

PAPER**PATHOLOGY/BIOLOGY; TOXICOLOGY***Ismail Birincioglu,^{1,2} M.D.; Hulya Karadeniz,² Ph.D.; and Hacer Yasar Teke,³ M.D.***Fatal Poisonings in Trabzon (Turkey)**

ABSTRACT: The aim of this study was to present the characteristics of medicolegal autopsies of fatal poisonings in Trabzon (Turkey), performed from 1998 to 2008, to contribute to the available data on this topic. A retrospective study of the forensic records and the toxicological data of all autopsies performed over that period revealed that 285 cases (6.34%) of the 4492 total autopsies performed were attributed to fatal poisoning. Major toxic substances were classified in five categories as follows: carbon monoxide (CO), insecticides, prescription medications, narcotic drugs, and alcohol (methyl and ethyl). CO was the most frequent cause of death (63.2%), followed by insecticides (17.2%), prescription medications and narcotic drugs (9.8%), alcohol (7.7%), and others (mushroom, rodenticide, and botulism) (2.1%). Ages of the patients ranged from 1 to 86 years (21.55 ± 36.56).

KEYWORDS: forensic science, forensic autopsy, toxic, fatal poisoning, carbon monoxide, insecticides

A poisoning episode may be defined as the exposure of an individual (by ingestion, injection, or inhalation) to an amount of a substance(s) associated with the significant potential to cause harm (1). In developed countries, the annual incidence of both unintentional and deliberate human poisoning varies from 0.2 to 9.3 poison exposures per 1000 population and continues to increase annually worldwide (2).

The extent of unnatural fatalities within a society is a gross indicator of the socioeconomic conditions and mental health of that society. Analysis of various factors influencing their trends enables policy makers to plan preventive and curative measures pertaining to human habitations and industries and also to equip the health care institutions accordingly (3). Death because of poisoning has been known since time immemorial. Poisoning is a major problem worldwide, although its type and the associated morbidity and mortality vary from country to country (3–13). According to the legal system in Turkey, all deaths by poisoning are recorded as unnatural death and furthermore, according to article 89 of the Penal Code Law Judicial Procedure (14), a medicolegal autopsy must be conducted in any case of death caused by suspected or obvious poisoning. Thus, medicolegal autopsies are one of the reliable data sources in fatal poisoning cases (15).

The aim of this study was to present the characteristics of medicolegal autopsies of fatal poisonings in Trabzon (Turkey), from 1998 to 2008, to contribute additional data to the literature available on this subject.

Trabzon is a large port city in the northeast region of Turkey, with a population of approximately 230,000 according to 2009 statistics. The Black Sea Regional Center for Forensic Medicine, one of the seven regional forensic centers in Turkey serving different

geographical areas, is located in Trabzon. The Center assists in medicolegal investigations in the region by offering expert opinions to facilitate legal authorization in understanding the medical implications of pathological examinations, including live medical examinations and postmortem examinations (autopsies) of bodies, and pathological investigations.

Materials and Methods

For this study, the autopsy records of the Morgue Department of the Trabzon Branch of the Council of Forensic Medicine were reviewed retrospectively for all fatal poisonings recorded during the period January 1, 1998 to December 31, 2008. Cases were analyzed according to the following criteria: toxic substance category and toxicological analysis reports, origin, age, sex, month, and year. Toxicological analyses were routinely performed in blood, urine, and organs (brain, lung, liver, heart, kidney, and stomach). Carboxyhemoglobin saturation was measured by UV/Vis spectrophotometry; prescription medications and narcotic drugs were analyzed by immunoassay (Cloned Enzyme Donor Immunoassay [CEDIA]) or gas chromatography–mass spectrometry (GC-MS); ethanol and other organic volatiles were analyzed by automated headspace gas chromatography; and pesticides were analyzed by thin-layer chromatography or GC-MS.

Major toxic substances were classified in five categories as follows: carbon monoxide (CO), insecticides, prescription medications, narcotic drugs, and alcohol (methyl and ethyl).

Results

From January 1998 to December 2008, a total of 4492 autopsies were performed; 285 (6.3%) of them were related with fatal poisoning death. The highest frequency of poisoning was found in the 21–40 years of age group (36.1%, $n = 103$), but it was also observed in the oldest and youngest age groups (Table 1). The age range was 1–86 years (21.55 ± 36.56). There were 172 men

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(60.4%) and 113 women (39.6%), and the male-to-female ratio was 1.52:1. The mean age of male cases was 38.51 ± 20.67 years and of females was 33.61 ± 22.61 years.

TABLE 1—Age distribution according to sex.

