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Original Research Article

A cross-sectional study on knowledge, attitude, and practice of using personal protective equipment among farmers using pesticides

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ABSTRACT

Background: India's vast agricultural sector is crucial to the global economy, providing food, raw materials, and employment. However, pesticide use poses significant health risks to farmers. Pesticides, classified by the WHO based on toxicity, can accumulate in the environment, leading to long-term health issues like neurotoxicity and cancer. Despite the availability of personal protective equipment (PPE), its use is often inadequate due to gaps in knowledge, attitude, and practice. This cross-sectional study evaluated these aspects among farmers in Bangalore, India, aiming to identify deficiencies and provide recommendations to improve PPE usage, thereby enhancing farmer safety and promoting sustainable agriculture. This study aimed to assess the knowledge, attitudes, and practices (KAP) regarding personal protective equipment (PPE) among farmers in Bangalore, India.
Methods: This study involved face-to-face interviews with 213 farmers using a structured questionnaire. The main objective was to evaluate the farmers' KAP towards pesticide use and PPE. Statistical analysis was performed using IBM SPSS Statistics software for Windows, version 22 (Armonk, NY, USA). Descriptive statistics summarized the socio-demographic characteristics of the study population, while Pearson's correlation analyzed the relationships between knowledge, attitude, and practice regarding PPE usage.
Results: Out of 213 farmers, 58.2% exhibited low knowledge of PPE, 36.6% moderate, and 5.2% high. Attitudinally, 46.5% were unconcerned, 52.6% neutral, and 0.9% concerned about PPE. Practically, 20.2% demonstrated poor PPE practices, 53.5% fair, and 26.35% good.
Conclusions: The study highlights significant gaps in knowledge and practice of PPE among farmers. Educational interventions are necessary to improve PPE usage, ensuring better health and environmental safety.

Keywords: Attitude, Cross-sectional study, Farmers, Knowledge, Personal protective equipment, Pesticides, Practice

INTRODUCTION

India, with its vast agricultural landscape, serves as a cornerstone of the global economy, supplying crucial food, raw materials, and employment opportunities to millions. The agricultural sector's significance extends beyond national borders, contributing substantially to global food security and economic growth. However, this vital industry is not without its challenges. Among the most pressing issues is the health risk posed by the use of pesticides. These chemicals, essential for pest control, are a double-edged sword, offering agricultural benefits while posing significant health hazards to those who handle them.[1]

Pesticides classified by the World Health Organization (WHO) into categories based on their toxicity- extremely hazardous, highly hazardous, moderately hazardous, and

slightly hazardous- pose various health risks depending on their physical and chemical properties.[2] The extensive use of these substances in agricultural practices can lead to their persistence in the environment, accumulating in soil, air, water, and food chains. This bioaccumulation can result in long-term exposure risks, affecting human health by disrupting endocrine, neural, and immune systems.[3] Numerous studies have highlighted the severe consequences of pesticide exposure, linking it to neurotoxicity, cancer, and other critical health issues.[4]

Given these risks, the use of personal protective equipment (PPE) becomes paramount in safeguarding farmers. Despite the availability of PPE, its effective usage is often hindered by gaps in knowledge, attitude, and practice among farmers.[5] This cross-sectional study aims to evaluate these aspects among farmers in Bangalore, India, who regularly use pesticides. By identifying the deficiencies in PPE usage and understanding the factors that contribute to these gaps, the study seeks to provide actionable insights and recommendations. These findings will help in formulating targeted educational programs and policies that enhance the safety and health of farmers, ensuring sustainable agricultural practices that protect those who are essential to the industry.

Primary objective

To assess the knowledge, attitudes, and practices regarding PPE among farmers using pesticides.

Secondary objectives

Investigate adverse events induced by pesticides and their management. Assess the use of appropriate PPE. Understand the management of leftover pesticides and storage practices. Provide first aid education to farmers.

METHODS

Study type and site

The study was designed as a cross-sectional survey to assess the knowledge, attitude, and practices (KAP) of farmers regarding the use of personal protective equipment (PPE) in pesticide application. Conducted in the rural areas of Bangalore, the study targeted farmers and farm laborers involved in pesticide spraying.

Study population

The participants included farmers and farm laborers aged 20 years and above, actively engaged in pesticide application.

