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Original paper

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Alcohol consumption epidemic and its complications during the COVID-19 pandemic in Khuzestan Province, Iran; 2020

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Abstract

Background: After unprecedented demand for ethanol in the pandemic, profiteers used methanol for making illegal alcoholic drink. **Methods**: This cross-sectional descriptive-analytical study investigated the effects of methanol poisoning on 400 patients who referred to hospitals affiliated with Ahvaz Jundishapur University of Medical Sciences from March 20 to September 20, 2020. **Results**: Ninety-eight-point five percent of patients had consumed alcohol for social reasons and only 0.3% had used it as a measure to avoid COVID-19. Eighty-seven percent of the patients used homemade alcohol bought from peddlers. The most common clinical symptom was gastrointestinal disorders (64.8%) and the most common complications were vision problems (12.3%). Ten-point-six percent (42 patients) of the patients died. The most important factors affecting mortality risk were dyspnea, neuropathic problems, abnormal radiological findings, dialysis, abnormal blood pressure, vision problems and dizziness. **Conclusions**: Informing the public about the risks of using homemade alcoholic beverages is essential if the associated disability and mortality has to be avoided.

Key words: Crisis, Alcohol, Methanol, COVID-19

Background

Due to religious restrictions, production, distribution, selling and consumption of alcohol is illegal in Iran. However, alcohol is made available through underground channels [1]. Alcoholic beverages such as whiskey, vodka, beer, wine, etc. sold in black markets may contain methanol, because they are made under poor conditions. For this reason, the most common cause of methanol poisoning in Iran is through using drinks contaminated with this alcohol. The same is true of industrial and medical alcohols. A 2018 report on Iranians over the age of 18 found that 4.9% of people drank alcohol in a year, and 8.8% consumed alcoholic drinks at least once in their lifetime [2].

Methanol (CH_3OH) is the simplest type of alcohol with colorless properties, specific odor and high volatility. It is not only highly toxic, but also has the least antiseptic properties among other alcohol types. Byproducts of its metabolites, formic acid and formaldehyde, can cause complications such as dermatitis, visual disorders (such as blindness), kidney failure, coma and death [3]. Methanol enters body through the mouth or inhalation or is absorbed through the skin. It is dangerous to be exposed to it continuously without using protective equipment (mask and gloves) [4]. The half-life of methanol absorption is short; five minutes after consumption, it is absorbed through the gastrointestinal tract. It reaches the maximum serum level after 30-60 minutes, and dissolves well in the body. Discharge rate of methanol through the liver and kidneys is 15-20 mg/dl/h in alcoholics and 30 mg/dl/h among non-alcoholics. In 2018, Aghababaeian reported that between September 7 and October 7, 768 individuals in Iran were poisoned through using alcohol that contains methanol, of which 10.1% died [1]. Moghadam's study on the prevalence of methanol poisoning from May 29 to June 3, 2013 reported that 6 out of 694 poisoned people died [5]. In another outbreak in Shiraz in 2004, 64 poisoning cases were identified, 11 of whom died [6]. Methanol poisoning is reported from other regions in the world, including Sudan [7], the Czech Republic [8], and Norway [9].

After the COVID-19 pandemic, the World Health Organization (WHO) recommended preventive measures including washing hands with soap and water or standard disinfectant solutions, especially ethanol-based products [10]. Due to the increased demand for 70% ethanol in the pandemic, there was an unprecedented shortage of ethanol. This led to using methanol (instead of ethanol) in the production of underground alcoholic beverages [11]. Meanwhile, with the spread of fake news about the preventive effect of alcohol intake against the virus, the consumption of alcoholic beverages boomed [11]. 383 cases of methanol poisoning were reported in Fars Province, while the total number of cases of COVID-19 in the province was 386 [12]. Due to the availability of more fake toxic drinks containing hand-made methanol during the pandemic, Iran witnessed poisoning and death of a large number of alcohol users. By definition, more than three cases of methanol poisoning in an area within 24 hours is considered an outbreak. Early diagnosis, treatment, and screening are significant measures for reducing death, blindness, and other physical and mental disabilities. Due to strict laws, few studies are conducted in this field in Iran. To help prevent the risks, minimize the damage and increase public awareness for a better response in Iran and similar countries, we tried to examine the cases seen in our region since the recent outbreak. Therefore, this study sought to determine the condition and causes and complications of alcohol consumption in the COVID-19 pandemic in Khuzestan province, Iran (2020).

