



# A decade of wild mushroom poisoning: Clinical and laboratory insights from Northern Iran

Seyed Mohammad Hosseini<sup>1</sup>, Hamid Mohammadi Kojidi<sup>2\*</sup>, Morteza Rahbar Taramsari<sup>2</sup>, Mirsaeed Attarchi<sup>2</sup>

1. Razi Clinical Research Development Unit, Razi Hospital, Guilan University of Medical Sciences, Rasht, Iran
2. Department of Forensic Medicine, School of Medicine, Guilan University of Medical Sciences, Rasht, Iran

## ABSTRACT

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Wild mushroom poisoning remains a significant public health concern in regions where foraging is common. Limited long-term data exist for northern Iran, despite its high-risk ecological and cultural context. The present study aims to characterize the clinical and laboratory features of patients hospitalized for mushroom poisoning over a ten-year period in northern Iran. This descriptive cross-sectional study reviewed all cases of confirmed wild mushroom poisoning admitted to the Toxicology Department of Razi Hospital, Rasht, Iran, from March 2012 to March 2022. Data on demographics, medical history, exposure characteristics, clinical manifestations, laboratory findings, and outcomes were collected from hospital records and analyzed using descriptive statistics. A total of 165 patients were included (mean age  $44.57 \pm 16.02$  years; 50.9% male). Housewives (43.0%) and self-employed individuals (29.1%) were the most affected occupational groups. Most patients (60.6%) resided in urban areas. The mean time from ingestion to hospital presentation was  $9.01 \pm 10.71$  hours. Vomiting (90.9%) and nausea (73.3%) were the most frequent symptoms. Laboratory tests showed variable hepatic involvement, with mean AST and ALT levels of  $45.72 \pm 94.95$  U/L and  $44.02 \pm 93.30$  U/L, respectively. The mean length of hospital stay was  $1.93 \pm 1.45$  days. Four patients (2.4%) died, 97.6% recovered and were discharged. Wild mushroom poisoning in northern Iran affects a wide demographic spectrum and is characterized predominantly by early gastrointestinal symptoms. Although most patients recover, the potential for severe hepatotoxicity and mortality underscores the need for preventive education, and careful inpatient monitoring to detect delayed complications.

### \*Corresponding Author(s):

Hamid Mohammadi Kojidi, MD

Address: Department of Forensic Medicine, Razi Hospital, Guilan University of Medical Sciences, Rasht, Iran

Tel: +98 13 33690006

E-mail: [h\\_mohammadi8778@yahoo.com](mailto:h_mohammadi8778@yahoo.com)



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## 1. Introduction

Wild mushrooms are consumed globally for their nutritional value, culinary appeal, and cultural significance. While many species are safe to eat and even considered delicacies, others are highly toxic and can lead to severe, sometimes fatal, poisoning. The growing popularity of foraging particularly in rural and forested regions has led to an increase in accidental mushroom poisonings worldwide, largely due to the challenge of distinguishing edible mushrooms from toxic varieties based on appearance alone [1,2].

Accidental ingestion of toxic mushrooms can result in a spectrum of clinical manifestations, ranging from mild gastrointestinal disturbances to fulminant hepatic and renal failure. The delay in symptom onset particularly with hepatotoxic species like *Amanita phalloides* often results in patients presenting late to medical care, reducing the effectiveness of treatment and increasing the risk of mortality [3-5]. In many regions, especially where traditional foraging is common, mushroom poisoning represents a significant public health issue. High morbidity, potential for multiorgan failure, and the need for intensive medical care underscore the importance of timely diagnosis and management [6-9].

Despite Iran's diverse geography and rich fungal biodiversity, there remains a notable gap in long-term, region-specific data. In particular, northern Iran home to dense forests and a strong tradition of mushroom foraging has not been the focus of a comprehensive study. Data on the specific toxic species prevalent in the area, their associated clinical and laboratory profiles, and regional outcome patterns remain sparse. This lack of sustained surveillance and large-scale analysis hinders both clinical preparedness and public health interventions. To address this gap, the present study aims to characterize the clinical and laboratory features of patients hospitalized for wild mushroom toxicity over a ten-year period at a tertiary care hospital in northern Iran. The findings are intended to inform local clinicians, improve early recognition and management strategies, and contribute to national and regional policies for poisoning prevention and public education.