Inclusion criteria

Farmers and farm laborers involved in pesticide spraying in a community setup. Individuals aged 20 years or older. Currently engaged in farming activities. Able to provide informed consent.

Exclusion criteria

Farmers with mental impairments. Farmers with congenital respiratory disorders. Farmers with existing dermatological problems. Retired or inactive farmers Unable to provide informed consent due to some other reasons.

Sample size

A sample size of 213 farmers was targeted to ensure sufficient statistical power to detect significant associations between risk factors and mental health outcomes.

Sampling method

A stratified random sampling technique was employed to ensure representation from different farming sectors (e.g., livestock, crops) and geographical regions.

Data collection

Data were collected through face-to-face interviews using a structured questionnaire, which covered aspects of KAP regarding PPE usage.

Ethical considerations

Participants were provided with detailed information about the study and were required to give written consent. Data were anonymized and stored securely to protect participants' privacy.

Study duration

This study took place from January to October 2023.

Study outcome

The results revealed a significant gap in knowledge among farmers about the health risks associated with pesticide exposure. Despite a generally positive attitude towards the importance of PPE, actual practices often fell short of recommended safety standards. Challenges such as inadequate training and limited access to affordable PPE were noted as consistent barriers to proper PPE usage. These findings highlight the urgent need for targeted educational campaigns and policy changes to bridge the knowledge gap, improve PPE accessibility, and enhance farmer safety.

Statistical analysis

Data were entered into Microsoft Excel spread sheets and cross checked for its accuracy. The statistical analysis

was performed using IBM SPSS statistics software for windows, version 22 (Armonk, NY, USA).

Data analysis

Descriptive statistics: To summarize socio-demographic characteristics of the study populations. Inferential statistics: Pearson's correlation was used to analyze the relationships between knowledge, attitude, and practice regarding PPE usage.

RESULTS

Socio-demographic characteristics

A total of 213 farmers were surveyed, of these, 84.5% were male and 15.5% were female. Participants were mainly aged between 30-45 years (56.3%), followed by those over 45 years (24.9%) and under 30 years (18.8%), and estimated mean age of the participants was approximately 38.3 years. Regarding education, the majority have primary education (51.6%), while others have no formal education (23.5%), secondary education (20.2%), and higher education (4.7%). In terms of farming experience, 42.3% have 5-10 years of experience, 36.6% have more than 10 years, and 21.1% have less than 5 years, Table 1 depicts the socio-demographic characteristics of the study population.

Analysis of knowledge, attitudes, and practices (KAP) on PPE usage

The analysis categorizes farmers into three groups based on their knowledge of PPE usage: low, moderate, and high. Farmers with low knowledge mostly exhibited fair practices, with some showing poor practices, though a few adhered to good practices despite their limited knowledge. Those with moderate knowledge showed a balanced attitude, better adherence to PPE, and more good practices compared to the low knowledge group. High knowledge farmers generally had the best practices, with the fewest poor practices and the highest proportion of good practices, indicating that higher PPE knowledge positively impacts adherence and proper use, Table 2 depicts the comparison of knowledge, attitude, and practice (KAP) levels in detail.

Table 1: Demographic characteristics of study participants.

Variables	Category	Frequency (n=213)	Percentage
Gender	Male	180	84.5
	Female	33	15.5
Age (years)	<30	40	18.8
	30-45	120	56.3
	>45	53	24.9
Education level	No formal education	50	23.5
	Primary education	110	51.6
	Secondary education	43	20.2
	Higher education	10	4.7
Years of farming experience	<5	45	21.1
	5-10	90	42.3
	>10	78	36.6
Knowledge level	Low	124	58.2
	Moderate	78	36.6
	High	11	5.2

Table 2: Comparison of knowledge, attitude, and practice (KAP) levels.

Knowledge level	Attitude level	Practice level	Frequency (n=213)	Percentage
Low knowledge	Unconcerned	Poor practice	25	11.7
		Fair practice	60	28.2
		Good practice	39	18.3
	Neutral	Poor practice	15	7.0
		Fair practice	25	11.7
		Good practice	30	14.1
	Concerned	Poor practice	3	1.4
		Fair practice	5	2.3
		Good practice	2	0.9
Moderate knowledge	Unconcerned	Poor practice	10	4.7
		Fair practice	25	11.7

Continued.

