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PATTERN AND CLINICAL PROFILE OF PESTICIDE POISONING IN RURAL POPULATION ATTENDING A TERTIARY CARE HOSPITAL IN NORTH INDIA: A HOSPITAL-BASED OBSERVATIONAL STUDY

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ABSTRACT

Background: Pesticide poisoning is a major public health issue in agricultural regions, particularly in developing countries where pesticides are widely accessible. Rural populations are at higher risk due to occupational exposure, unsafe storage practices, and psychosocial stressors. Organophosphate compounds are frequently implicated in acute poisoning cases and are associated with significant morbidity and mortality.
Objectives: To study the pattern of pesticide poisoning among rural patients admitted to a tertiary care hospital in North India, with respect to demographic profile, type of pesticide involved, mode and intent of poisoning, clinical presentation, and outcomes.
Methods: This hospital-based descriptive observational study was conducted from March 2024 to October 2024 in a tertiary care hospital in North India. A total of 40 patients with confirmed pesticide poisoning from rural areas were included using consecutive sampling. Data were collected using a structured proforma covering demographic details, type of pesticide, mode and intent of exposure, clinical features, and outcomes. Statistical analysis was performed using SPSS version 22.0, with descriptive statistics expressed as frequencies and percentages. A p-value <0.05 was considered statistically significant.
Results: Out of 40 patients, the majority were aged 21–40 years, with a male predominance. Organophosphates were the most common agents involved (55%). Suicidal ingestion accounted for 70% of cases, followed by accidental (25%) and occupational exposure (5%). Most patients presented with moderate severity (45%), followed by mild (30%) and severe cases (25%). The overall recovery rate was 85%, while mortality was observed in 12.5% of cases.
Conclusion: Pesticide poisoning in rural North India predominantly affects young adults and is most commonly due to suicidal ingestion of organophosphates. Despite favorable recovery in most cases, mortality remains significant. Strengthening pesticide regulation, improving rural mental health services, and enhancing community awareness are essential to reduce the burden of poisoning.

Keywords: *Pesticide poisoning; Organophosphates; Rural population; Suicidal poisoning; Toxicology; North India.*

INTRODUCTION

Pesticide poisoning represents a major global public health concern, particularly in agrarian societies where pesticides are widely used for agricultural productivity. According to the World Health Organization, an estimated 3 million cases of pesticide poisoning occur annually worldwide, resulting in more than 2,20,000 deaths, with a significant proportion being intentional self-harm in low- and middle-income countries [1]. The burden is disproportionately higher in rural populations due to easy availability, unsafe storage practices, and limited regulation of pesticide sales. Organophosphates, carbamates, and organochlorines remain the most commonly implicated agents in acute toxic exposures [2].

Globally, pesticide self-poisoning accounts for nearly one-third of all suicides in some agricultural regions, making it one of the most lethal means of self-harm due to high case fatality rates [3]. The toxicological profile, severity of clinical presentation, and outcomes depend on multiple factors including type of compound, dose, route of exposure, and delay in initiation of treatment. Despite regulatory efforts in several countries, pesticide-related morbidity and mortality continue to pose a substantial challenge to healthcare systems, especially in resource-limited settings [4].

In the Indian context, agriculture remains a dominant occupation in rural areas, and pesticide consumption has increased significantly over the past decades. The National Crime Records Bureau (NCRB) reports consistently highlight pesticide poisoning as a major contributor to accidental and suicidal deaths in rural India [5]. Easy over-the-counter availability, inadequate awareness regarding safe handling, and socio-economic stressors contribute to this ongoing burden. Studies have shown that pesticide poisoning cases frequently present to emergency departments with acute cholinergic crises, respiratory failure, and cardiovascular instability, requiring intensive care management [6].

North India, with its extensive agricultural belt, reports a substantial number of pesticide poisoning cases, particularly during peak farming seasons. However, regional variations exist in the pattern of poisoning agents, demographic characteristics, and outcomes. Hospital-based data from tertiary care centres remain crucial for understanding the clinical spectrum and management challenges in such cases [7]. Despite this, there is a relative paucity of structured hospital-based studies focusing specifically on the pattern of pesticide poisoning in rural populations in this region.

Existing literature largely focuses on mortality trends or isolated case series, with limited emphasis on detailed clinico-epidemiological patterns, including type of pesticide, mode of exposure, intent (suicidal, accidental, occupational), and associated risk factors. Furthermore, changing agricultural practices and evolving pesticide formulations necessitate updated region-specific data to guide prevention strategies and clinical protocols [8].