## 2. Materials and Methods

### 2.1 Study design

This investigation was conducted as a descriptive cross-sectional study aimed at evaluating the demographic characteristics, clinical manifestations, and laboratory findings of patients with confirmed mushroom poisoning. The study design was chosen to allow a comprehensive assessment of all cases admitted during the specified period without intervention. The study protocol was reviewed and approved by the Ethics Committee of Guilan University of Medical Sciences (approval code: IR.GUMS.REC.1402.074) and conducted in accordance with the principles of the

Declaration of Helsinki. Informed consent was waived by the committee due to the retrospective nature of the study; however, strict confidentiality was maintained throughout.

### 2.2 Study setting and population

The study was carried out at the Department of Toxicology of Razi Hospital, Rasht, Iran. This is a tertiary referral hospital that serves as the primary center for the management of poisoning cases in the region. The study population comprised all patients diagnosed with mushroom poisoning and admitted between March, 2012 and March, 2022. Diagnosis was confirmed based on clinical evaluation, and patient history.

### 2.3 Eligibility criteria and sampling

Patients were eligible for inclusion if they had a confirmed diagnosis of mushroom poisoning and were hospitalized in the Toxicology Department during the study period. Cases with concurrent poisoning from multiple substances were excluded to avoid confounding effects on clinical presentation and outcomes. A census sampling approach was employed, whereby all eligible cases within the 10-year period were included. Patient records were identified through the hospital's electronic medical records and poisoning admission registry.

### 2.4 Data collection

Data were extracted using a standardized, pretested checklist developed specifically for this study to minimize variability in abstraction. The checklist recorded data on demographics, exposure-related information, medical history, clinical presentation, laboratory findings, and outcomes. Incomplete records were excluded from analyses.

### 2.5 Statistical analysis

All data were coded and entered into SPSS software, version 24 (IBM Corp., Armonk, NY, USA). Descriptive statistics were used to summarize the data. Quantitative variables were presented as mean  $\pm$  standard deviation (SD) or median (interquartile range, IQR) when not normally distributed. Categorical variables were expressed as frequencies and percentages.

## 3. Results

A total of 165 patients with confirmed wild mushroom poisoning were included in the analysis (Table 1). The mean age of patients was  $44.57 \pm 16.02$  years, median (IQR): 44 (33, 55) years, range: 13–88 years. Of these, 84 patients (50.9%) were male and 81 (49.1%) were female. Occupation data showed that 43.0% were

housewives followed by 29.1% self-employed, and 9.1% farmers. Regarding place of residence, 60.6% of patients lived in urban areas and 39.4% lived in rural areas.

Overall, 28.5% of patients had a documented history of at least one chronic underlying condition. Hypertension was present in 15.2%, and diabetes mellitus in 12.7% of cases. The mean time from mushroom ingestion to presentation at the medical center was  $9.01 \pm 10.71$  hours (median (IQR): 6 hours; range: 1–72 hours). The most frequent symptoms at admission were vomiting (90.9%), and nausea (73.3%).

The complete laboratory results are presented in Table 2. Briefly, renal function was assessed by measuring blood urea nitrogen (BUN) ( $17.29 \pm 6.95$  mg/dL) and creatinine ( $1.08 \pm 0.58$  mg/dL), while liver function was evaluated using aspartate aminotransferase test (AST) ( $45.72 \pm 94.95$  U/L), alanine transaminase (ALT) ( $44.02 \pm 93.30$  U/L), and alkaline phosphatase (ALP) ( $210.90 \pm 97.91$  U/L).

