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Research Article

Evaluation of Clinical and Paraclinical Manifestations of Mushroom poisoning: A Cross-Sectional Study

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ABSTRACT

Background: Mushroom poisoning is a major health condition with a wide range of clinical and paraclinical features. This study aimed at evaluating the frequency of clinical and paraclinical manifestations of mushroom poisoning in patients referred to Shahid Rahimi Hospital in Khorramabad, Iran, over a one-year period (2018-2019).

Methods: The data collected were associated with the clinical manifestations, age, sex, seasons, type of mushrooms, patients' residence, latent phase, clinical and laboratory findings, length of hospital stay, interventions and the treatments. The underlying diseases were also recorded. After data collection, they were entered into SPSS, version 18 software and analyzed statistically.

Results: 124 patients with a mean age of 36.65 years old were recruited into the study, 73 of whom were male and 51 female. The mean duration of the hospital stay was 2.19 days. The mean time elapsed between the consumption and the symptoms development was 4.42 hours. Similarly, the duration between the consumption and referral to the hospital was 4.72 hours. Most cases occurred in the Spring (91.1%). The most common clinical signs in the poisoned subjects were nausea and vomiting (81.5%). The most therapeutic medications were Livergol (48.4%) and Atropin (33.1%), and most subjects had consumed mushrooms grown in the nature (79.8%). One person died because of the poisoning (0.8%).

Conclusion: A large majority of the patients developed nausea and vomiting, whom were treated with drugs, but one patient died. People should be aware of, warned againt, and educated about the types of mushrooms before consumption.

Keywords: Amanita Mushroom poisoning, Fungi, Diagnosis

Introduction

Some mushrooms may be nutritious foods [1], and it has been estimated that 1.5 million different species of them exist worldwide [2]. However, due to the existence of poisonous mushrooms, it's crucial to identify the type before consumption [1]. Poisonous mushrooms contain toxic substances, such as amatoxins, muscarine, coprine, orellanus, and psilocybin, that are hazardous to human health [3, 4]. They are subdivided into groups based on the clinical signs and symptoms they cause in humans at presentation. Common syndromes associated with mushroom poisoning

include damage to major internal organs, neurotoxicity, metabolic, endocrine and gastrointestinal disorders [5]. Most poisoning cases present with gastroenteritis and psycho-neurological disorders; however, the patients usually recover without serious clinical consequences [6]. The most dangerous fungal species known today are Amanita mushrooms (*A. phalloides*, *A. virosa*, and *A. verna*), which cause severe clinical symptoms or even fatal outcome [7].

Three stages have been described for Amanita poisoning: a) gastrointestinal symptoms in the first 6 to 24 hours, b) hepatic sign and symptoms appear with a 12-48 hour latency, and c) acute kidney and liver failure develop 24-72 hours later [8]. Although certain methods have been suggested to identify toxic mushrooms, there is no definitive standadrds for their identification [4]. Features such as the mushroom's shape, surface, and color of the cap, gill, stalk, and the odor might help diffrentiate safe mushrooms from the poisonous ones [9]. The prevalence of mushroom toxicity has been estimated at 7428 cases per year in the United States [10]. In Iran, a total of 50 species of poisonous mushrooms have been identified. In the Spring, sporadic cases of mushroom poisoning occur in Iran [11]. In a study at a poisoning center in Tehran, 37 cases of mushroom poisoning were reported over a 10-year period [12].

In the diagnostic process, the clinical differences for various poisoning syndromes should be distinguished [5]. Identification of the consumed mushrooms and the time elapsed between the consumption and onset of symptoms are the key to the diagnosis. Macroscopic identification of the ingested mushrooms or the leftovers, and the microscopic features of the spores in the plant are the most useful data for the diagnosis [8]. To date, such a study has not been conducted.

Aim of the study: Khorramabad city is located in Lorestan province, a mountainous area in western Iran. Due to its unique geographical nature, a high variety of herbal plants is grown in this area, thus leading to a high incidence poisoning [13]. In 2018, the second highest mushroom poisoning outbreak in Iran occurred in Lorestan province [11]. Given the high rate of mushroom poisoning reported in Lorestan province, this study aimed to evaluate the frequency of clinical and paraclinical manifestations of poisoning cases due to the consumption of mushrooms, as referred to Shahid Rahimi Hospital in Khorramabad, Iran, during a one year period (2018-2019).