Given this background, it is essential to systematically study pesticide poisoning patterns in rural populations attending tertiary care hospitals. Such data can aid in identifying high-risk groups, common agents involved, and gaps in preventive strategies. This may also contribute to strengthening poison control measures, emergency preparedness, and policy formulation at regional and national levels [9].
Therefore, the present study was undertaken to analyze the pattern of pesticide poisoning in a rural population attending a tertiary care hospital in North India, with special reference to demographic profile, type of pesticide involved, mode and intent of poisoning, clinical presentation, and outcomes.

METHODOLOGY

Study Design: This was a hospital-based descriptive observational study conducted to evaluate the pattern of pesticide poisoning among patients from rural areas admitted to a tertiary care hospital in North India.

Study Setting: The study was conducted in the Departments of Medicine and Emergency Medicine of a tertiary care teaching hospital in North India, which serves as a referral center for predominantly rural population from surrounding districts.

Study Duration: March 2024 to October 2024

Study Population: All patients admitted with a history of pesticide poisoning during the study period and fulfilling inclusion criteria were considered for the study.

Inclusion Criteria

Patients of all age groups and both sexes
Confirmed history of pesticide ingestion, inhalation, or dermal exposure
Patients originating from rural areas
Patients admitted within the study duration

Exclusion Criteria

Patients with poisoning due to non-pesticidal agents (e.g., household chemicals, drugs)

Patients with incomplete clinical records
Patients unwilling to give consent or where consent could not be obtained from attendants

Sample Size: A total of 40 cases of pesticide poisoning admitted during the study period were included consecutively. Sample size was not calculated using a formal statistical formula due to the descriptive nature of the study and limited number of cases presenting during the study duration. All eligible cases fulfilling inclusion criteria during the study period were enrolled (total enumeration sampling).

Sampling Technique: Consecutive sampling technique was used. All patients meeting inclusion criteria during the study period were included until the desired sample size was achieved.

Data Collection Tools & Procedure:
Data were collected using a pre-designed, structured proforma. After obtaining informed consent, detailed history was taken either from the patient (if conscious) or attendants. Information regarding demographic profile, type of pesticide exposure, mode of poisoning (oral, inhalational, dermal), intent (suicidal, accidental, occupational), time of exposure, and delay in presentation was recorded. Clinical examination findings at admission were documented, including vital signs and systemic examination. Relevant laboratory investigations and toxicology reports (if available) were noted from hospital records. Patients were managed as per standard hospital treatment protocols, and outcomes such as recovery, referral, or mortality were recorded.

Study Variables:
Independent variables included age, sex, occupation, socioeconomic status, type of pesticide, mode of exposure, intent of poisoning, and time interval between exposure and hospital presentation. Dependent variables included clinical severity at presentation, need for intensive care admission, duration of hospital stay, and outcome (recovery or death).

Statistical Analysis:
Data were entered into Microsoft Excel and analyzed using Statistical Package for the Social Sciences (SPSS) software version 22.0. Categorical variables were expressed as frequencies and percentages, while continuous variables were summarized as mean ±standard deviation. Associations between categorical variables were analyzed using Chi-square test or Fisher's exact test as applicable. A p-value of less than 0.05 was considered statistically significant.

Ethical Considerations:
Written informed consent was obtained from all participants or their legal guardians. The study adhered to the principles of the Declaration of Helsinki. Confidentiality of patient information was strictly maintained, and data were used solely for research purposes without disclosing personal identifiers.

RESULTS
A total of 40 cases of pesticide poisoning were included in the study. The majority of patients belonged to the 21–40 years age group (45%), followed by 41–60 years (25%). Males (60%) were more commonly affected compared to females (40%). (Table 1)

Table 1: Age and Sex Distribution of Study Participants (n = 40)

Age Group (years)	Male	Female	Total
0–20	4	2	6
21–40	11	7	18
41–60	6	4	10
>60	3	3	6
Total	**24**	**16**	**40**

Organophosphates were the most frequently involved agents, accounting for 55% of cases, followed by carbamates (15%). Organochlorines, herbicides, and unspecified pesticides each contributed 10% of cases.(Table 2)

Table 2: Distribution of Type of Pesticide Involved (n = 40)

Type of Pesticide	Number	Percentage (%)
Organophosphates	22	55.0
Carbamates	6	15.0
Organochlorines	4	10.0
Herbicides	4	10.0
Unknown/Not specified	4	10.0

Total	**40**	**100**

Regarding the mode and intent of poisoning, suicidal ingestion was the predominant pattern observed in 70% of cases, while accidental exposure accounted for 25% and occupational exposure for 5%.(Table 3)

Table 3: Mode and Intent of Pesticide Poisoning (n = 40)

