Original Article

Perceptions and practices regarding pesticide exposure among pregnant women in a south Indian teaching institution

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Abstract

Introduction: Agriculture is the primary source of livelihood for about 58% of India's population. In recent years, there have been pressing public health and food safety concerns related to pesticide residues. Pesticides are a class of man-made environmental chemicals that can affect the body's development, growth, and hormone balance. Pregnant women are a particularly vulnerable group when it comes to pesticide exposure. Focusing on this population provides crucial data for designing protective interventions. Hence for formulating effective intervention strategy to combat this problem, proper quantification of the root cause was needed, hence the study was being conducted. **Methods:** Hospital-based, cross-sectional study was conducted among 151 pregnant mothers. The questionnaire was administered by the principal investigator in a simple local language. Chi-square test was done to find the association between socio-demographic variables and knowledge of pregnant mothers about fetal complications due to pesticide. **Results:** The overall knowledge about pesticide was through newspaper (44.3%) and social media (24.5%) whereas 84.1% believed pesticide has adverse effects on the fetus. It is shown that age <35 years, third trimester participants, educated participants, higher socio-economic status participants showed adequate knowledge about fetal complications due to pesticides. **Conclusions:** The study concluded that knowledge is adequate about pesticide exposure, but the practice is not. Safe pesticide practices during pregnancy are necessary to protect the developing fetus.

Keywords: Maternal health, occupational exposure, prenatal care, safety, toxins

Introduction

With a population of 1.27 billion, India is the world's second most populous country. Agriculture, with its allied sectors, is India's largest source of livelihood. 70 percent of its rural households still depend primarily on agriculture for their livelihood, with 82 percent of farmers being small and marginal.[1] Agriculture is the primary source of livelihood for about 58% of India's population.[2] In recent years, there have been pressing public health and food safety concerns related to pesticide residues. Increased reporting of these problems may partially be related to the growing consumer demand for safe food in developed countries and increasing in developing countries. Human exposure to pesticides occurs primarily through dietary residues, outdoor pesticide exposures, indoor pesticide exposures, occupational exposures, and through unsafe use of pesticides on domestic animals.[3]

Pregnant women are a particularly vulnerable group when it comes to pesticide exposure. Focusing on this population

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provides crucial data for designing protective interventions. Based on the incidence of sporadic pregnancy loss, the incidence of Recurrent Pregnancy Loss (RPL) should be approximately 1 in 300 pregnancies. Although the specific cause of RPL is not yet known, considerable evidence suggests that both genetics and the environment play an important role in the origin and evolution of this disease. Pesticides are a class of man-made environmental chemicals that can affect the body's development, growth, and hormone balance.[4] Pesticides are usually designed to target a particular pest, but due to their broad range of toxicity they can also be directed to other non-target species. In most cases, however, human exposure is unintentional.

Pesticides such as dichlorodiphenyltrichloroethane and hexachlorocyclohexane are officially banned in India.[5] Pesticide exposure may occur soon after a single exposure (acute effects) or gradually after repeated low- or high-dose exposures over some time (chronic effects). Acute effects may include eye, nose and/or throat irritation, allergic reactions, skin irritation, headache, dizziness, muscular weakness, nausea, vomiting, stomach cramps, diarrhea, blurred vision, sweating, salivation, a tingling sensation, respiratory symptoms, and, in some cases, muscle twitching. Chronic effects may include damage to the liver or kidneys, to the endocrine, reproductive, immune, metabolic, and/or nervous systems and cancer. In addition, genotoxic and mutagenic effects may occur. Symptoms may occur gradually after repeated exposure over a period of time.[6] The key aspects of first aid for occupational exposure are decontamination, removal of any contaminated clothing and personal protective equipment (PPE) in a safe manner, cover the patient with a blanket or clean clothes, and wash exposed parts of the body with soap and plenty of clean, cold water. If the eyes have been splashed with a pesticide, wash them immediately with ≥ 500 mL of clean water and gently irrigate the eyes for at least 15 min. Keep the patient in the "recovery position," on their left side with the neck extended and following the instructions on the label.[7]

However, they are still in use to control the disease-carrying vectors.[5] Hence for formulating effective intervention strategy to combat this problem, proper quantification of the root cause was needed, hence the study was being conducted.

