

Research Paper: Epidemiology of Acute Poisoning in Mazandaran Province, Iran



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ABSTRACT

Background: Poisoning is a critical medical emergency worldwide. The present study aimed to determine the characteristics and treatment outcomes of patients admitted to the poisoning department.

Methods: This cross-sectional descriptive study was conducted from March 2015 to September 2016 (for 18 months). We explored the epidemiology of poisoned patients hospitalized at Razi and Imam hospitals in Mazandaran Province, Iran. The obtained results were described as the frequency of poisoning, percentages, confidence intervals (95% CI), and mean values. The standard deviation scores were also presented for quantitative variables. The Student t-test and Chi-squared test were used for data analysis.

Results: The prevalence rate of poisoning equaled 4.98% of the total hospitalized patients. Of 71192 of the investigated cases, 3544 patients were hospitalized for acute poisoning. In terms of poisoning type, 65.2% belonged to drug toxicity, (95% CI) (64.7-77.2); 6.7% were related to methadone; 5.7% to an agricultural pesticide; 4.15% to aluminum phosphide (rice tablets); 2.2% to rat poison paste, and the remaining cases were caused by other poisons. There was a gender-wise significant difference in the poisoning method ($P < 0.001$). The mortality rate in this study was calculated as 1.71% of all cases. The most frequent causes of death were aluminum phosphide (33.33%) and narcotics (16.16%) poisonings.

Conclusion: Acute poisoning is a fundamental health problem in Mazandaran Province, i.e., located in the north of Iran. Pharmaceutical medications, opioid agents, and aluminum phosphide were the main means of poisoning in the investigated adult patients. Most cases of poisoning occurred in the young-adult groups. Aluminum phosphide and organophosphate agents consumption generated the most critical states and were the main causes of death. It is suggested that aluminum phosphate be recalled from the market, as appropriate training must be provided for its proper use.

Keywords:

Lead poisoning, Epidemiology, Risk factors, Emergency service, Hospital

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1. Introduction

Poisoning is a condition where a person is exposed to drugs or any other substance that requires emergency care due to the severity of illness. Poisoning has been defined as any case of exposure to drugs or any environmental substance resulting in an emergency ward visit [1]. Poison consists of any substance that can cause illness in the human body through chemical changes [2]. Poisoning is typically a medical crisis. It remains an intense general medical issue worldwide, as it is hazardous for individuals' wellbeing [3-5]. Acute poisoning is increasing due to the growth and development of pharmaceuticals, the growth of agricultural products, and the development of industrial technology [3, 6]. The pattern of poisoning may vary based on socioeconomic, cultural, technological, and agricultural conditions [7-9].

Poisoning occurs either intentionally or unintentionally [10-12]. In developed countries, the annual prevalence rate of poisoning is reported to range between 0.2 and 9.3 per 1000 individuals, i.e., increasing in various countries [1]. In the United States, the cases of deaths from poisoning have increased to 10.3 per 100000 general population from 1985 to 2004 [4].

Poisoning is the third cause of death in some developing countries; it is the fifth cause of hospital visits [13]. Poisoning is also the most frequent cause of hospitalization. Additionally, drug poisoning is described as the second leading cause of death in hospitalized patients. In general, there is a high prevalence of drug poisoning in various provinces of Iran [3, 14, 15]. A study has reported that teenagers account for 22% of poisonings in emergency departments in hospitals in Iran. Besides, >60% of the intentional poisoning cases are lost [16]. Studies have indicated that the prevalence of poisoning in children and youth is higher than in other age groups. The mortality rate is approximately 8 and 109 out of 1000 hospitalized patients in emergency departments and the intensive-care unit, respectively [12, 17].

Multiple causes increase poisoning risks in developing countries, including inadequate awareness, inappropriate monitoring, easy access to various chemical substances and medications, and geographic features [2, 18]. High humidity and agricultural areas; as well as consuming chemicals, insecticides, and pesticides enhance the risks of poisoning [18]. Mazandaran Province is located in the north of Iran near the Caspian Sea with more than 3 million population and millions of tourists visit this prov-

ince each year. The knowledge about poisoning could help improve controlling and taking prevention methods in this province. The current study aimed to determine the epidemiological characteristics of poisoning and its consequences in Mazandaran Province, Iran.