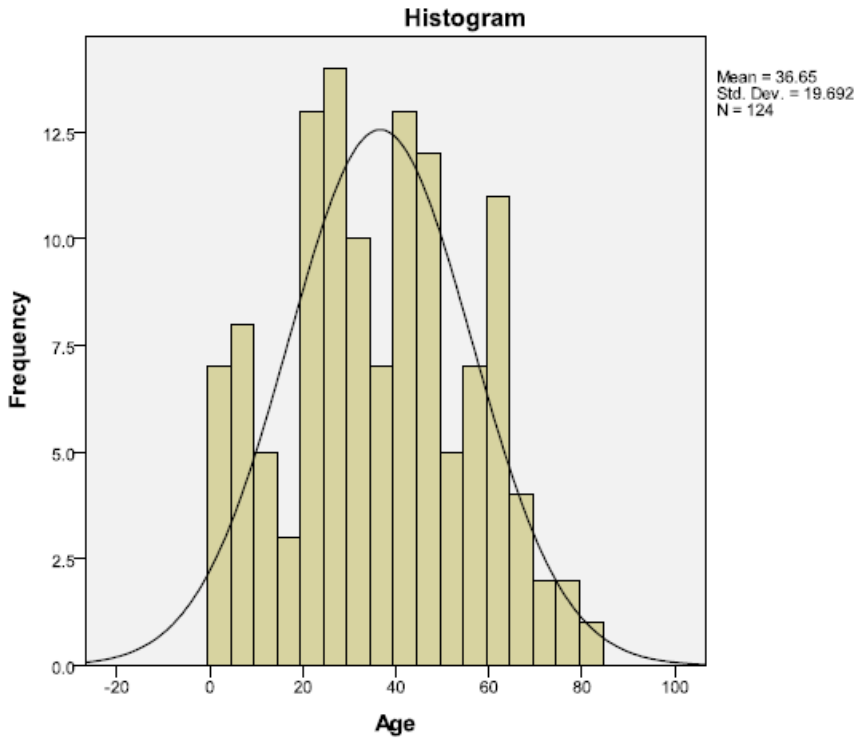

Figure 1. Histogram of the subjects' age distribution

Table 1. Characteristics of the study subjects

Category	Occupation	No. (%)
Study population	Housewife	45(36.3)
	Self-employed	34(27.4)
	Unemployed	21(16.9)
	Employees	7(5.6)
	Students	6(4.8)
	Retired	4(3.2)
	Farmers	3(2.4)
	Workers	2(1.6)
	University students	2(1.6)
	Total	124(100)
Poisoning season	Spring	113(91.1)
	Summer	6(4.8)
	Fall	2(1.6)
	Winter	3(2.4)
Treatment	Livergol	60(48.4)
	Atropine	41(33.1)
	NAC	17(13.7)
	Charcoal	4(3.2)
	FFP	1(0.8)
	Vitamin K	0(0)
	Bicarbonate	0(0)
	Platelets	0(0)
	Gastric lavage	0(0)

NAC: N-acetyl cysteine; FFP: Fresh frozen plasma

Materials and Methods

Study design and participants: This cross-sectional, descriptive study was undertaken to investigate the frequency of clinical and paraclinical manifestations due to mushroom poisoning at Shahid Rahimi Hospital in Khorramabad, Iran. The study subjects were patients who were reffered to, diagnosed and hospitalized due to mushroom poisoning. Patients with incomplete medical records and those who did not consent to participate in the study were excluded.

Data collection: The frequency of clinical manifestations of mushroom poisoning, such as gastrointestinal or neurological symptoms, and others, such as the age, sex, seasons, type of mushrooms consumed, patient's residence, latent phase, clinical and laboratory findings, length of hospital stay, therapeutic interventions, and the underlying diseases were reviewed and recorded. Initially, the responsible factors were tabulated as a checklist of full description and review of the each useful study found over a literature search.