Materials and Methods

Study setting

The present study was a hospital-based, cross-sectional study undertaken in Sri Manakula Vinayagar Medical College and Hospital, Madagadipet, Puducherry. The hospital has an in-patient capacity of more than 932 Beds, with exclusive of 100 critical care beds in different specialties.[8]

Study population

The study participants were all antenatal mothers irrespective of their gestational age was included for the study. Pregnant mothers in active labor, eclampsia mothers, comatose patients, patients not willing to give consent were not included.

Sample size

The sample size of 151 was calculated after considering the percentage of good knowledge regarding pesticide among farmers to be 42%, absolute precision of 7.5% with 95% confidence Interval (CI) (calculated by Epi Info version 3.5.4).[8]

Study procedure

Antenatal mothers irrespective of their gestational age gave consent for the study were included by systematic random sampling technique. Questionnaire was being used and modified after obtaining consent from Dr Alyson Lorenz, Department of Environmental Health, Rollins School of Public Health, Emory University, Atlanta (through email). The duration of the study was for two months from April 2022 to June 2022. Questionnaire was administered by the principal investigator who was trained in administering the questionnaire, in a simple local language easily understandable by the participants, after obtaining consent from the participant. For patients anxious regarding her pesticide exposure can cause abortion, reassurance was given by the PI. To create more awareness in the hospital and patients, posters regarding the guidelines for personal protection while handling pesticides were hung at the obstetrics and gynecology OPD. In case of controversy/internal conflicts in questionnaire administration, the final decision was made by the guide and co-guide together and was considered as the final answer. Internal validity of the study was ensured by appropriate sample size calculation, sampling technique and administration of predesigned and pretested questionnaire.

Statistical analysis

The data was entered in Epi info version 7 and was analyzed in SPSS version 24. Discrete variables were expressed as frequency and percentages. Chi-square test was done to find the association between socio-demographic variables and knowledge of pregnant mothers about fetal complications due to pesticide.

Ethical clearance

The present study was cleared by the Research Committee and the Institutional Ethics Committee (Human studies) (IEC No – 20/2022) of SMVMCH, Puducherry. All the information collected from the study participants was kept confidential and their privacy was maintained.

Results

Demographic and pesticide use among family members characteristics of the 151 participants were presented in Tables 1 and 2. The age distributed was 95.3% below 35 years and 4.63% above 35 years, and participants were distributed across the first (2.64%), second (24.5%), and third (72.8%) trimesters of pregnancy. Approximately one-fourth (25.8%) of the participants reported currently working in agriculture since becoming pregnant and 67.5% were past agricultural workers. About half of them belong to nuclear family (52.3%), urban residence (62.9%), completed school education (47.6%), and

Table 1: Social demographic details (*n*=151)

Variables	*n*=151	Percentage
Age of the mother		
18-35	144	95.3
>35	7	4.63
Place of residence		
Urban	95	62.9
Rural	56	37.1
Gestational age of mother in weeks		
0-12	4	2.64
13-28	37	24.5
>29	110	72.8
Family type		
Nuclear family	79	52.3
Joint family	56	37.1
Extended family	12	7.9
Living alone	4	2.6
Educational status of Mother		
Illiterate	24	15.9
School education	72	47.6
Diploma	32	21.2
Graduate	23	15.2
Type of occupation of mother		
Agricultural works	38	25.8
Non-agricultural works	11	6.7
Previous agricultural workers currently not working	102	67.5
Husband's occupation		
Legislators, senior officials, and manager	0	0
Professional	1	0.7
Technicians and associate professionals	16	10.6
Clerks	28	18.5
Skilled workers and shop/market/sales workers	34	22.5
Skilled agricultural & fishery workers	42	27.8
Craft and related trade workers	11	7.3
Plant & machine operators and assemblers	15	9.9
Elementary occupation	0	0
Unemployed/homemaker	4	2.6
Socio-economic status (Modified BG Prasad)		
Lower	8	5.3
Middle class	11	7.3
Upper class	38	25.2
Upper middle class	94	62.3