Knowledge level	Attitude level	Practice level	Frequency (n=213)	Percentage
		Good practice	20	9.4
	Neutral	Poor practice	15	7.0
		Fair practice	50	23.5
		Good practice	20	9.4
	Concerned	Poor practice	1	0.5
		Fair practice	4	1.9
		Good practice	3	1.4
High knowledge	Unconcerned	Poor practice	1	0.5
		Fair practice	1	0.5
		Good practice	2	0.9
	Neutral	Poor practice	0	0.0
		Fair practice	2	0.9
		Good practice	3	1.4
	Concerned	Poor practice	0	0.0
		Fair practice	2	0.9
		Good practice	2	0.9

Table 3: Correlation between knowledge, attitude, and practice.

Variables	Correlation coefficient (r)	P value
Knowledge-attitude	0.45	<0.001
Knowledge-practice	0.62	<0.001
Attitude-practice	0.38	<0.001

Correlation between knowledge, attitude, and practice regarding PPE usage

In our research study, we used Pearson's correlation to analyze the relationships between knowledge, attitude, and practice regarding PPE usage. We found positive correlations between these variables. Specifically, there is a moderate positive correlation between knowledge and attitude (r=0.45), indicating that higher knowledge levels are associated with more concerned attitudes towards PPE usage. Additionally, we observed a strong positive correlation between knowledge and practice (r=0.62), suggesting that increased knowledge significantly improves PPE practices among farmers. Furthermore, there is a moderate positive correlation between attitude and practice (r=0.38), meaning that a more concerned attitude towards PPE use is linked to better practices. These correlations, all with p values less than 0.001, underscore the interconnectedness of knowledge, attitude, and practice in promoting effective PPE use, as depicted in Table 3.

Summary of farmers' symptoms, therapy received, and preventive measures

The study reveals that among the 213 surveyed farmers, 46 (21.6%) experienced eye irritation, 24 (11.3%) had dermal irritation, 16 (7.5%) faced breathing difficulty, and 13 (6.1%) reported other symptoms while 114 (53.5%) reported no symptoms. Therapy was received by a small fraction: 13.04% of those with eye irritation, 8.33% with dermal irritation, 12.5% with breathing difficulty, and 53.85% with other symptoms, indicating significant gaps in medical treatment accessibility. Additionally, preventive measures were largely neglected, with 82.6% of farmers not taking any, highlighting the need for improved education and resources for personal protective equipment (PPE) usage and overall safety practices (Table 4).

Table 4: Summary of farmers' symptoms, therapy received, and preventive measures.

Symptom type	No. of farmers	Frequency	Percentage	No. received therapy	Percentage receiving therapy
Breathing difficulty	16	0.075	7.5	2	12.5
Dermal irritation	24	0.113	11.3	2	8.33
Eye irritation	46	0.216	21.6	6	13.04
None	114	0.535	53.5	0	0
Others	13	0.061	6.1	7	53.85
Preventive measures taken	**No. of farmers**	**Percentage**			
Yes	37	17.4			
No	176	82.6			
Total	213	100			

Distribution of farmers according to the storage and management of pesticides

Out of 213 farmers surveyed, 49.8% stored their pesticides in warehouses, 45.5% stored them in the working field, and only 4.7% kept them at home. This indicates that nearly half of the farmers use warehouses for pesticide storage, likely for reasons of safety and accessibility, while a significant proportion still store pesticides directly in the fields where they work. A very small number store pesticides at home, which might pose safety risks, as depicted in Table 5.

Table 5: Distribution of farmers according to the storage and management of pesticides.

Place of storage	No. of farmers	Percentage
Warehouse	106	49.8
Working field	97	45.5
Home	10	4.7
Total	213	100

Distribution of farmers according to the management of leftover pesticides

The table and corresponding graph illustrate the methods used by 213 farmers for managing leftover pesticides. Statistically, it is evident that a significant majority (52.1%) of farmers opt to reuse the leftover pesticides, highlighting a prevalent practice aimed at minimizing waste and potentially reducing costs. Conversely, 29.1% of farmers finish the pesticide, ensuring complete utilization of the product. A smaller segment, 16.9%, disposes of the pesticide in the open field, which could raise environmental concerns due to potential contamination. Only a minimal 1.9% of farmers bury the leftover pesticide, suggesting limited adoption of this method. These statistics underscore the importance of educating farmers on safe and environmentally-friendly pesticide management practices to mitigate adverse effects on the ecosystem, as depicted in Table 6.