2. Materials and Methods

This descriptive cross-sectional study has focused on Mazandaran Province, Iran. This province occupies about 23756 square kilometers of Iran. It has an estimated population of three million individuals. Razi Hospital in Qaemshahr City and Imam Khomeini Hospital in Sari City are the referral centers for poisoning in Mazandaran Province. All infected patients are examined and evaluated in these two hospitals. The required data were collected and analyzed from March 2015 to September 2016, over 18 months. We have included all cases of clinically-diagnosed acute poisoning admitted to the emergency wards, as the referral toxicology hospitals in Mazandaran Province. The cases were hospitalized for >24 hours.

The study samples were selected using a simple random sampling method. The required data were collected from patients' medical records. The patient characteristics data included age, gender, marital status, occupational status, poisoning hospitalization, consumed agent, the time of admission, season, intervention type, morbidity, mortality, and the therapeutic outcomes. These data were extracted from patients' records using a data collection form. Descriptive statistics were used to describe the research results. The frequency and percentage of qualitative variables, as well as confidence intervals (95% CI), mean, and standard deviation values were reported, subsequently. Chi-squared test and Student t-test were used to analyze the research findings in SPSS. $P < 0.05$ was considered as the significance level.

3. Results

In total, 446811 patients were admitted to the investigated hospitals in 18 months from March 2015 to September 2016. Moreover, 71192 patients were admitted to different departments for at least one day. This is while 3544 (4.98%) patients were hospitalized due to acute poisoning at poisoning wards. In other words, poisoning cases included 4.98% of the total hospitalized patients. In terms of poisoning type, 65.2% belonged to drug toxicity, (95% CI) (64.7-77.2); 6.7% were related to methadone; 5.7% to an agricultural pesticide; 4.15% to aluminum phosphide (rice tablets); 2.2% to rat poison

Table 1. Distribution of the different poisoning types admitted to the referral hospitals in Mazandaran in 2015-2016

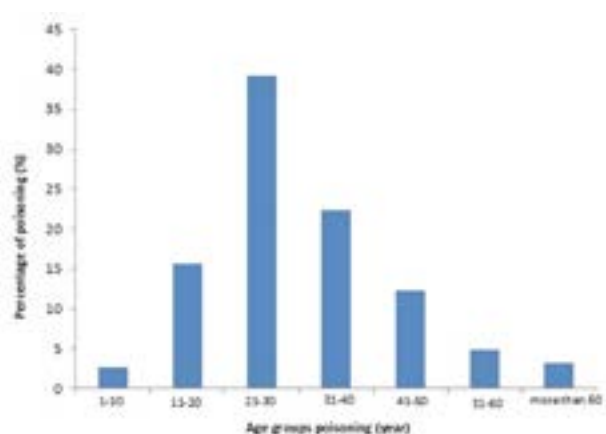
Type of Poison	Razi Hospital	Imam Hospital	Total
	No (%)	No (%)	No (%)
Drug	1401 (61.85)	910 (71.26)	2311 (65.25)
Agricultural pesticide	146 (6.45)	56 (4.39)	202 (30.32)
Pesticides	191 (8.43)	57 (4.46)	248 (7)
Methadone	201 (8.87)	35 (2.74)	236 (6.66)
Opium	76 (3.36)	28 (2.19)	104 (2.94)
Alcohol	57 (2.52)	24 (1.88)	81 (2.29)
Detergents	25 (1.10)	21 (1.64)	46 (1.30)
Food poisoning (bacterial)	11 (0.49)	14 (1.10)	25 (0.71)
Herbals	12 (0.53)	5 (0.39)	17 (0.48)
Petroleum, oil	9 (0.40)	7 (0.55)	16 (0.45)
Other poisons	136 (6.00)	120 (9.40)	256 (7.23)
Total	2265 (100)	1277 (100)	3542 (100)

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paste, and the remaining cases concerning other poisons, such alcohol, detergents, opium, and so on (Table 1).