Table 2: Details of family members

Variables	*n*=151	Percentage
Types of agricultural work done by the mother or anyone else in her family (Multiple responses)		
Pesticide handling, control of insects, food processing plant, greenhouse work, fertilizer handling	24	15.8
Fertilizer handling, waxing fruits and vegetables, food processing plant, pesticide handling, greenhouse work, control of insects	27	17.8
Fertilizer handling, pesticide handling, greenhouse work, waxing fruits and vegetables, control of insects, food processing plant	30	19.8
Fertilizer handling, control of insects	53	3.5.09
Not agricultural work	11	7.3
Usage of pesticide or insecticide at workplace of the mother		
Yes	63	41.7
No	88	58.3
Wearing work clothes in home, including the family members		
Yes	106	70.2
No	45	29.8
Pesticide-related adverse effects in the family		
Yes	31	20.5
No	120	79.5
Usage of pesticides around house since pregnancy		
Yes	93	61.6
No	58	38.4
Frequency of pesticide application		
Daily	10	6.6
Weekly	6	4.0
Every month	56	37.1
Once in 3 months	34	22.5
Once in a year	16	10.6
Not applicable	29	19.2

upper middle class (62.3%). Agricultural pesticides work done exclusively by the pregnant mother was 41.7% but along with family members, 53 (35.09%) women reported doing agricultural works and were in contact with people doing fertilizer handling and control of insecticides, and 81 (53.64%) were doing the same works along with other agricultural works (pesticide handling, food processing, greenhouse work, et.c), so total pesticide usage since pregnancy along with household members comes to 61.6% (higher that 41.7%). Pesticides which were applied every month (37%) and once in three months (22.5%) hold the larger percentage of pesticide application. Among them 70.2% wear work clothes at home including family members. 20% reported pesticide-related adverse effects in the family. There were no missing data for any of the variables included in the descriptive statistics.

Tables 3-5 present knowledge, attitude, and practices of pesticide exposure among pregnant women irrespective of their exposure status. The overall knowledge about pesticide was through newspaper (44.3%) and social media (24.5%) whereas 84.1% believed pesticide has adverse effects on the fetus. Almost 74.2% had adequate knowledge to prevent pesticide exposure with 92.1% believing pesticides were poisonous and can cause death in fetus or mother (67.5%). Over two-third (59%) were able to identify symptoms of pesticide toxicity. About half (52.9%) attributed cancer to be the potential health hazard of pesticide exposure. Table 6 presents results from the association between socio-demographic variables and knowledge of pregnant mothers about fetal complications due to pesticide. There were no missing data in these analyses, though some questions did not apply to all participants. In our study, 127 of the participants showed adequate knowledge about fetal complications due to pesticide, among them the effect of age of the mother, gestational age, educational status, and socio-economic status of the mother was proved statistically significant ($P < 0.05$). It is shown that age <35 years, third-trimester participants, educated participants, higher

Table 3: Knowledge about pesticide exposure

Variables	*n*=151	Percentage
Source of knowledge about pesticide exposure (multiple response)		
Newspaper, Radio & TV	67	44.3
Social media	37	24.5
Friends and relatives	21	13.9
Training done at workplace, social media	15	9.93
None	11	7.4
Knowledge on exposure to pesticide of any kind have any adverse effect on the fetus?		
Yes	127	84.1
No	24	15.9
Which form of pesticide entry into the body is harmful?		
Inhalation, swallowing pesticides, getting through skin	102	67.5
Inhalation	19	12.5
Getting through on skin	16	11
Swallowing	14	9
Knowledge on effective ways in preventing pesticide exposure?		
Wearing full personal protective equipment, wearing gloves, washing fruits and vegetables before consuming, hand washing in the stream after handling pesticides, washing clothes worn at farm separate from other clothes	112	74.2
Covering mouth and nose with hands while spraying pesticides	31	20.5
None	8	5.3
Symptoms of toxicity of pesticides		
Nausea/vomiting, excess salivation, headache, skin rash, heat attack, stroke, cough, chest pain, breathlessness, cold, watery eyes/ sore eyes, abdominal pain/diarrhea, muscle weakness/fatigue/body pain	89	59
Symptoms related to CNS manifestation	54	35.7
None	8	5.3
Potential health impacts of pesticides?		
Cancer	80	52.9
Cough, pesticide poisoning	11	7.28
Congenital anomalies	11	7.28
Slower learning abilities in children	39	25.8
Irritated skin	10	6.8

socio-economic status participants showed adequate knowledge about fetal complications due to pesticides.