Age	Gender				Total	
	Males		Females			
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
1–20	32	11.23	41	14.37	73	25.60
21–40	67	23.50	36	12.60	103	36.10
41–60	44	15.50	16	5.60	60	21.10
61+	29	10.17	20	7.03	49	17.20
Total	172	60.40	113	39.60	285	100.00

The most common cause of fatal poisoning was CO (63%, $n = 180$), followed by insecticides (17%, $n = 49$), prescription medications and narcotic drugs (10%, $n = 28$), alcohol (ethyl and methyl) (8%, $n = 22$), and others (mushroom, rodenticide, and botulism) (2%, $n = 6$) (Fig. 1).

Cases included a variety of accidental (25.61%), suicidal (14.7%), and homicidal (1.06%) poisonings. In the remaining cases (58.6%), the circumstances surrounding the poisoning were undetermined because of insufficient history and data.

During the 11-year study period from 1998 to 2008, the number of unintentional deaths because of CO poisoning increased (Fig. 2). The mean age was 37.16 ± 22.65 years. In the winter, CO exposure was greater than exposure to the other causes of poisoning. The greatest number of CO poisoning deaths was reported in January and the fewest in August (Fig. 3). The deaths were associated with water heaters

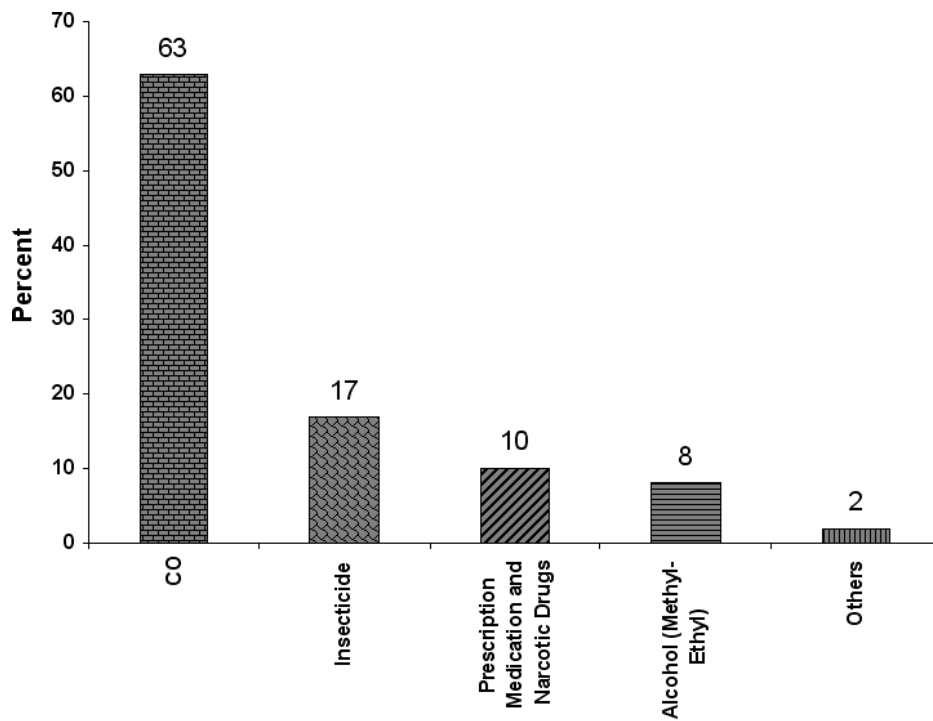


FIG. 1—Distribution of the different causes of poisoning, as a percentage of total deaths caused by poisonings.