In this study, 350 poisoned cases were selected by simple random sampling method. Accordingly, we conducted epidemiological assessments on them. The Mean±SD age of patients was 29.6±12.9 years; (95% CI) (28.3-31). The study subjects' age ranged from 1 to 81 years. One hundred forty six (41.7%) patients were poisoned deliberately (intentional poisoning), (95% CI) (36.5%-46.9%) and unintentional poisoning included 204 (58.3%) cases (95% CI) (53.1%-63.5%), followed

by accidents. The most severely-poisoned cases were 159 (45.4%) patients from Qaemshahr and Savadkooch cities; 137 (39.46%) cases were also from Sari and 54 (15.4%) from other cities of Mazandaran Province. The obtained data suggested that the duration of hospitalization was 1-13 days. Furthermore, 185 (52.9%) cases were hospitalized for only one day. There was a gender-wise significant difference between the number of hospitalization days ($P<0.001$). The Mean±SD scores of the same value for males and females were 2.1±1.9 and 1.8±1.2 days, respectively. Moreover, there was a gender-wise significant difference in the poisoning


Figure 1. The distribution of poisoning by age

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Table 2. The classification of poisoning by agent

Agent	N	%	95%CI (Min- UMax)
Drugs	250	71.4	(64.7-77.2)
Pesticides & chemical	54	15.4	(12.7-20.5)
Alcohol	17	4.9	(2.2-7.3)
Opioids	10	2.9	(1.1-4.6)
Medicinal herbs	2	0.6	(0.01-1.4)
Unknown	17	4.9	(2.6-7.1)
Total	350	100	

CI: Confidence Interval.

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Agent	F	%
Benzodiazepines	62	17.7
Tramadol	57	16.6
Cardiovascular drugs	13	3.7
Opium	10	2.9
Antibiotics	10	2.9
Acetaminophen	9	2.6
Diabetic drugs	8	2.3
Gastrointestinal drugs	6	1.7
NSIADS	4	1.1
Adult cold	3	0.9
Anti-depressive	3	0.9
Herbal	2	0.6
Anti-seizure	1	0.3
Two and more drugs	34	9.7
Other substances	128	36.6
Total	350	100

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Time	N(%)	95 %CI (Min-Max)
Day	225(64.3%)	(52.9-69.3)
Night	125(35.7%)	(30.7-40.8)

CI: Confidence Interval.

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Table 5. The primary outcome of poisoning according to the place of residence

Place of Residence	No (%)			P
	Survival Rate	Mortality Rate	Critical Status (transferred)	
Rural area	104 (29.7)	2 (0.57)	7 (2)	0.007
Urban area	230 (65.7)	4 (1.14)	3 (0.9)	
Total	334 (95.4)	6 (1.71)	10 (2.9)	
95% CI	(93.2-97.6)	(0.01-3.2)	(1.1-4.6)	

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Final State	No (%)		P
	Male	Female	
Deceased	6 (1.71)	-	0.062
Critical transference	7 (2)	3 (0.86)	
Survival discharge	203 (58)	131 (37)	
Total	216 (61.71)	134 (37.86)	

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Poisoning Method	No (%)	95%CI (Min-MAX)
Oral	327 (93.4)	(90.8-96)
Inhalational	16 (4.6)	(2.4 –6.9)
Injection	3 (0.3)	(0.1-0.9)
Miscellaneous (dermal, etc.)	4 (1.1)	(0.01–2.2)
Total	350 (100)	-

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CI: Confidence Interval.

method ($P<0.001$). The wards that patients were admitted included poisoning (67.1%), emergency (25.1%), Intensive Care Unit (ICU) (0.9%), and other wards such as internal and infectious disease departments (6.9%).

In addition, 101 (28.9%) patients were poisoned in winter, 95 (27.1%) in autumn, 85 (24.3%) in spring, and 69 (19.7%) in summer. The highest prevalence of poisoning equaled 40 (11.4%) has cases that occurred in February-March months; the lowest prevalence rate belonged to May-June with 17 (4.9%) cases.

Concerning the time of the poisoning, 225 (64.3%), (95% CI) (59.2%-69.3%) were poisoned during the day, 125 (35.7%), (95% CI) (30.7-40.8) at night. There was no significant gender-wise difference in terms of poison-

ing type, the repetition of poisoning, educational level, the month of poisoning, and day or night poisoning (Figure 1).