Table 6: Distribution of farmers according to the management of leftover pesticides.

Management of leftover pesticide	N	Percentage
Bury it	4	1.9
Reuse it	111	52.1
Dispose it	36	16.9
Finish it	62	29.1
Total	213	100

DISCUSSION

A total of 213 farmers were surveyed, with 84.5% being male and 15.5% female. Participants were mainly aged between 30-45 years (56.3%), followed by those over 45 years (24.9%) and under 30 years (18.8%). The estimated mean age of the participants was approximately 38.3 years. More than 50% of respondents were between 31 to 50 years old. These findings are similar to other research demonstrating an average age of 43.6 years, with 58.4% of participants aged between 31 to 50 years.[6] Interestingly, 13.6% of people in the 21-35 age range were farmers, suggesting a representation of younger people in agriculture, potentially indicating a new generation's interest in farming or an extension of family agricultural traditions. Regarding gender distribution, there is a significant imbalance among the surveyed farmers, with only 1.9% being female and 98.1% male. This discrepancy aligns with historical trends where males have dominated agriculture in many regions. However, studies by Norkaew et al and Beyene Negatu et al reported a higher proportion of female candidates involved in farming, suggesting regional differences in attitudes toward female participation in agriculture.[7,8] The study also revealed significant disparities in the knowledge, attitude, and practices (KAP) regarding personal protective equipment (PPE) among farmers in Bangalore, India. A majority of farmers (58.2%) exhibited low knowledge about PPE, which correlates with poor or fair practices in using PPE while handling pesticides. This low level of knowledge is further reflected in the education levels of the respondents, with 71.2% having only primary school education.[9] This finding is consistent with a study conducted in Brazil, where 83.2% of workers had less than 8 years of education, and similar research in Nepal, which also revealed that most farmers had less than 8 years of education.[10,11] The correlation between low education levels and poor PPE practices highlights a critical gap in awareness and training that needs to be addressed to improve safety among farmers. Attitudinal issues further compound this lack of knowledge, with nearly half of the farmers being unconcerned about PPE use, reflecting a critical gap in awareness and education. This finding aligns with a study in Ethiopia, where respondents were more concerned about careful pesticide handling than using PPE.[12] Many believed that showering would remove pesticides from contaminated body surfaces and did shower after working with pesticides.[13] Despite some farmers being aware of the importance of PPE; proper usage remains limited due to barriers such as inadequate training and limited access to affordable PPE. The high cost of PPE was mentioned as a significant factor in its limited use.[14,15] The correlation analysis indicates a moderate to strong positive relationship between knowledge, attitude, and practice. Higher knowledge levels significantly improve both attitudes towards PPE and the actual practice of using PPE, underscoring the need for educational interventions. Additionally, the findings highlight that despite the majority of farmers experiencing adverse health symptoms from pesticide use, very few received medical treatment, revealing gaps in healthcare accessibility and awareness. Poor management and storage practices of pesticides were also noted, with nearly half of the farmers storing pesticides in the working field, posing environmental and health risks. This study underscores the critical need for targeted educational and policy interventions to enhance farmer safety and health, particularly in improving PPE

awareness and usage, and addressing broader healthcare and educational deficiencies.

This study, with a sample of 213 farmers, may not represent the entire farming community, leading to selection bias. It focuses on pesticide handling but omits details like pesticide types and usage frequency. While correlations between behaviors, attitudes, knowledge, and health outcomes are noted, causes are not deeply explored. Findings are limited to a specific geographic area, and the cross-sectional design hinders causality determination and long-term monitoring. Self-reported data may be influenced by recall and social desirability biases.

CONCLUSION

The study revealed significant gaps in the knowledge, attitudes, and practices related to PPE use among farmers in Bangalore, India. Despite a generally positive attitude towards the importance of PPE, actual practices often fell short of recommended safety standards. Factors such as inadequate training and limited access to affordable PPE were identified as major barriers to proper PPE usage. The findings underscore the urgent need for targeted educational campaigns and policy changes to bridge the knowledge gap, improve PPE accessibility, and enhance farmer safety. Ensuring that farmers have the necessary knowledge and resources to use PPE effectively is crucial for mitigating the health risks associated with pesticide exposure. Additionally, promoting safe and environmentally friendly pesticide management practices is essential for protecting both human health and the environment.

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