Methods

This cross-sectional descriptive-analytical study was performed on 400 patients with alcohol poisoning in Khuzestan Province. Khuzestan Province is located in southwestern Iran, at the geographical coordinates 31.33°N and 48.69°E. The area of Khuzestan province is 64055 km^2. With a population of 4711000 people, it is considered as the fifth populated province in Iran.

Population of the study included all patients with alcohol poisoning who referred to the hospitals affiliated with Ahvaz Jundishapur University of Medical Sciences from March to the end of September, 2020. The researchers obtained approval for the research proposal and received permission from the Vice-Chancellor's Office for Research, Ahvaz Jundishapur University of Medical Sciences. Then, we

referred to clinical poisoning hospitals in public and private sectors in Khuzestan Province and included all patients with alcohol poisoning during the six-month period by census. The research used a standard questionnaire prepared by the Ministry of Health to collect data on patients with alcohol poisoning. The questionnaire included:

- Demographic information
- History of previous disease(s)
- History of alcohol use
- History of hospitalization due to alcohol poisoning
- Type of beverage: alcohol, bleaches and chlorinated compounds, other disinfectant compounds, caustic beverage, unknown beverage prepared from perfumeries, and vitamin D
- Exposure type: oral, inhaled, dermal, other
- Cause of exposure: accidental, with the intention of disinfecting the body to counteract COVID-19, social reasons
- Purchased from: supermarket, pharmacy, perfumeries, perfumery equipment stores, sanitary equipment stores
- Final status: uncomplicated recovery, recovery with vision problem, recovery with neurological problem, recovery with lung problem, recovery with gastrointestinal complication, voluntary discharge and death
- Daily alcohol intake
- Laboratory findings in patients
- Dialysis and treatments performed in patients with alcohol poisoning.

After collecting the checklists, we coded and entered the data into SPSS (version 20). Descriptive statistics tests included mean, standard deviation, frequency and analysis. The univariate logistic regression model (odds ratio and 95% confidence interval) was used to identify risk factors related to mortality. Significance level was considered less than 0.05.

Results

The results of the present study showed that the mean age of patients was 28.5 ±8.4 years with an age range of 10 to 72 years. Ninety-two-point-five percent were male and 7.5% were female. Fifty-one-point-five percent had a diploma degree, 44.8% were under diploma and only 4% had education higher than diploma. Majority of the patients were single (70.5%), employed (60.5%) and 79.0% were living in the city. A hundred percent of patients consumed alcohol orally. Ninety-eight-point-five percent consumed alcohol for social reasons and 1.3% had inadvertently consumed alcohol. Only 0.3% (1 person) drank alcohol to avoid COVID-19 infection. Eighty-seven percent of the patients used homemade alcohol purchased from peddlers. In terms of clinical symptoms, 5.5% had chest pain, 14.0% had shortness of breath and 64.8% had gastrointestinal symptoms. Complications of the disease included: 12.3% experienced visual problems, while 1.5% had neurological problems (lower limb weakness). Ten-point-five percent (42 patients) died (Table 1). The mean time of alcohol consumption before hospitalization was 37.65 ±18.64 hours and the average consumption was 389.95±364.88 cc. The mean level of consciousness of patients was 13.62 ±3.65 (Table 2). Other details of the epidemiological and clinical characteristics of the patients are presented in tables 1 and 2.

In terms of factors affecting the mortality risk of patients, this study found that the death risk was 53 times higher in patients with symptoms of dyspnea. There was a significant relationship between vision problems and mortality risk. Patients with vision problems were seven times more likely to die. There was a significant relationship between the clinical sign of confusion and mortality risk, the chance of death was three times higher. Similarly, death risk was 22 times higher in patients with abnormal radiological findings. Individuals who underwent dialysis were 14 times more likely to die than those who did not. Patients with abnormal blood pressure had an 11-fold higher risk of death than other patients with normal blood pressure. There was a significant relationship between having neuropathic problems and death risk. The chance of death increased up to 48 times in these patients. There was a significant direct association between age, time before referral to hospital, alcohol consumed, pulse rate, creatine and blood urea ($P < 0.05$) (Table 3). The results also confirmed that the higher the consciousness level, number of breaths, percentage of blood oxygen and blood bicarbonate, the lower the probability of death ($P < 0.05$) (Table 3). Figure 1 shows a sample of alcohol consumed sent to the Food and Drug Laboratory of

Ahvaz Jundishapur University of Medical Sciences. Synthesis of the alcohol sample shows that the concentration of methanol in the sample was 132.20 mg/100.