Discussion

The knowledge about pesticide exposure among pregnant women is vital for providing sound educational and policy strategies that aim at limiting the health and environmental hazards caused by pesticides. In general, most of our study participants (127) demonstrated relatively adequate levels of knowledge about pesticides. However, agricultural workers showed significantly lower attitudes and practices about responsibility for the safe use of pesticides. This suggests that even though farmers may know the hazards of pesticides very well, they may often adopt risky

Table 4: Attitude toward pesticide exposure

Variables	*n*=151	Percentage
Pesticides protect people from pest-related diseases		
Yes	146	96.7
No	5	3.3
Pesticides are poisonous		
Yes	139	92.1
No	12	7.9
Pesticide can cause death of fetus or mother?		
Yes	102	67.5
No	49	32.5
Do you think using large amount of pesticide for only a short times is harmful to your health?		
Yes	108	71.5
No	43	28.5
Do you think using large amount of pesticide for only a short time is harmful to the health is your fetus?		
Yes	96	63.6
No	55	36.4
Pesticide when sold in market it means it is safe no matter how or by whom it is used?		
Yes	56	37.1
No	95	62.9

Table 5: Practice toward pesticide exposure

Variables	*n*=151	Percentage
Application of any of these pesticides personally		
Yes	86	57.0
No	65	43.0
Application of flea or tick shampoo on any of the pets personally		
Yes	94	62.3
No	57	37.7
Anyone else applied pesticide at home		
Yes	101	66.9
No	50	33.1
Storage of any bags of pesticide/containers at home		
Yes	71	47.0
No	80	43.0
Ever closed the window during pesticide application		
Yes	96	63.6
No	65	36.4
Wearing personal protective equipment while handling pesticide		
Yes	71	47.1
No	80	52.9
Type of personal protective equipment		
Gloves	11	7.3
Gloves and work clothes	6	4
Mask	6	4
Mask and gloves	42	27.8
Mask gloves and gown	6	4
None	80	52.9
Restoring pesticide containers after cleaning		
Yes	91	60
No	60	40

Contd...

Table 5: Contd...

Variables	*n*=151	Percentage
Discarding the pesticide when it crosses the expiry date		
Yes	70	46.4
No	81	53.6
Ways of disposing unused pesticide		
Dustbin	20	13.2
Giving others	3	2.0
In dustbin	5	3.3
Municipal van	44	29.1
None	79	52.4
Practice of washing hands before eating in workplace		
Yes	104	68.9
No	47	31.1
Practice of bath after work		
Yes	86	57
No	65	43
Washing fruits and vegetables before eating		
Yes	123	81.5
No	28	18.5
Frequency of washing fruits and vegetables before eating		
Always	56	37.1
Usually	30	19.9
Sometimes	39	25.8
Almost never	26	17.2
Handling mosquitoes repellents at home		
Yes	142	94.0
No	9	6.0
First aid given to anyone ingests pesticide		
Don't know what to do	37	24.5
Asking to drink water	11	7.3
Getting to hospital	78	51.6
Giving native medical plants	6	4.0
No Idea	2	1.3
Spraying water on them	8	5.3
Stomach wash	1	0.7
Taking them away from the spot	8	5.3

behaviors because of lack of education and poor knowledge and understanding of safe practices in pesticide use,[9] or they are more concerned with high economic returns from their crops than with their health.[10]

Studies have showed educated farmers are more knowledgeable about pesticide safety, have better ability to read, understand and follow hazard warnings on labels, and conceptualized the consequences of poor pesticide usage practices.[11] Even when able to read, respondents in this study showed significantly higher number of risky behaviors at home where 47% stored pesticides at home, 52.9% (pregnant women and their family members) does not wear pesticide protective equipment at work, 36.4% does not close windows while pesticide application, 53.6% does not discard pesticides even when it crosses the expiry date. Of the 151, more than half (52.4%) do not discard pesticide properly, 31.1% do not hand wash before eating at workplace. Despite this condition, all of them do not know the first aid to provide prevent pesticide toxicity.

Previous studies also examined the role of other factors such as infections, hormonal aberrations, menstrual irregularities, malnutrition, psychological conditions, stressful events, and high alcohol, nicotine, and caffeine intake, but the results are inconsistent.[12,13]

Settimi *et al.*[14] also reported a positive association between pesticide exposure and increased risk of pregnancy loss. Pesticides exposure may also cause reproductive and developmental disorders.[15-17]A definite cause of RPL can be identified only through intensive diagnostics.