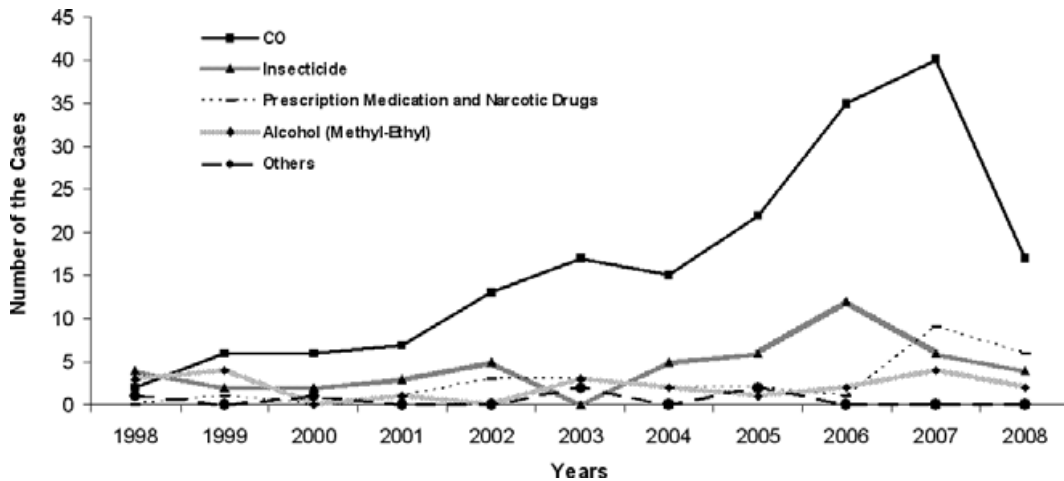


FIG. 2—The distribution of the number of fatal poisonings according to causative agents by year.

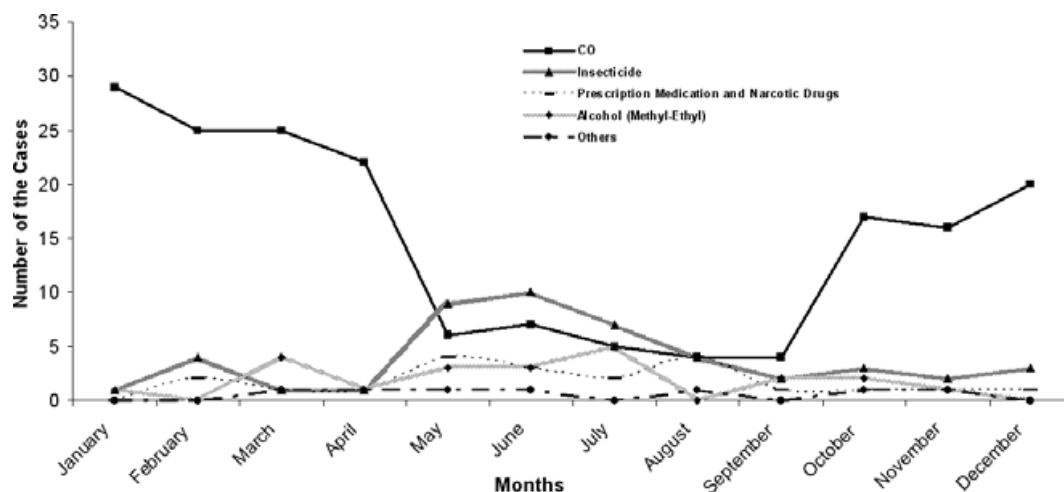


FIG. 3—The distribution of the number of fatal poisonings according to causative agents by month.

in the bath (33.8%), coal stoves (33.3%), fires (20.5%), and others (7.2%, e.g., exhaust gases and charcoal). Insecticides were the second most frequent toxic agent category ($n = 49$). The frequency of insecticide poisoning was greatest in June followed by May and July (Fig. 3). The mean age of these cases was 36.55 ± 22.80 years.

The insecticide intoxications were mostly because of suicidal ingestions (61.2%, $n = 30$), followed by accidental (36.7%, $n = 18$), and only one case was determined to be homicidal. Carbamate insecticides were responsible for 63.2% of total insecticide poisonings followed by organophosphorus compounds (22.5%) and organochlorine compounds (14.3%).

The third leading cause of death was drug poisoning ($n = 28$). The mean age in this group was 31.71 ± 17.81 years. The prescription medications responsible for death were benzodiazepines in six cases, tricyclic antidepressants in five cases, antidepressants in three cases, antiarrhythmic in two cases, antihypertensive in one case, anticholinergic in one case, narcotic analgesic in one case, antifungal in one case, and antidiabetic in one case. The narcotic drugs responsible for death were heroin in six cases, and heroin and morphine together with benzodiazepine in one case.

The other cause of death was alcohol poisoning ($n = 22$). The mean age in this group was 40.22 ± 11.30 years. The mean blood alcohol (ethanol) concentration was 210.31 ± 178.10 mg/dL (range: 12–888). Methyl alcohol was found in 13 cases, with a mean blood methyl alcohol concentration of 198.84 ± 160.43 mg/dL (range 15–482). Furthermore, ethanol was present in 8/180 (4.4%) of the deaths caused by CO, in 2/49 (4%) of the deaths caused by insecticides, in 6/28 (21.4%) of the deaths caused by drugs, and in one case of death caused by a volatile compound.

Discussion

During the 11-year study period (1998–2008), deaths caused by poisoning accounted for 6.3% of all the medicolegal autopsies performed in Trabzon (Turkey). The following rates have been reported in other studies in Turkey: 7.1% by Duman et al. (16), 9.8% by Fedakar et al. (15), and 22% by Salaçin et al. (17).