Table 1. Distribution of Subjects According to Demographic and Clinical Characteristics in Ahvaz

Variable	Class	N	%
The final outcome	live	358	89.5
	death	42	10.5
Gender	male	370	92.5
	female	30	7.5
Education level	secondary school and lower	179	44.8
	high school	205	51.3
	academic degree	16	4.0
Marital status	married	118	29.5
	single	282	70.5
Region	urban	316	79.0
	rural	84	21.0
Employment status	employed	278	69.5
	unemployed	122	30.5
Type of material used	alcohol	400	100.0
	bleaches and chlorinated compounds	0	0.0
	unknown substances prepared from perfumeries	0	0.0
Type of exposure	oral	400	100.0
	inhalation	0	0.0
	skin	0	0.0
Cause of consumption	suddenly	5	1.3
	for disinfection	1	0.3
	social reasons	394	98.5
Place of purchase	supermarket	29	7.3
	drug store	3	0.8
	sanitary ware shop	20	5.0
	vendors	348	87.1
Type of alcohol consumed	industrial alcohol	32	8.0
	handmade alcohol	259	64.8
	apparently ethanol	109	27.3
Liquor glass lid	open	311	77.8
	closed	89	22.3
Chest pain	no	378	94.5
	yes	22	5.5
Dyspnea	no	344	86.0
	yes	56	14.0
Type of dyspnea	intubated	32	8.0
	non-intubated	24	6.0

Variable	Class	N	%
Confusion	no	352	88.0
	yes	48	12.0
Headache	no	310	77.5
	yes	90	22.5
Blood pressure	normal	371	92.8
	abnormal	29	7.3
Gastrointestinal symptoms	no	141	35.3
	yes	259	64.8
Type of gastrointestinal symptoms	abdominal pain	95	23.8
	nausea	73	18.3
	vomiting	87	21.8
	gastrointestinal bleeding	1	0.3
	pain &vomiting	3	0.8
Ocular symptoms	no	49	12.3
	yes	351	87.8
Neuropathy	no	394	98.5
	yes	6	1.5
Lung CT scan findings	normal	369	92.3
	abnormal	31	7.8
Abnormal radiological findings	no	385	96.3
	yes	15	3.8
Perform dialysis	no	261	65.3
	yes	139	34.8
The final outcome	live	358	89.5
	death	42	10.5

Table 2. Mean Distribution of Clinical and Demographic Variables

Variable	Mean	SD	Min.	Max.
Age	28.47	8.36	10.00	72.00
Alcohol use history (years)	3.94	3.99	1.00	23.00
Approximate time of alcohol use before hospitalization (hours)	37.65	18.64	4.00	144.00
Amount of alcohol use (cc)	389.95	364.88	30.00	4000.00
Glasgow coma scale (GCS)	13.63	3.65	3.00	15.00
Pulse	98.74	16.50	60.00	150.00
Respiratory rate (RR)	21.87	2.55	12.00	28.00
Percentage of blood oxygen saturation	93.30	6.20	40.00	99.00
creatinine (mg/dL)	1.04	0.65	0.10	8.00
blood urea nitrogen (mg/dL)	18.35	17.42	1.60	290.00
PH	7.17	0.15	6.50	7.50
PCO_2	29.44	9.19	11.00	70.00
Bicarbonate	12.76	4.47	1.00	28.00

Table 3. Unadjusted Odds Ratio (95% CI) for risk factors associated with Mortality risk