The mean length of hospital stay was  $1.93 \pm 1.45$  days (median (IQR): 2 days; range: 1–10 days). Four patients (2.4%) died during hospitalization, and 161 patients (97.6%) recovered and were discharged

**Table 1.** Demographics, medical history, and clinical characteristics of patients with mushroom poisoning.

Variable	Group	No. (%)
Age (Year)	Mean $\pm$ SD	44.57 $\pm$ 16.02
	Median (IQR)	44 (33, 55)
	Min-Max	13-88
Ingestion time to hospital admission (Hours)	Mean $\pm$ SD	9.01 $\pm$ 10.71
	Median (IQR)	6 (4, 12)
	Min-Max	1–72
Place of residence	Urban	100 (60.6%)
	Rural	65 (39.4)
Gender	Male	84 (50.9%)
	Female	81 (49.1%)
Occupation	Housewives	71 (43.0%)
	Self-Employed	48 (29.1%)
	Farmers	15 (9.1%)
	Students	10 (6.1%)
	Retirees	9 (5.5%)
	Laborers	8 (4.8%)
	Office Employees	4 (2.4%)
History of underlying diseases	Hypertension	25 (15.2%)
	Diabetes mellitus	21 (12.7%)
	Hyperlipidemia	14 (8.5%)
	Cardiovascular disease	10 (6.1%)
	Kidney disease	3 (1.8%)
Symptoms	Vomiting	150 (90.9%)
	Nausea	121 (73.3%)
	Abdominal Pain	64 (38.8%)
	Diarrhea	59 (35.8%)
	Dizziness	22 (13.3%)
	Visual disturbances	19 (11.5%)
	Headache	13 (7.9%)
	Fever	10 (6.1%)
	Drowsiness	2 (1.2%)

**Table 2.** The complete laboratory results of patients with mushroom poisoning

Variable	Number of valid data	Mean $\pm$ SD	Median (IQR)	Min	Max	Normal Range
BUN	146	17.29 $\pm$ 6.95	16 (13, 20)	8	55	7-21 mg/dl
CR	146	1.08 $\pm$ 0.58	1 (0.9, 1.12)	0.58	5.9	0.6-1.2 mg/dl
AST	155	45.72 $\pm$ 94.95	27 (21, 23)	10	973	8-45 U/L
ALT	155	44.02 $\pm$ 93.30	25 (18, 33)	10	720	7-56 U/L
ALP	135	210.90 $\pm$ 97.91	189 (155, 235)	107	714	20-140 U/L
WBC	127	10.45 $\pm$ 4.71	10 (7, 12.6)	3.2	29.5	4-10 x 10 <sup>3</sup> /CUMM
PLT	114	227.48 $\pm$ 57.07	220 (185, 266)	114	409	140-450 x 10 <sup>3</sup> U/L
HB	135	13.97 $\pm$ 2.01	13.9 (12.8, 15.5)	8.1	18.4	12-16 g/dL
CPK	115	16.84 $\pm$ 120.63	147 (93, 198)	35	698	10-120 mcg/L
LDH	109	540.27 $\pm$ 309.74	475 (368, 619)	209	2820	230-460 U/L
PT	121	13.02 $\pm$ 2.56	12.5 (12, 13.3)	12	38	10-2-12 Second
PTT	121	31.35 $\pm$ 8.77	30 (28, 32)	25	120	30-45 Second
INR	119	1.11 $\pm$ 0.48	1 (1, 1.1)	1	6	0.8 to 1.2
Bili T	14	1.65 $\pm$ 2.15	1.05 (0.55, 1.7)	0.3	8/8	0.3-1.2 mg/dl
Bili D	13	0.68 $\pm$ 1.05	0.3 (0.2, 0.7)	0.1	4.1	<0.2 mg/dl

Blood urea nitrogen (BUN), Creatinine (CR), Aspartate aminotransferase test (AST), Alanine transaminase (ALT), Alkaline phosphatase (ALP), White blood cells (WBC), Platelet count (PLT), Hemoglobin (HB), Creatine Phosphokinase (CPK), Lactate dehydrogenase (LDH), Prothrombin time (PT), Partial thromboplastin time (PTT), International Normalized Ratio (INR), Bilirubin total (Bili T), Bilirubin direct (Bili D)