The major toxic agent in our study was CO (63%). According to the other studies, CO as the cause of poisoning was reported at rates of 47.8% by Vougiouklakis et al. (1), 43.5% by Fedakar et al. (15), and 27% by Elif et al. (4). When the deaths caused by poisonings were analyzed, CO was found to be the most common type of poisoning in the Eastern Black Sea region and in the South Marmara

region, while insecticides were the most common poison in the Aegean and Mediterranean regions of Turkey (4,15,16). CO poisonings were a result of unintentional exposure because of water heaters, coal stoves, and fires. It was most common in winter in our region. Unintentional poisonings are highly correlated with the winter months (18). The observed peak in CO poisonings in 2007 may be explained by the following: Unusually extreme winter conditions and heavy snowfall in 2007, with strong northwesterly winds, necessitated an increasing need for coal stove usage. Additionally, widespread use of gas boilers and placement of the boilers in the bathroom are among the common contributing factors in CO poisonings. Lastly, the dramatic decline in deaths caused by CO poisonings in 2008 is likely related to the residential use of natural gas for heating, which became available in most parts of the area that year.

The main source of unintentional CO-related deaths in our region was also domestic coal stoves. In recent years, CO poisoning was reported as a new method of suicide in Hong Kong by intentional burning of charcoal in a confined space (19). It was also previously reported that the most common method of suicide with CO was by motor vehicle exhaust gases (18,20).

Risser and Schneider (21) investigated CO deaths in Vienna, Austria 1984–1993. Unintentional deaths were identified as those caused by malfunctioning appliances such as flueless gas-fueled water heating appliances. These investigators found the frequency of such deaths did not change significantly over the study period. Most deaths occurred in the winter and the elderly were the age group most represented.

Most of the deaths caused by CO poisoning in our region were preventable. It is pointed out that the utilization of detectors and community education could help to prevent CO poisoning (15,22).

Insecticide was the second most common toxic agent category (17%). Our data showed that insecticides were the most common poisons used for suicidal purposes (61.2%). Similar data have been reported in other studies: 43% by Elif et al. (4), 52.9% by Soltaninejad et al. (23), 64.3% by Vougiouklakis et al. (1), and 71.9% by Fedakar et al. (15). The number of fatal insecticide poisoning cases was higher in summer than in other seasons. Our study showed that carbamate insecticides were the most important cause of mortality in insecticide poisonings. In our region, these compounds are known as a “hazelnut poison insecticide” by the public and are widely used for insect control, especially for hazelnut. In the other studies, organophosphorus insecticides were the primary agent in poisonings in Tehran, Sri Lanka, Jordan, and Taiwan (11,23–27).

Organophosphorus and carbamates were the main insecticides encountered in our study, in agreement with other studies from the Mediterranean region (28,29). Insecticide application without adequate protection, illiteracy, economic problems, difficult living conditions, and various psychological problems seems to correlate with high rates of insecticide poisoning, both intentional and unintentional.

The third toxic agent in our study was medications and drugs, and the most common cause of medication-related deaths was intentional intake of prescription medications. According to the studies from the developed countries, analgesics, particularly acetaminophen, are the most common agent in deliberate poisonings in adults (30,31). In some other studies, psychoactive drugs have been reported as the most common agent in deliberate self-poisonings (32,33). In Denmark, Norway, and Sweden, heroin and morphine are the most frequently encountered drugs (34). In our study, medication poisonings were primarily with antidepressants and benzodiazepines. Cases who utilized these drugs for intentional suicide had easy access to them, because either they themselves or their relatives used such medicines.

The abuse of heroin and cocaine in the area is low because of the low socioeconomic status of the population; the use of marijuana is more common. This can account for the low number of deaths caused by poisonings with heroin and cocaine.

In our study, deaths were alcohol-related in 22 cases. In 13 of these cases, deaths were methanol-related; they were all unintentional. They were poisoned through the consumption of alcoholic beverages and cologne from illicit sources.

The case of overdose with antidiabetic medication was recorded as intent to commit suicide.

Conclusion

Based on our retrospective evaluation of fatal poisoning cases subjected to medicolegal autopsy in Trabzon and surrounding provinces, our results implicate CO poisoning as a serious risk factor for mortality in our region. It was concluded that educational programs for the community, particularly those of low socioeconomic level, should be initiated to educate individuals regarding poisoning and the possibility of death as a result of such exposure. Such efforts should help to decrease the number of the fatal poisonings in the future.

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