Risk factor	Class	Live	Death	OR	95% CI	P-Value
Gender	male	89.7	10.3	1.34	0.44-4.06	0.600
	female	86.7	13.3			
Education level	secondary school and lower	91.1	8.9	1.29	0.74-2.25	0.371
	high school	88.3	11.7			
	academic degree	87.5	12.5			
Marital status	married	85.6	14.4	1.73	0.90-3.340	0.102
	single	91.1	8.9			
Region	urban	92.1	7.9	2.95	1.51-5.78	0.002
	rural	79.8	20.2			
Employment status	employed	89.9	10.1	1.16	0.59-2.28	0.674
	unemployed	88.5	11.5			
Cause of consumption	suddenly	60.0	40.0	5.92	0.96-36.47	0.055
	social reasons	89.9	10.1			
Place of purchase	supermarket	75.9	24.1	3.50	1.38-8.88	0.008
	drug store	100.0	0.0	0.0	0-0	>0.999
	sanitary ware shop	70.0	30.0	4.71	1.68-13.19	0.003
	vendors	91.7	8.3	-	-	-
Type of alcohol consumed	industrial alcohol	62.5	37.5	10.30	3.46-30.66	<0.001
	handmade alcohol	90.7	9.3	1.75	0.70-4.42	0.234
	apparently ethanol	94.5	5.5	-	-	-
Liquor glass lid	open	90.7	9.3	0.60	0.30-1.21	0.155
	closed	85.4	14.6			
Chest pain	no	89.7	10.3	1.37	0.40-4.85	0.623
	yes	86.4	13.6			
Dyspnea	no	97.4	2.6	53.41	22.84-124.89	<0.001
	yes	41.1	58.9			
Confusion	no	91.2	8.8	3.08	1.43-6.63	0.004
	yes	77.1	22.9			
Headache	no	87.1	12.9	0.15	0.04-0.65	0.011
	yes	97.8	2.2			
Blood pressure	normal	92.5	7.5	11.43	5.02-26.06	<0.001
	abnormal	51.7	48.3			
Gastrointestinal symptoms	no	88.7	11.3	0.87	0.45-1.69	0.683
	yes	90.0	10.0			
Ocular symptoms	no	92.9	7.1	6.93	3.39-14.16	<0.001
	yes	65.3	34.7			
Neuropathy	no	90.6	9.4	48.24	5.49-424.03	<0.001
	yes	16.7	83.3			
Lung CT scan findings	normal	89.4	10.6	0.91	0.26-3.12	0.876
	abnormal	90.3	9.7			
Abnormal radiological findings	no	91.7	8.3	22.06	7.11-68.49	<0.001
	yes	33.3	66.7			
Perform dialysis	no	97.7	2.3	14.85	6.08-36.32	<0.001
	yes	74.1	25.9			
Age	-	-	-	1.04	1.01-1.08	0.014
Approximate time of alcohol consumption before hospitalization (hours)	-	-	-	1.02	1.01-1.04	0.005
Amount of alcohol consumption (cc)	-	-	-	1.001	1.000-1.001	0.022
GCS	-	-	-	0.48	0.39-0.58	<0.001
Percentage of blood oxygen saturation	-	-	-	0.87	0.82-0.92	<0.001