#### 4. Discussion

This 10-year retrospective analysis provides comprehensive insight into the demographic, clinical, and laboratory characteristics of wild mushroom poisoning cases in northern Iran. Our findings indicate that mushroom poisoning affects a wide age range, with a mean age of 44.6 years, and occurs almost equally among men and women. These demographic patterns are consistent with previous Iranian reports, such as those from West, North, Northeast, and Central provinces, which also showed no strong gender predominance and a concentration of cases among middle-aged adults [6,10-13]. The predominance of housewives and self-employed individuals in our study likely reflects the demographic profile of those more engaged in mushroom foraging or food preparation.

Also, the majority of patients (60.6%) resided in urban areas, which may initially seem counterintuitive given that wild mushrooms are typically foraged in rural or forested regions [14,15]. This could be possibly because many urban residents maintain close ties with rural relatives or purchase wild mushrooms in local markets without adequate species verification.

Clinical presentation in our study was dominated by gastrointestinal symptoms, particularly vomiting (90.9%) and nausea (73.3%), aligning with the early manifestations reported in amatoxin and other cytotoxic mushroom poisonings [2,16]. Similar findings have been described in retrospective analyses from Turkey, India, and Iran highlight gastrointestinal complaints as the predominant presentation [6,12,13,17-19]. The mean time from ingestion to hospital presentation in our study (9.0 hours) may have contributed to the predominance of early gastrointestinal symptoms over overt hepatic signs. Laboratory findings revealed generally preserved renal and hepatic parameters in most patients at admission, although some exhibited markedly elevated aminotransferases and LDH, indicating hepatocellular injury in a subset. The wide range of AST and ALT values, with maximum readings exceeding 900 and 700 U/L respectively, highlights the potential severity of hepatotoxicity in certain cases, similar to patterns documented in previous retrospective series [19,20]. The case-fatality rate in our study was 2.4%, comparable to that reported in other Iranian and international studies [6, 11, 13, 17, 21]. However, some reports have documented higher mortality rates [22], which may be attributed to differences in the predominant mushroom species involved, the toxin profile, delays in hospital presentation, variations in access to intensive care facilities, and differences in public awareness regarding the dangers of wild mushroom consumption. From a public health perspective, the persistent incidence of wild mushroom poisoning in northern Iran calls for targeted interventions [23]. Public awareness campaigns focusing on the dangers of foraging without expert identification, coupled with regulation of wild

mushroom sales in local markets, could reduce accidental ingestions. Furthermore, strengthening clinician training in early recognition and risk stratification, particularly for amatoxin-containing species remains critical. Strengths of this study include its large sample size, decade-long follow-up, and comprehensive assessment of both clinical and laboratory parameters. Limitations include its retrospective design, potential underreporting of mild cases not requiring hospitalization, and lack of confirmed mycological identification of ingested species, which restricts etiologic specificity. In conclusion, wild mushroom poisoning in northern Iran predominantly presents with gastrointestinal symptoms and affects a broad demographic spectrum. While most cases have favorable short-term outcomes, the risk of severe hepatotoxicity and mortality persists. These findings support the need for preventive strategies, early hospital evaluation, and cautious inpatient monitoring to mitigate delayed complications.

#### Authors' contributions

Project administration, Supervision, Conceptualization, Methodology, and Data curation: HM, MR, MA. Resources, and Investigation: SMH, MA. Writing—original draft: SMH, HM, Writing—review & editing: HM, MR, MA. All authors read and approved the final version of the manuscript.

#### Conflict of interest

No potential conflict of interest was reported by the authors.

#### Ethical declarations

The research conducted in this study adhered to the principles outlined in the Declaration of Helsinki and study design was approved by the Ethics Committee of Guilan University of Medical Sciences (approval code: IR.GUMS.REC.1402.074). Informed consent was waived by the committee due to the retrospective nature of the study; however, strict confidentiality was maintained throughout.

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