Table 2. Mean, standard deviation, minimum and maximum of laboratory findings

Blood Parameter	Minimum	Maximum	Mean±SD
ALP	2.50	1056.00	265.04±206.43
Na	134.00	152.00	143.15±3.31
K	.80	9,90	4.07±0.86
BUN	.60	76.00	30.72±10.95
Cr	.40	3.70	0.91±0.38
AST	8.00	5023.00	142.27±601.19
ALT	4.00	4425.00	179.88±704.63
PT	11.00	60.00	14.83±7.43
PTT	23.00	233.00	36.27±25.79
INR	.80	12.50	1.54±1.87

ALP: Alkaline phosphatase; Na: Sodium; K: Potassium; BUN: Blood urea nitrogen; Cr: Creatinine;
AST: Aspartate aminotransferase; ALT: Alanine aminotransferase; PT: Prothrombin time;
PTT: Partial thromboplastin time; INR: International normalized ratio; SD: Standard deviation

Table 3. Frequency and percentage of the clinical symptoms in the study subjects

Symptom	No. (%)
Nausea, vomiting	101(81.5)
Sweating	51(41.1)
Abdominal pain	46(37.1)
Diarrhea	42(33.9)
Blurred vision	37(29.8)
Drooling	20(16.1)
Fever, shivering	19(15.3)
Dizziness	14(11.3)
Headache	13(10.5)
Weakness, lethargy	7(5.6)
Hepatitis	3(2.4)
Shortness of breath	3(2.4)
Lacrimation	3(2.4)
High blood pressure	1(0.8)
Low blood pressure	0(0.0)
Loss of appetite	1(0.8)

Table 4. The laboratory findings in the study subject

Blood Parameter	No. (%)			Normal Ranges
	Low	Normal	High	
ALP	0(0)	88(71.0)	23(18.5)	Less than 300
Na	1(0.8)	88(71.0)	30(24.2)	135-145
K	9(7.3)	106(85.5)	3(2.4)	3.5-5
BUN	3(2.4)	101(81.5)	13(10.5)	15-40
Cr	14(11.3)	95(76.6)	8(6.5)	0.6-1.3
AST	0(0)	85(68.5)	26(21.0)	AST<40
ALT	0(0)	75(60.5)	36(29.0)	ALT<40
PT	0(0)	75(60.5)	12(9.7)	11-15
PTT	0(0)	73(58.9)	12(9.7)	20-40
INR	0(0)	58(46.8)	29(23.4)	0.7-1.1

ALP: Alkaline phosphatase; Na: Sodium; K: Potassium; BUN: Blood urea nitrogen; Cr: Creatinine; AST: Aspartate aminotransferase; ALT: Alanine aminotransferase; PT: Prothrombin time; PTT: Partial thromboplastin time; INR: International normalized ratio

Table 5. Distribution of the clinical symptoms versus gender among the study subjects

Symptom	No. (%)		
	Male	Female	Total
Weakness, lethargy	4(5.5)	3(5.9)	7(5.6)
Diarrhea	22(30.1)	20(39.2)	42(33.9)
Nausea and vomiting	59(80.8)	42(82.4)	101(81.5)
Sweating	35(47.9)	16(31.4)	51(41.1)
Blurred vision	17(23.3)	20(39.2)	37(29.8)
Drooling	14(19.2)	6(11.8)	20(16.1)
Low blood pressure	0(0)	0(0)	0(0)
High blood pressure	1(1.4)	0(0)	1(0.8)
Abdominal pain	24(32.9)	22(43.1)	46(37.1)
Headache	10(13.7)	3(5.9)	13(10.5)
Dizziness	7(9.6)	7(13.7)	14(11.3)
Hepatitis	2(2.7)	1(2.0)	3(2.4)
Fever and shivering	12(16.4)	7(13.7)	19(15.3)
Loss of appetite	1(1.4)	0(0)	1(0.8)
Shortness of breath	2(2.7)	1(2.0)	3(2.4)
Lacrimation	1(1.4)	2(3.9)	3(2.4)

Iranian Journal of Toxicology
ARAK UNIVERSITY OF MEDICAL SCIENCES

Table 6. Distribution of the clinical symptoms in the patients versus their occupations