In countries where risk assessment and registration procedures are not adequate, pregnant and nursing women should also not be involved in pesticide-related activities because of their increased risks (e.g., to fetuses and newborns).[7]

The strength of the study includes usage of pre-tested and validated questionnaire in assessing pesticide knowledge, attitudes, and practices. Pregnant women are a particularly vulnerable group when it comes to pesticide exposure. Focusing on this population provides crucial data for designing protective interventions. Although conducted in a hospital setting, the findings may not be generalizable to all antenatal populations, especially those in rural or less healthcare-accessible areas. Self-reported knowledge and practices, which can be subject to recall bias or social desirability bias, where participants may underreport risky behaviors were the limitations of the study.

Conclusions and Recommendations

The knowledge gaps we identified in this study could be used to design knowledge-based interventions aimed at pregnant women in South India. Some of the women we surveyed reported knowledge of risky behaviors but engaged in them, nonetheless. Measures include health education, protective gear, prenatal monitoring, safe practices, reducing exposure, promoting organic alternatives, and community awareness programs. It must be noted that the family plays a bigger part in increasing pesticide exposure by working in agricultural fields and returning homes with little best practices to eliminate the dissemination of pesticide exposure to their families. This finally shows that the knowledge is adequate about pesticide exposure but the practice is not. Implementing stricter practices to reduce pesticide exposure in pregnant women family. Behavior change interventions may have only modest impact without changes to national and international pesticide policy. The context of pesticide and agricultural policy in India is unique and challenging, given the large population engaging in agricultural works.

These important behavioral observations should be considered when planning interventions in this or similar populations. Agricultural workers were more likely to report risky behaviors at home, so the additional finding that having an agricultural job before becoming pregnant was significantly associated with

Table 6: Association between socio-demographic variables and knowledge of pregnant mothers about fetal complications due to pesticide (*n*=151)

Variables	*n*=151	Knowledge about fetal complications due to pesticide		*P*
		Adequate (*n*=127)	Inadequate (*n*=24)	
Age of the mother				
18-35	144 (95.3)	125 (98.4)	19 (79.2)	<0.001*
>35	7 (4.6)	2 (1.6)	5 (20.8)	
Place of residence				
Urban	95 (62.9)	82 (64.6)	13 (54.2)	0.33
Rural	56 (37.1)	45 (35.4)	11 (45.8)	
Gestational age of mother in weeks				
0-12	4 (2.6)	2 (1.6)	2 (8.3)	<0.001*
13-28	37 (24.5)	21 (16.5)	16 (66.7)	
>29	110 (72.8)	104 (81.9)	6 (25)	
Family type				
Nuclear family	79 (52.3)	65 (51.2)	14 (58.3)	0.82
Joint family	56 (37.1)	49 (38.6)	7 (29.2)	
Extended family	12 (7.9)	10 (7.9)	2 (8.3)	
Living alone	4 (2.6)	3 (2.3)	1 (4.2)	
Educational status of mother				
Illiterate	24 (15.9)	22 (17.3)	2 (8.3)	0.02*
School education	72 (47.6)	54 (42.5)	18 (75)	
Diploma	32 (21.2)	31 (24.4)	1 (4.2)	
Graduate	23 (15.2)	20 (15.8)	3 (12.5)	
Type of occupation of mother				
Agricultural works	38 (25.8)	32 (25.2)	6 (25)	0.98
Non-agricultural works	11 (6.7)	9 (7.1)	2 (8.3)	
Not working/Home maker	102 (67.5)	86 (67.7)	16 (66.7)	
Socio-economic status (Modified BG Prasad)				
Lower	8 (5.3)	5 (3.9)	3 (12.5)	0.01*
Middle class	11 (7.3)	8 (6.3)	3 (12.5)	
Upper class	38 (25.2)	28 (22)	10 (41.7)	
Upper middle class	94 (62.3)	86 (67.7)	8 (33.3)	

*P<0.05 is significant

risky behaviors in the home was not surprising. Women who are pregnant may need reminders that safe pesticide practices during pregnancy are necessary to protect their developing fetus. The study aims to expand its scope by monitoring long-term health outcomes of mothers and children, implementing educational interventions, and advocating for policy changes to reduce pesticide exposure.

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Conflicts of interest

There are no conflicts of interest.

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