The young age group was the most poisoned patients. In this study, 137 cases (39.1%) of the poisoned patients were young. The lowest number of poisoned patients was children from 1 to 10 years old (2.6%). We found that a greater proportion of poisoning cases were men rather than women. 216 (61.7%) patients were male 134 (38.3%) patients were female (Figure 1).

The young age group created the most share of poisoned patients. In this study, 137 (39.1%) cases of the poisoned patients were young. The lowest proportion of poisoned patients belonged to 1- to 10-year-olds (2.6%).

We found that a greater proportion of poisoning cases were males. Moreover, 216 (61.7%) of the investigated patients were male and 134 (38.3%) patients were female.

The collected results revealed that 148 (42.3%) of the male patients versus 102 (29.1%) of the females were poisoned by drugs. Besides, there was poisoning by opium in males (2%) and in females (0.86%), alcohol poisoning rates were also 4.6% and 0.3% in males and females, respectively. Married patients were more prone to be poisoned than single ones (53.8% vs. 46.2%). We found that the proportion of unintentionally-poisoned patients was higher than the intentionally-poisoned ones (202, 58.3% vs. 146, 41.7%). The classification of poisoning in this study included agents, drugs, chemical agents and pesticides, opioids, and herbal medicines. The classification of poisoning by agents in 350 cases is listed in Table 2.

TDDrug-related poisoning was the main cause of poisoning in our study (Table 3). Table 3 highlights benzodiazepines as the most frequent cause of poisoning among all drug poisoning types (17.7%); subsequently, tramadol and cardiovascular drugs follow this rate. The main route of intoxication was from 6 AM to 6 PM or daytime (Table 4).

The educational status of poisoned patients was mostly unrecognized (247 [70.9%]). Furthermore, 59 (16.9%) patients had elementary or high school education, and 44 (12.6%) cases had bachelor's degrees or above. While 113 (32.29%) patients lived in rural areas, 209 (67.71%) lived in urban areas. The relevant primary outcomes were presented in Table 5.

In this study, mortality rate was 1.71%. All patients were male and no woman died. Distribution of mortality and outcome according to sex is shown in Table 6. Aluminum phosphide (33.33%) was the main cause of death from poisonings, followed by methadone, tramadol, Rat death gel, and other (16.66 %) for each agent respectively. 10 (2.86%) patients had a critical status and have been transferred to Tehran (capital city that is the modern center in Iran). These cases required great medical care. Among those who had a critical condition, Organophosphores (40%) were the main cause of critical condition from poisonings, followed by Aluminum phosphide (20%), Benzodiazepines (20%), and tramadol (10%) (Table 6).

The most common method of poisoning was digestive way, inhalation and then injection method, respectively (Table 7).

The therapeutic interventions for poisoning included the following: a combination of lavage, charcoal, Oxygen therapy, serum therapy, and using Epica (83.7%). The combination of lavage, oxygen therapy, and serum therapy equaled 6.6%. The rate of the combination of oxygen therapy and serum therapy was 9.4%, and lavage alone was 0.3%. The frequency of implementing antidote in poisoned cases was as follows: naloxone (29.1%), flumazenil (8.9%), atropine (6.9%), and no antidote (55.1%). Our findings indicated that specialized counseling was conducted in most cases in the poisoning ward. Specialized advice were provided by psychologists (52.5%), pediatricians (0.6%), nephrologists (0.6%), anesthesiologist (0.3%), more than two specialists (0.9%), and no need to for consultation (45.1%). This study suggested that other medications were used for treating intoxication cases during hospitalization; they included ranitidine (40.3%), ondansetron and ranitidine (10.3%), pantoprazole and ranitidine (4.3%), metoclopramide and ranitidine (3.4%), diazepam or midazolam and ranitidine (3.7%), clindamycin, ceftriaxone and ranitidine (4%), and >4 drugs (31.4%). The number of cases that underwent no pharmacotherapy was 7 (2%).

