

Mortality rate associated with carbon monoxide poisoning in Turkey: A national database study

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Abstract

Objective: To investigate non-fire and unintentional deaths caused by carbon monoxide poisoning in the light of official national data, and to calculate the national mortality rate associated with carbon monoxide poisoning in Turkey.

Methods: The retrospective cross-sectional study was conducted in Ankara, Turkey, from January to March 2019, and comprised data of deaths registered with the Turkish Statistical Institute between January 1, 2013, and December 31, 2017. Data was analysed using SPSS 21 and Microsoft Excel.

Results: Of the 1896 deaths, 1310 (69.1%) were males, and the highest number of deaths 622 (33%) was recorded in 2014. Deaths were most common in the 18-64 years age group 1071 (56.6%). Overall, there were 1841 (97.1%) Turkish citizens and 55 (2.9%) foreign nationals. Manisa had the highest number of deaths 266 (14%) at a mortality rate of 3.84 per 100,000 population.

Conclusion: The factual situation of death associated with carbon monoxide in Turkey will lead to steps to reduce the risk.

Keywords: Carbon monoxide poisoning, Mortality rate, Unintentional poisoning. (JPMA 71: 262; 2021)

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Introduction

Carbon monoxide (CO) is a colourless and odourless gas formed as a result of incomplete burning of fossil fuels. In general, CO poisoning occurs as a result of the burning of fuel for heating purposes. Although less frequent, poisonings have been reported after exposure to generator, vehicle exhaust fume, and grill smoke.¹ CO inhibits oxygen delivery to tissues due to its high affinity towards haemoglobin. After acute CO poisoning, systemic tissue hypoxia occurs followed by death within a short time.²

World Health Organisation (WHO) acknowledges that CO poisoning is an important public health problem, but it also emphasises the need for more information in death reports associated with such poisoning.³ Although approximately 50,000 CO poisoning cases occur every year in the United States, the number of deaths is approximately 1,000-2,000.⁴ In another study, the number of hospital admissions associated with non-fire and unintentional CO poisoning was 20,000 and the number of deaths was 450.⁵ Studies in this regard done in Turkey are mostly single-centre or autopsy-based.⁶⁻⁹ Only a few countrywide studies have been conducted in Turkey, and they are either

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outdated or not based on official national data.^{1,3,10}

Mortality rates associated with CO poisoning represent a dynamic variable and studies are required to keep the data-set updated. The current study was planned to investigate the number of deaths caused by non-fire and unintentional CO poisoning in Turkey.

Materials and Methods

The retrospective study was conducted in Ankara, Turkey, from January to March 2019, and comprised mortality data associated with unintentional and non-fire CO poisonings that occurred between January 1, 2013, and December 31, 2017.

The study was done after permission from the Turkish Statistical Institute (TSI), and the sample size was not calculated. Data was included related to deaths registered with the TSI database and it was retrieved using the International Classification of Diseases 10th Revision (ICD10) code of T58 which is about the toxic effect of CO. Other diagnoses that may involve CO poisoning, such as fire-related incidents or suicide attempts, were excluded. Persons with missing data were not completely excluded from statistical analyses and other known characteristics of the persons were taken into account.

The mortality rate associated with CO poisoning per 100,000 people was calculated by the average number of deaths caused by CO poisoning in a 5-year period divided

by the average population in the same time period. The total countrywide and provincial population data was obtained from the official TSI website.¹¹ Since an address-based population system is used in Turkey, outsiders who reside in Turkey for >6 months are counted and included in the total population of the country.¹² Therefore, Turkey citizens (TCs) and people of foreign descent were both included. Microsoft Power BI Desktop ® March 2019 version was used for mapping the mortality rate associated with CO poisoning in Turkey.

Data on national death statistics were obtained in accordance with the Personal Data Protection Act.¹³ Data was analysed using SPSS 21 and Microsoft Excel. General demographic characteristics, ratios and average values of

the groups were calculated. Mortality rate associated with CO poisoning per 100,000 people was calculated.

Results

Of the 1896 deaths, data was partly missing for 5(0.26%) individuals. Besides, 45(2.37%) foreign nationals had no residence registration in any province during the study period. Of the victims, 1310(69.1%) were males, and the highest number of deaths was recorded in 2014, 622(33%). Deaths were most common in the 18-64 years age group 1071(56.6%). Overall, there were 1841(97.1%) TCs and 55(92.9%) foreign nationals (Table-1).

Mortality rate and mortality ratio were calculated, with Manisa having the highest number of deaths (Table-2).

Table-1: Mortality data on carbon monoxide poisoning in Turkey between 2013 and 2017.

Characteristics		Year 2013	Year 2014	Year 2015	Year 2016	Year 2017	Total (%)
Gender*	Female	102	119	102	131	131	585 (30.8)
	Male	190	503	198	228	191	1310 (69.1)
Age (years)**	0-17	43	43	49	61	26	222 (11.7)
	18-64	141	451	139	178	162	1071 (56.6)
	65 +	108	127	110	120	134	599 (31.6)
Nationality	Citizen	282	614	289	349	307	1841 (97.1)
	Foreign	10	9	11	10	15	55 (2.9)
Mortality Rate (1/100,000)	0.38	0.80	0.38	0.44	0.44	5-year average 0.47	

