya D et al, also showed a similar gender representation, with 88 % of males as study participants. (10) A lower (69%) number of males were seen working as farmers in study done in south India by Sai MVS etal, which may be due to more participation of females in agricultural practices, in this part of the country. (9)

In the present study 79.33% were literate, similar literacy has been reported in other studies done in various states of India. (4, 7, 9, 10). In another study done in Gaza, the literacy rate was much higher (92%). (10) These differences can be because of the difference in literacy rates of the two countries.

In this study, 55.34% of the farmers were applying pesticides three times at particular stages of crop and 32.53% of the farmers were using pesticides twice. In a study by Delco MD among farmers working in rice fields, in Philippines, 29.3% sprayed pesticides one to five times, while 34.7% sprayed six to ten times. (11) In another study by Mergia MT etal, in Ethiopia, the frequency of spraying was much higher, with around 47.5% spraying 12 to 15 times per planting season, followed by 7 to 10 times(32%) per season. (12) In another study, by Perez I et al, among farmers in Mindanao, Southern Philippines, and 72.88% sprayed 2 to 3 times per season. (13,14) These differences in the spraying frequencies in different countries may be due to differences in the types, forms and dosages used.

In the current study, the overall knowledge about safe pesticide use was poor (68.4%). Around 49.17% reported to have got the information about pesticides from neighbors, followed by pesticide salesman (33.73%), community leader (4.52%), television (4.27%), and agricultural office (2.61%), and health volunteers (2.14%), articles in newspaper and magazine (1.67%) and public health office (1.42%). In a study by Perez I et al, among farmers in Mindanao, Southern Philippines, 40.15% reported to have received information from other farmers, followed by the association of farmers (38.07%), and rest(21.78%) by reading the labels.(14) In another study by Mergia MT etal, in Ethiopia , 42.5% had heard from retailers, other farmers (39.4%). (12,14) in a study done in Malaysia had similar findings (41.7% from retailers, 39.4% from farmers and 18.9% from TV/Internet/books). (15) The sources of information depends upon various factors like educational status of the farmers, the guidelines for selling pesticides (as in many countries retailers were the source of information).

Only 7.37% had attended the IPM training. In another study by study by Mergia MT etal (12), around 4.3 % had received training and in a study by Ugbelu JE et al(15), in Enugu state, 20% farmers were trained. (16) Another study by Pandher S etal, among farmers in Punjab, 28.9% had knowledge on pesticide use (pre-awareness session), but the knowledge improved post the awareness campaign, hinting on the fact that sensitization programs are needed to raise the awareness. (4) In another study done in south India by Sai MVS etal, the knowledge was similar (61 %), but their practices were not appropriate, and a need for continuous safety education for farmers about pesticide use was recommended by the authors. (9) Similar knowledge and practices were also reported by another study from India, wherein the authors concluded that there was a need for training, education and financial support. (10) Contrary to studies done in India, a study from Gaza reported the knowledge to be as high as 97.9% with practices being fair. (10) The authors recommended prevention and intervention programmes regarding the use of protective measures and monitoring the health status of farm workers. This difference can be ascertained due to the fact that the countries, and their literacy and economic status being different, the levels of awareness are different.

Amongst the farmers in this study, 61.04% had the correct knowledge about “storage of pesticide” Other studies by Ugbelu JE et al (15), among farmers in Enugu state, the knowledge was poorer (36.6%) and 26.2% in the study by Oztaş D etal, amongst farmers in Çukurova Region. (16) Another Indian study reported a much higher (94.7%) figures. (17) In another study, by Perez I et al among farmers in Mindanao, Southern Philippines 94.89% of the farmers reported of having storage location away from their houses. (13) In the present study the knowledge about “ways of destroying pesticide residues” was much higher (64.37%) in comparison

to another study by Perez I et al (43.94%). (13) As few as 16.38% of the participants had the correct knowledge "on ways to know dangerous pesticides" in this study; another study from South India reported much higher (78%), citing that they did so by reading the labels on the container. (18) The literacy status being higher in that state may be the reason for the same.

Around 61.53 % of the farmers in this study had poor practices with relation to safe pesticide use, 47.75% reported of changing their clothes after using pesticides. A study from Philippines reported much higher (87.88%) (13), while another study from Malaysia reported much lesser (18.3) percentage. (14) The use of various PPEs reported were boots (28.51%), gloves (27.56%) and glasses. In a study by Lekei,E.E. etal in Tanzania around 38.2% used boots while spraying (19). In another study from Uttarakhand, India 67.2% used gloves and 56.3% masks. (18) The awareness levels between the farmers on pesticide safety may be the reasons for these differences. Lack of training has been identified one of them.

Conclusion

In this study, the farmers used pesticides extensively, with nearly all agreeing to have been using it. Despite the fact that the overall knowledge on safe use of pesticides was poor, still the practices were found to be poorer. Most of the farmers didn't attend any training on integrated pest management. Training in integrated pest management was found to have a positive impact on their knowledge about safe use of pesticides.

Based on findings of the present study the authors, suggested a training of these farmers, who were using pesticides so that this would improve their knowledge and with time their practices too. The periodical health check-up, which is essential to identify early stages of pesticide poisoning, was also very poor. The preventive periodical health check-up and its need was emphasized to the study participants.

Recommendation

Safe pesticide use significantly improves public health by reducing diseases related to pesticides and environmental pollution. It contributes to human health by guaranteeing the safety of food supplies and promoting sustainable agricultural practices. In addition, the responsible application and regulation of pesticides mitigate harmful exhibitions, promoting a healthier ecosystem and avoiding chronic health problems.

Limitation of the Study

The interviews being based on self-reporting, there is a possibility of reporting bias. The interviews were conducted in workplaces where privacy and suitable spaces were not available and the reluctance to divulge, apprehension of revealing unwanted information about the owner, in some cases are some of the study limitations.

Relevance of the Study

Examining secure use of pesticides among farmers is critical to protecting public health, ensuring environmental sustainability and increasing agricultural productivity. Understanding these implications promotes safer agricultural practices, reduces toxic exposure and promotes ecological resilience, contributing to a more sustainable agricultural system that meets the demands of contemporary food production.

Authors Contribution

All authors have contributed equally.

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Nil

Conflict of Interest

There are no conflicts of interest.

Acknowledgement

Nil

Declaration of Generative AI and AI Assisted Technologies in the Writing Process

The authors haven't used any generative AI/AI assisted technologies in the writing process.

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