Symptom	No. (%)								
	Self-Employed	Retired	Unemployed	House-Wife	Student	Univ. Student	Worker	Employee	Farmer
Lethargy	2(5.9)	0(0)	0(0)	3(6.7)	0(0)	0(0)	0(0)	1(14.3)	1(33.3)
Diarrhea	11(32.4)	2(50)	9(42.9)	15(33.3)	3(50)	0(0)	0(0)	1(14.3)	1(33.3)
Nausea, vomiting	28(82.4)	4(100)	18(85.7)	38(84.4)	5(83.3)	0(0)	2(100)	3(42.9)	3(100)
Sweating	18(52.9)	2(50)	2(9.5)	18(40)	0(0)	2(100)	2(100)	6(85.7)	1(33.3)
Blrd. vision	8(23.5)	0(0)	5(23.8)	16(35.6)	2(33.3)	2(100)	1(50)	2(28.6)	1(33.3)
Drooling	7(20.6)	0(0)	2(9.5)	7(15.6)	0(0)	1(50)	1(50)	2(28.6)	0(0)
Low BP	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
High BP	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1(33.3)
Belly ache	10(29.4)	1(25)	10(47.6)	20(44.4)	3(50)	0(0)	0(0)	1(14.3)	1(33.3)
Headache	5(14.7)	1(25)	0(0)	4(8.9)	1(16.7)	0(0)	0(0)	0(0)	2(66.7)
Dizziness	3(8.8)	0(0)	0(0)	7(15.6)	1(16.7)	1(50)	0(0)	1(14.3)	1(33.3)
Hepatitis	1(2.9)	0(0)	1(4.8)	1(2.2)	0(0)	0(0)	0(0)	0(0)	0(0)
Fever, shiver	7(20.6)	0(0)	2(9.5)	7(15.6)	0(0)	1(50)	1(50)	1(14.3)	0(0)
LOA	0(0)	0(0)	0(0)	0(0)	1(16.7)	0(0)	0(0)	0(0)	0(0)
SOB	1(2.9)	0(0)	0(0)	1(2.2)	0(0)	0(0)	0(0)	0(0)	1(33.3)
Lacrimation	1(2.9)	0(0)	0(0)	2(4.4)	0(0)	0(0)	0(0)	0(0)	0(0)

Blrd: Blurred; BP: Blood pressure; LOA: Loss of appetite; SOB: Shortness of breath

Table 7. Distribution of clinical symptoms versus season of poisoning

Symptom	No. (%)			
	Spring	Summer	Autumn	Winter
Weakness, lethargy	5(4.4)	2(33.3)	0(0)	0(0)
Diarrhea	39(34.5)	2(33.3)	0(0)	1(33.3)
Nausea, vomiting	91(80.5)	6(100)	1(50)	3(100)
Sweating	49(43.4)	1(16.7)	1(50)	0(0)
Blrd. vision	37(32.7)	0(0)	0(0)	0(0)
Drooling	20(17.7)	0(0)	0(0)	0(0)
Low BP	0(0)	0(0)	0(0)	0(0)
High BP	1(0.9)	0(0)	0(0)	0(0)
Belly ache	39(34.5)	4(66.7)	2(100)	1(33.3)
Headache	12(10.6)	1(16.7)	0(0)	0(0)
Dizziness	14(12.4)	0(0)	0(0)	0(0)
Hepatitis	3(2.7)	0(0)	0(0)	0(0)
Fever/shivering	18(15.9)	0(0)	0(0)	1(33.3)
LOA	1(0.9)	0(0)	0(0)	0(0)
SOB	3(2.7)	0(0)	0(0)	0(0)
Lacrimation	3(2.7)	0(0)	0(0)	0(0)

Blrd.: Blurred; BP: Blood pressure; LOA: Loss of appetite; SOB: Shortness of breath

Data analyses: After collecting the relevant data and clinical information, descriptive statistical methods were used to analyze the data. A statistical software (SPSS, version 18) was utilized to analyze the data. Using descriptive methods, the frequency, percentage, mean and standard deviation, and other findings are presented in this article as one Figure and nine Tables.