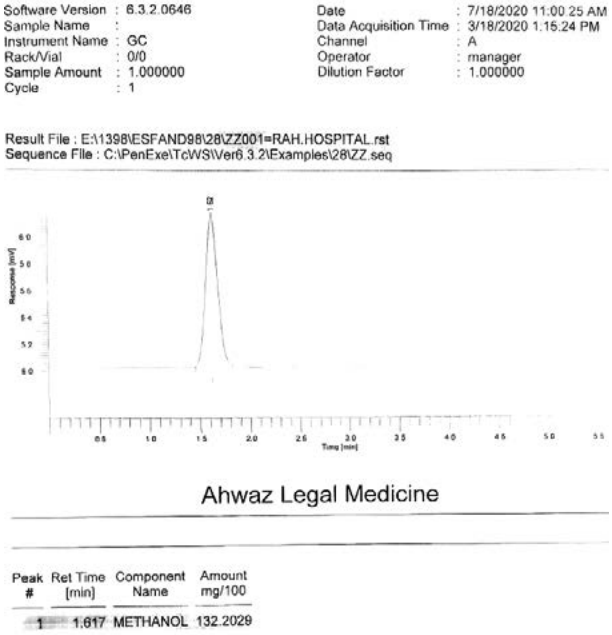

Figure 1. Synthesis of alcohol sample

Discussion

Nearly a year after the COVID-19 outbreak in Iran, health workers and the public are still grappling with the crisis, and side effects such as methanol poisoning have added to the problems of fighting the disease. The poisoning of more than 5,000 people and the death of more than 500 people from February to April 2020 in 26 of the 31 provinces became the largest outbreak of methanol poisoning in recent decades throughout Iran and the world [12]. In the present study, the mean age of patients was 28.5±8.4 years and the majority were men. More than half had high school diploma, were single and lived in urban areas. Ninety-eight-point five percent stated that they had consumed alcohol for social reasons. Only one individual reported using alcohol to prevent COVID-19 infection. Eighty-point-zero percent bought handmade alcohol from. Gastrointestinal symptoms, dyspnea and chest pain were the most common symptoms, respectively. Complications of the disease included vision and neurological problems (weakness of the lower limbs). Eventually, 10.5% of the patients died. Methanol poisoning was not confined to Khuzestan Province. According to Soltaninejad's study, a week after the first official case of COVID-19 (February 26, 2020), cases were reported in other parts of the country claiming to have consumed alcohol to prevent infection. As of March 28, 2020, the number of individuals poisoned after oral consumption of homemade alcohol reached 2,200 throughout the country, of which 37.5% were hospitalized in the intensive care unit and 13.5% died. The majority were men aged 20-30 years old. However, even a 5-year-old child was observed among patients [13]. Previously, in another study by Eghbali et al., in Tehran, over a one-year period (October 2010 to October 2011), 28 methanol poisoning patients with varying decreased level of consciousness were hospitalized. The majority were men (82.1%) with a mean age of 30 years as the present study. Their clinical symptoms included metabolic acidosis (67.9%), dizziness (17.9%), headache (7.1), and 46.6% of patients developed visual impairment which led to blindness in 14.3% of patients. More than half of the poisoned (53.6%) recovered completely. About 18% lost their lives [14]. During the pandemic, in another study at Loghman Hakim Hospital in Tehran, Simani et al. obtained brain CT scans of 40 patients poisoned with methanol whose level of consciousness did not change after treatment. The results showed that unilateral or bilateral cerebral necrosis was significantly more common in subsequent deaths (22 patients) than in survivors. Intracerebral hemorrhage and cerebral edema were other common findings among deceased individuals [15]. Similarly, in Malaysia, following the methanol poisoning outbreak in September 2018, 31 cases were reported during nine days, of which 61.3% died. Out of 12 survivors, two patients developed visual neuropathy and one had uveitis [16]. In another study in Malaysia, in the Hulu Langat area, on September 16, 2018, 12 cases of alcohol poisoning with common symptoms of vomiting (75%) and abdominal pain (41.7%) were reported, and six (50%) died of severe metabolic acidosis [17]. In the Czech Republic (2012), the prevalence of methanol poisoning affected 50 individuals with a mean age of 48 years, which resulted in prolonged vision complications in 40% of patients, 8% of patients losing their sight [18]. In southern Nigeria, of 55 individuals poisoned by methanol in May 2015, 83.3% died, of which 41.8% had primary edu-

cation [19]. In the present study, more than half the patients had no higher education. One of the reasons for the side-effects of alcohol use is the lack of knowledge and understanding of individuals about the types of alcohol and their applications. Therefore, these complications are more common in individuals with low levels of education.

Drinking alcoholic beverages is illegal in Iran; patients do not refer to the hospital in time to avoid being arrested [1, 2, 20]. In addition, most hospitals do not have the appropriate laboratory equipment to determine the concentration of alcohol in the blood, antidotes, and drugs required for treating such patients [21]. Late treatment of complications such as visual impairment makes recovery less likely. In addition, if the disease enters the phase of increased level of consciousness during seizures, the likelihood of mortality rises with more time gap [1].

Some reasons for the increase in methanol poisoning during the COVID-19 were probably the use of methanol in non-standard alcoholic beverages due to ethanol shortage, being cheaper, staying home and having less physical activities after sports centers were closed; using alcohol in their leisure time [11, 22, 23].

Conclusions

The prevalence of methanol poisoning during the COVID-19 pandemic in Khuzestan Province, which resulted in 10.5% deaths, is highly significant. Due to the high mortality rate in such outbreaks, timely diagnosis and increasing awareness through the mass media have a very important role in reducing mortality and disability. All physicians working in emergencies are recommended to take courses for diagnosis and treatment of such poisoning to be able to manage it properly. Countries with legal restrictions on production and consumption of alcohol need to increase public awareness about the possibility of fake beverages, poisoning and even death due to excessive consumption of alcohol of any kind at any time.

List of abbreviations

GCS: *Glasgow Coma Scale*
RR: Respiratory rate
COVID-19: Corona virus disease 2019
SPSS: Statistical Package for Social Sciences
WHO: World Health Organization

Declarations

Ethics approval and consent to participate

Ethics license of the present study was acquired from the Ethics Committee of Ahvaz Jundishapur University of Medical Sciences (Code of Ethics: IR.AJUMS.REC.1399.662). Written informed consent was received on voluntary participation in the study and the patients were assured that their information would remain confidential.

Consent for publication

Not applicable.

Availability of data and materials

Data sharing: Participant level data are available from the corresponding author.

Competing interests

Not applicable.

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Authors' contributions

FJ, AHR and NM conceived and designed the project. NM acquired the data. MD analyzed and interpreted the data. FJ, MD and NK wrote the paper. All authors approved the final text.

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