4. Discussion

Over the study period (18 months), the frequency of the hospitalized acute poisoning cases was equal to 4.98%, including 10 (2.86%) critical conditions, and 6 (1.71%) deaths. Among the poisoning deaths, 2 (33.3%) cases were due to aluminum phosphide. Among the poisoning critical cases, 4 (40%) belonged to organophosphorus. A similar study reported that 21% of total admissions were poisoning cases and about 3% of the cases died [19].

The detected incidence of poisoning was much lower (4.98%), in comparison to Hossain et al.'s findings. In our study, 6 patients died of poisoning. Among them, 2 (33.33%) cases were due to aluminum phosphate toxicity. The mortality rate of poisoning in our study (1.71%) was lower than that of other studies; Reza (2%), Ali (3%), Hossain (3%) [19], Moazzam (2.2%) [20], Ahmad (5.87%) [21], Rahman (7.06%) [22], Wan Li et al. (2.9%) [23], Bari et al. (5.1%) [24], and Montazer et al. (30.76%) [25]. The lower fatality rate in the present study may be due to poisoning trend changes in our region, compared with other places and different poisoning patterns. Geographic, cultural, and socioeconomic characteristics in different regions may influence the poison-

ing agent choices, the prevention principles, managing the involved cases, and outcomes of poisoning [23, 26]. The overall mortality rate in the present research (1.71%) was slightly higher than that of (1.3%) Shadnia's study in Tehran [27], and another study (0.6%) by Afshari and associates [28].

The difference in the incidence rate may be because the mentioned studies were based on the data of a rural hospital or different countries with different geographic areas; however, our study was conducted in an agricultural area with humid weather in Mazandaran Province, Iran.

In our study, the male/female ratio (216/134) was measured as 61.7% to 38.3%. These results are consistent with a study in Guilan by Mohammadi and colleagues. In that study, of the 3789 poisoned patients, 2635 were male and 1154 were female. Besides, the poisoning rate was higher in men (69.5% in men vs. 30.5% in women) [29]. The WHO addressed a higher global rate of poisoning in males, compared to females, according to 20084 reports [28]. Abd-Eihaleem specifically explored the aspects of poisoning in males (73.6%) [18]. This study revealed that the incidence of poisoning in the young age group was higher than that in children and other groups of acute poisoning. A higher proportion of poisoning was reported in younger adults poisoning [18, 30]. In this study, children's and adolescents' poisoning rate was less than that of adults (39 cases vs. 311 cases). Increased intoxication among young individuals could be due to feasible access; in children, it could be due to unawareness about substances, accidental access, and the neglect of parents [29].

This study demonstrated that oral insertion was the main means of poisoning, i.e., similar to other study publications [31, 32]. The obtained data suggested that the ingestion route accounts for 93.4% of all exposures, i.e., consistent with the study of Ahmadi et al. [33]; they stated that approximately 96.2% of poisonings were caused orally. Regarding the poisoning type, pharmaceuticals as shaped the highest percentage of inpatient poisoning cases.

Nearly 71.4% of all poisonings involved medications. Benzodiazepine was the most prevalent cause (17.7%) of drug poisoning; cardiovascular drug poisoning was also of a high incidence. This result was per previous studies, such as the WHO [18] that found a higher pharmaceuticals poisoning percentage in female adolescents and adults. The WHO [3] also concluded that the most common poisoning agent belonged to the pharmaceutical group (84.1%) and a common drug involved in the inten-

tional overdose of benzodiazepines. A high frequency of benzodiazepine poisoning was previously reported [31]. Overall, the major role of benzodiazepines in all groups remained stable with its widespread availability without a prescription. Besides, the extent of cardiovascular diseases may increase the consumption of cardiovascular medications. Some cardiovascular drugs, like digoxin, have wider clinical use and a low therapeutic index [34]. Therefore, digoxin may potentially cause poisoning.

In general, individuals' lack of knowledge about drugs and psychological problems, as well as easy access to drugs may increase drug poisoning risks. Medications were a major problem in several reports from other countries. Some related reasons comprise individuals' easy access to medications and the inappropriate maintenance of the medications at home [18, 35, 36].