Ethical considerations: The study protocol was approved by the Research Ethics Committee at Lorestan University of Medical Sciences (Code #: IR.LUMS.REC.1399.064). The data for each patient were collected from the available clinical records, such that there was no direct communication with the patients. They had signed a consent form at admission into the hospital. All patients' information were kept strictly confidential and no disclosure was made to any sources other than the attending physicians. In order to avaoid registering the patients by their names, we used a specific code to refer to each individual. The information was kept confidential and recorded in numerical codes, using SPSS software, version 18. Prior to conducting this study, necessary arrangements were made with the administration of the Lorestan University of Medical Sciences' Hospital via submitting a formal document, containing the study protocol and the aims. Subsequently, the Ethics Committee reviewed the study protocol and approved it.

Results

In this study, 124 patients with mushroom poisoning participated, 73 of whom (58.9%) were male and 51 (41.1%) were female. The patients' mean age was 36.65±19.7 years old, with the minimum being 2 and the maximum 83 years old. Figure 1 represents the study population age distribution. The mean duration of hospital stay was 2.19±1.7 days, ranging from zero to seven days. In terms of patients' occupation, the highest frequency of the study population were housewives (36.3%). Most of the poisoning cases occurred in the Spring (91.1%), and the most frequently used medica-

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Table 8. Distribution of the clinical symptoms versus underlying diseases

Symptom	No .(%)						
	Renal Disease	Liver Disease	Hematological Disease	Diabetes	Hypertension	Coronary Disease	Total
Lethargy	0(0)	0(0)	0(0)	1(14.3)	2(18.2)	3(37.5)	7(5.6)
Diarrhea	1(50)	0(0)	1(50)	2(28.6)	4(36.4)	2(25)	42(33.9)
Nausea, vomiting	2(100)	1(100)	2(100)	6(85.7)	11(100)	8(100)	101(81.5)
Sweating	1(50)	0(0)	0(0)	2(28.6)	5(45.5)	3(37.5)	51(41.1)
Blrd. vision	0(0)	0(0)	0(0)	1(14.3)	3(27.3)	2(25)	37(29.8)
Drooling	1(50)	0(0)	0(0)	0(0)	1(9.1)	0(0)	20(16.1)
Low BP	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
High BP	0(0)	0(0)	1(50)	0(0)	1(9.1)	1(12.5)	1(0.8)
Belly ache	2(100)	0(0)	0(0)	3(42.9)	6(54.5)	5(62.5)	46(37.1)
Headache	0(0)	0(0)	1(50)	0(0)	2(18.2)	3(37.5)	13(10.5)
Dizziness	0(0)	0(0)	0(0)	0(0)	2(18.2)	1(12.5)	14(11.3)
Hepatitis	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	3(2.4)
Fever/ shivers	0(0)	(0)	1(50)	0(0)	0(0)	1(12.5)	19(15.3)
LOA	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1(0.8)
SOB	1(50)	0(0)	1(50)	0(0)	1(9.1)	1(12.5)	3(2.4)
Lacrimation	0(0)	0(0)	0(0)	1(14.3)	1(9.1)	0(0)	3(2.4)

Blrd.: Blurred; BP: Blood pressure; LOA: Loss of appetite; SOB: Shortness of breath.

Table 9. Distribution of the clinical symptoms versus the outcomes

Symptom	No. (%)						
	Admission at Ward	Consented Discharge	ICU Admission	Discharge From ER	Death	Referral to Specialists	Total
Lethargy	3(4)	2(5.6)	1(11.1)	0(0)	1(100)	0(0)	7(5.6)
Diarrhea	21(28)	11(30.6)	6(66.7)	2(100)	1(100)	1(100)	42(33.9)
Nausea, vomiting	61(81.3)	28(77.8)	9(100)	1(50)	1(100)	1(100)	101(81.5)
Sweating	31(41.3)	18(50)	1(11.1)	0(0)	1(100)	0(0)	51(41.4)
Blrd vision	22(29.3)	13(36.1)	0(0)	2(100)	0(0)	0(0)	37(29.8)
Drooling	12(16)	8(22.2)	0(0)	0(0)	0(0)	0(0)	20(16.1)
Low BP	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
High BP	1(1.3)	0(0)	0(0)	0(0)	0(0)	0(0)	1(0.8)
Belly ache	26(34.7)	12(33.3)	6(66.7)	1(50)	0(0)	1(100)	46(37.1)
Headaches	8(10.7)	4(11.1)	1(11.1)	0(0)	0(0)	0(0)	13(10.5)
Dizziness	11(14.7)	3(8.3)	0(0)	0(0)	0(0)	0(0)	14(11.3)
Hepatitis	0(0)	0(0)	2(22.2)	0(0)	1(100)	0(0)	3(2.4)
Fever/shiver	13(17.3)	4(11.1)	1(11.1)	0(0)	1(100)	0(0)	19(15.3)
LOA	0(0)	0(0)	0(0)	0(0)	0(0)	1(100)	1(0.8)
SOB	3(4)	0(0)	0(0)	0(0)	0(0)	0(0)	3(2.4)
Lacrimation	(2.7)	2.8	0(0)	0(0)	0(0)	0(0)	3(2.4)