Mode/Intent	Number	Percentage (%)
Suicidal	28	70.0
Accidental	10	25.0
Occupational	2	5.0
Total	**40**	**100**

On clinical assessment, moderate severity of poisoning was most commonly observed (45%), followed by mild (30%) and severe presentations (25%).(Table 4)

Table 4: Clinical Severity at Presentation (n = 40)

Severity Level	Number	Percentage (%)
Mild	12	30.0
Moderate	18	45.0
Severe	10	25.0
Total	**40**	**100**

In terms of outcome, the majority of patients recovered following treatment (85%). Mortality was observed in 12.5% of cases, while 2.5% of patients were referred to higher centers for advanced care.(Table 5)

Table 5: Clinical Outcome of Patients (n = 40)

Outcome	Number	Percentage (%)
Recovered	34	85.0
Death	5	12.5
Referred	1	2.5
Total	**40**	**100**

DISCUSSION

The present hospital-based study evaluated the pattern of pesticide poisoning among 40 patients from rural areas admitted to a tertiary care centre in North India. The findings highlight that young adults, particularly those aged 21–40 years, were most commonly affected, with a male predominance. Organophosphates emerged as the most frequently implicated agents, and suicidal ingestion was the leading mode of poisoning. Moderate clinical severity was most common at presentation, and overall mortality was 12.5%.

The predominance of young adults in the present study is consistent with the broader epidemiological pattern observed in pesticide poisoning globally. Similar age distribution has been reported in studies from other developing countries, where economically productive age groups are more frequently exposed to psychosocial stressors and occupational hazards [1]. Male predominance observed in this study may be attributed to higher occupational exposure in agricultural activities and greater access to pesticides, a finding also supported by prior regional studies [2].

Organophosphates being the most common agents involved aligns with the global and national trend. These compounds are widely used in agriculture due to their effectiveness and affordability. However, their high toxicity and easy accessibility make them a major contributor to both accidental and intentional poisoning cases. Comparable findings have been reported in multiple Indian hospital-based studies, where organophosphates accounted for the majority of acute poisoning cases [3]. The continued dominance of these agents reflects inadequate regulation and unsafe storage practices in rural settings.

The high proportion of suicidal poisoning (70%) in the present study is a critical public health concern. Similar trends have been observed in other studies from rural India and South Asia, where pesticide ingestion is a common method of self-harm due to easy availability and high lethality [4]. Psychological stress, financial instability, and lack of mental health support systems in rural populations may contribute significantly to this pattern [5]. Accidental and occupational exposures were comparatively less frequent, but still highlight gaps in safety awareness and handling practices.

Clinically, most patients presented with moderate severity, which may be due to delayed presentation to healthcare facilities after exposure. Delay in initiation of treatment is a well-recognized factor contributing to increased morbidity and mortality in pesticide poisoning cases [6]. The mortality rate of 12.5% observed in this study is comparable to reported case fatality rates in similar hospital-based studies, although variations exist depending on healthcare accessibility, type of pesticide, and treatment protocols [7].

The overall recovery rate of 85% reflects the effectiveness of timely intensive care management in a tertiary care setting. However, the need for referral in some cases underscores limitations in local critical care resources for managing severe poisoning cases requiring ventilatory support or advanced monitoring.

From a public health perspective, the findings emphasize the need for stricter regulation of pesticide sales, promotion of safe storage practices, and community-based awareness programs in rural populations. Strengthening mental health services and early counseling interventions may also help reduce suicidal pesticide ingestion. Additionally, training of primary healthcare providers in early recognition and management of poisoning cases can improve outcomes significantly [8].

Strengths of the study include its real-world hospital-based design and focus on a rural population, providing practical insights into clinical patterns. However, **limitations** include a small sample size, single-center design, and lack of long-term follow-up outcomes. Additionally, toxicological confirmation of specific pesticide agents was not available in all cases, which may have led to some classification limitations.

CONCLUSION

Pesticide poisoning continues to be a significant clinical and public health problem in rural regions of North India, predominantly affecting young adults in the economically productive age group. In the present study, organophosphates were the most common agents involved, and suicidal ingestion was the leading mode of exposure. The majority of patients presented with moderate severity, reflecting delayed healthcare-seeking behavior and high toxic exposure burden.Although most patients recovered with appropriate medical management in a tertiary care setting, a notable case fatality rate was observed, highlighting the severity of such poisonings. The findings underscore the urgent need for stricter regulation of pesticide availability, safe storage practices at the household level, and increased community awareness regarding their toxic effects.

Strengthening mental health support systems in rural areas, along with early recognition and prompt referral of poisoning cases, may significantly reduce morbidity and mortality associated with pesticide poisoning.

DECLARATIONS

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