The present study results revealed that the rate of intentional poisoning (self-poisoning: 41.7%) was lower than the unintentional cases (accidental: 58.3%). A study in India reported that the deliberate poisonings were 72% and the remaining toxicity cases were accidental [37, 38]. Overall, poisoning rates varied in studies conducted in Iran; Masoumi (2012): 8.7%, Azin (2004): 24%, Ghasem Pouri (2014): 28.2%, Tabibzadeh (2011-2012): 33%, Mohammadi (2012-2013): 44%, Moghadam Nia (1994-1996): 46.5%, and Jaafarzadeh (2014-2016): 80.40%. All studies suggested that unintentional poisoning in the present study was higher than that in most regions of Iran [39-43].

The cause of the increase in the number of accidental poisonings different among studies. Perhaps it depends on factors, such as Mazandaran climate and agricultural areas, which enhance the paste of life; therefore, it is less likely to consider suiciding with toxic substances.

In this study, the most frequent cause of death was due to toxicity with aluminum phosphate and methadone. It might be because individuals easily access these materials; however, they are unaware of the potential hazard. Mortality due to acute poisoning is a major global challenge. Thus, it is essential for medical, legal, and social issues. In recent decades, significant advances have been made in the fields of agriculture, industry and technology, medicine, and pharmacology. These developments simultaneously have changed the lifestyle and patterns of poisoning worldwide. Various reports introduced substance abuse and suicide commitments as the main causes of acute poisoning, globally. Some studies have revealed that mortality from acute poisoning is higher in women than men [33, 39]. In our study, men were more

prone to suffer from acute poisoning and death. These results are probably due to men's exposure to toxic substances, and occupational stress. In addition, growing rice in this province is among the most common careers. Individuals use rice pills to counteract bothers. Consequently, rice pills are promptly accessible to everybody while individuals are inadequately educated about their threats.

Individuals lack an ideal substitution for aluminum phosphide to store their rice in the rice bags. Poisonous substances of choice may change due to geographical and economic conditions. In some developed countries, poisoning is usually caused by drugs, household cleaning products, cosmetics, and beauty agents. This is while in developing countries, poisoning is dependent on economic and agricultural conditions, such as hydrocarbons, opioids, traditional drugs, medicinal herbs, and pesticides. Some natural herbs, like mushrooms that grow in the rainy season, are very lethal. Therefore, individuals should be adequately aware of their threats [18].

Our investigation had some limitations. Our study was based on the existing data in the literature. Therefore, there was a possibility of a defect in measuring some variables. Some limitations of these data, like the educational level, were unavailable for some cases. Another limitation of this study concerned the missing information. The number of poisoning-induced deaths in the present study was only a part of overall death due to poisoning in Mazandaran Province in 18 months. This is presumably because most poisoning-related deaths occurred outside the hospitals or in the emergency departments before hospitalization.

5. Conclusion

Acute poisoning is a main health issue in Mazandaran Province in the north of Iran; especially in the young age group. Pharmaceuticals, opioids, and aluminum phosphide were the main causes of poisoning in the explored adult patients. Aluminum phosphide and organophosphate agents are used in Mazandaran for geographical and economic reasons. They are very dangerous and deadly. Further information provision and education are required concerning the application and risks of organophosphate products and opioids for the general population. Aluminum phosphide tablets must be collected in Mazandaran and be replaced with natural products. It is also suggested that aluminum phosphate be collected and appropriate training be given for its proper use. Patients who have been deliberately poisoned should receive psychotherapy at the time of admission and subse-

quently after hospital discharge. Sufficient information and education on toxin agents must be provided to the general population, especially the farmers engaged with these products in agriculture and gardening. In addition, any potential poisoning drugs should not be used, except for the instructions of the physicians. Besides, training should be provided to individuals. Safeguarding of medications and other poisonous agents must be performed with additional information provision. The application of a national wide protocol for the treatment of main poisoning types could lead to an excellent prognosis.

Ethical Considerations

Compliance with ethical guidelines

This study was approved by the Ethics Committee and the Research Council of the University of Medical Sciences (Grant no: 2388-95) (Ethics Code: IR.MAZUMS.REC.95.2509).

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Authors' contributions

All authors were equally contributed in preparing this article.

Conflict of interest

The authors declared no conflict of interest.

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