Blrd: Blurred; BP: Blood pressure; ER: Emergency room; LOA: Loss of appetite; No.: Number; SOB: Shortness of breath

tions to treat the symptoms and side effects were Liver-gol (48.4%), and Atropin (33.1%) (Table 1).

The mean and standard deviation for the duration of the mushroom consumption until being symptomatic was 4.58 hours, ranging from zero to 24 hours. The duration from the mushroom consumption to the patients being referred to the hospital was 6.05 hours (minimum,0.5, maximum 24 hours). Table 2 lists the data for the mean, standard deviation, minimum and maximum laboratory findings.

Most of the subjects had collected the mushrooms from the nature (79.8%). As seen in Table 3, the most common clinical symptoms reported by the patients were nausea and vomiting (81.5%), sweating (41.1%), and abdominal pain (37.1%). Of the total cases, 23 of them (18.5%) were examined by a second physician before being admitted to the hospital. The most frequent underlying diseases were as follows: hypertension (8.9%); coronary artery disease (6.5%); diabetes (5.6%); renal disease (1.6%); hematological disease (1.6%); and liver disease (0.8%). Considering the final outcomes, 75 patients (60.5%) were hospitalized, while 36 of them (29%) left the hospital voluntarily, 9 (7.3%) were admitted to the ICU, 2 (1.6%) were discharged from emergency room, 1 (0.8%) was referred to a specialized center, and one patient (0.8%) died. Table 4 presents the distribution of the laboratory findings for the subjects.

Table 5 provides information on the distribution of the subjects' clinical signs based on gender.

Table 6 lists the data on the distribution of clinical signs based on the patients' occupation.

Table 7 presents information on the clinical signs for each patient based on the season.

Table 8 shows the information on the clinical signs based on the patients' underlying diseases.

Finally, Table 9 presents the patients' signs based on the clinical outcomes.

Discussion

This study evaluated the clinical and paraclinical manifestations observed in patients with mushroom poisoning in Khorramabad, Lorestan province, Iran. In Iran, a total number of 50 species of poisonous mushrooms have been identified and Amanita is the most dangerous species identified in the country [14]. In the 2018 mushroom poisoning outbreak in Iran, the following species were involved: Lepiota brunneioncarnata, Hypholoma fasciculare, and Coprinopsis atramentaria [11]. In a previous study in Lorestan province, muscarin toxin was reported as the most common cause of mushroom poisoning [13].

Demographic characteristics: Regarding the demographic characteristics of patients, most of our subjects were male. Consistent with our findings, Chen et al. [15] and Pajoumand et al [12] also observed a higher incidence of poisoning in men. The mean age of our patients was 36.65, consistent with 35 year old as reported by Erenler et al. [17]. The mean length of hospital stay in our study was 2.19 days. However, in another study by Keller et al. [18], 78.4% of cases stayed in the ER for less than 24 hours, similar to 1.89 days that was observed by Khatir et al. [19].

Our findings showed that 79.8% of the cases had consumed self-picked poisonous mushrooms, which is similar to 83% of the patients, that was found by Jiang et al. [20]. Further, we found the mean time elapsed between the mushroom consumption and the onset of symptoms was 4.58 hours. Also, the interval between the mushroom consumption and the admission to the hospital was 6.05 hours. Our findings were similar to those reported by two earlier studies [18, 20] who observed that in 68.6% and 62% of the subjects, respectively, the clinical symptoms began within the first 6 hours of the mushroom ingestion. Also, with respect to the season of the year when the poisoning happened, we found that 91.1% of them occurred in the Spring. Similarly, Varshouchi et al. reported that 68% of poisoning cases occurred in the Spring [21]. However, Gold et al. [22] have reported that a greater number of similar poisoning (36.8%) happened in the Summer while only 22.5% of them occurred in the Spring.

Clinical and paraclinical findings: In our study, the most frequently reported clinical symptoms by the patients were nausea and vomiting, followed by sweating, abdominal pain, and diarrhea. Nausea and vomiting was the most common symptom in both male and female, and in patients with various underlying diseases. However, in retired patients and employees, and in those who were admitted in the Fall, sweating and abdominal pain were the most frequently reported symptoms. Similarly in 2016, Chan et al. reported 67 mushroom poisoning cases in Hong Kong, 90% of whom presented with gastrointestinal symptoms [16]. In these patients, all of the laboratory tests were within normal ranges. Evidently, the identification of the type of mushrooms consumed and the knowledge of clinical variations among poisoning syndromes remain the major diagnostic challenge to date [5, 8]. However, a significantly higher neutrophil-to-lymphocyte ratio and lower platelet count have been observed in patients with mushroom poisoning [23]. In our study population, impaired liver function test was the most common paraclinical finding. Similar observations have also been reported in two previous studies performed in Iran [14, 24].

Therapeutic interventions: Currently, there is no definitive and preferred treatment for the human cases with mushroom poisoning. Although there are controversies over the use of activated charcoal, this approach has been recommended by many earlier studies. Supportive treatments, such as correction of electrolyte abnormalities and dehydration should also be considered [25]. Ordinarily, drugs and antidotes are used in some poisoning cases. In case of a neurological sign, such as seizure, benzodiazepines and pyridoxine may be prescribed. Also, atropine is beneficial to counter the cholinergic presentations. In cases of Amanita toxicity, patients may benefit from Silibinin, N-acetylcysteine, or even liver transplant if a fulminant hepatic failure has occurred [18].

In our study, the most common therapeutic interventions were Livergol (containing *Silybum marianum*), atropine, and N-acetylcysteine. In Keller et al.'s study, 56.9% of the cases received activated charcoal, and the other 24% were treated with N-acetylcysteine [18]. The overall mortality rate of mushroom poisoning cases is fairly low at 2.17% [6], although, a wide range of mortality has been reported in the reviewed literature. In our study, this rate was very low, at 0.8% of the mushroom poisoning cases. Chen et al. reported only two deaths among the 429 patients they treated with mushroom poisoning in China [15]. Conversely, De Olano et al. have reported a higher rate of mortality at 8.8% among their poisoning cases that ingested cyclopeptide mushrooms in the United States [26].

Conclusions

In this study, a large majority of the patients developed gastrointestinal (GI) symptoms, such as nausea and vomiting, whom were managed clinically with medications; however, there was one fatal case. In addition to the GI symptoms, our subjects complained of sweating and abdominal pain. Among them, the most frequent underlying diseases were hypertension, coronary artery disease, diabetes, and renal, hematological or liver diseases. Health authorities are highly advised to educate the public on poisoning due to mushroom ingestion. Such efforts will positively lead to reductions the number of poisoning cases, especially in the Spring and Summer. It will also shorten the patients' hospital stay, and ultimately reduce the subsequent mortality.

Limitations of the study: We had the following limitations in this study: a) the medical records of some patients were incomplete, which led to their exclusion from the study; b) the types of consumed mushrooms had not been recorded in all patients record.

Ethical Considerations

Compliance with ethical guidelines

This study was approved by the Research Ethics Committee at Lorestan University of Medical Sciences (Ethics code: IR.LUMS.REC.1399.064).

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Authors' contributions

Conceptualization and Supervision: Dr. GA Mahmoudi; Methodology: Dr. GA Mahmoudi; Investigation, Writing – original draft, and Writing – review & editing: All authors; Data collection: Dr. MH Bazrafkan; Data analysis: Dr.S Zare; Funding acquisition and Resources: Dr. GA Mahmoudi

Conflict of interest

The authors declare no conflict of interest with any entities to disclose.

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