* Excluding one person with no gender information in the national data system

** Excluding four persons with no age information in the national data system.

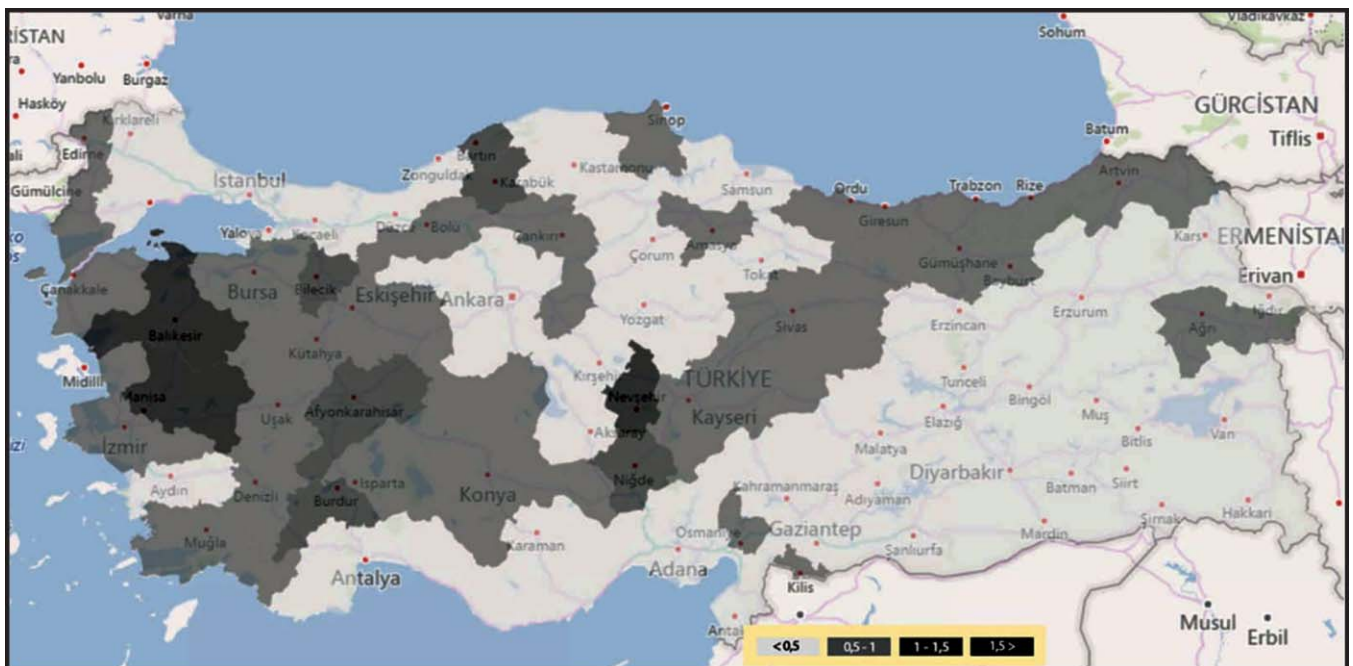


Figure: Mortality rate associated with carbon monoxide (CO) poisoning in Turkey.

Table-2: Provinces with the highest mortality rate associated with carbon monoxide poisoning between 2013 and 2017, and mortality rates of the provinces with the highest population.

Highest Mortality			Highest Population		
City	Mean	Mortality Rate (1/100,000)	City	Mean	Mortality Rate (1/100,000)
Manisa	53.2	3.84	Istanbul	18.6	0.12
Balikesir	20.4	1.71	Ankara	19.8	0.37
Nevsehir	4.6	1.59	İzmir	34.2	0.82
Nigde	4.8	1.38	Bursa	18.6	0.65
Bilecik	2.8	1.30	Antalya	6.6	0.29
Karabük	3	1.26	Adana	6	0.27
Burdur	3.2	1.23	Konya	15	0.7
Afyon	7.8	1.09	Sanliurfa	1.8	0.09
Bartın	2	1.04	Gaziantep	6.2	0.3
Usak	3	0.84	Kocaeli	1.6	0.08

Table-3: Number of deaths due to carbon monoxide (CO) poisoning between 2013 and 2017 for each province of Turkey and detailed list of mortality rates per 100,000 people.

City	2013	2014	2015	2016	2017	Mean	MR*	City	2013	2014	2015	2016	2017	Mean	MR*
Manisa	12	215	9	17	13	53.2	3.84	Igdir	1	2	0	1	0	0.8	0.41
Balikesir	10	52	14	12	14	20.4	1.71	Samsun	3	0	10	7	6	5.2	0.4
Nevsehir	8	3	7	4	1	4.6	1.59	Aydin	2	2	7	2	8	4.2	0.39
Nigde	8	5	2	4	5	4.8	1.38	Corum	1	4	4	0	1	2	0.37
Bilecik	4	4	1	2	3	2.8	1.3	Ankara	15	37	17	24	6	19.8	0.37
Karabük	3	4	5	2	1	3	1.26	Kastamonu	0	1	4	1	1	1.4	0.37
Burdur	1	2	3	6	4	3.2	1.23	Aksaray	1	1	3	1	1	1.4	0.35
Afyon	8	9	8	9	5	7.8	1.09	İcel	2	6	7	8	8	6.2	0.35
Bartın	1	3	0	3	3	2	1.04	Elazig	1	2	1	3	3	2	0.34
Usak	6	3	1	4	1	3	0.84	Erzurum	1	3	6	3	0	2.6	0.34
Kütahya	3	7	3	6	5	4.8	0.83	Gaziantep	7	10	5	2	7	6.2	0.32
Bolu	4	2	0	1	5	2.4	0.82	Malatya	1	4	0	4	3	2.4	0.3
İzmir	27	77	19	24	24	34.2	0.82	Kahramanmaraş	0	2	3	4	8	3.4	0.3
Kayseri	12	8	9	18	7	10.8	0.8	Zonguldak	2	3	0	2	2	1.8	0.3
Canakkale	4	4	4	0	8	4	0.77	Tokat	1	4	1	1	2	1.8	0.3
Bayburt	2	0	1	0	0	0.6	0.74	Tekirdag	2	2	4	3	3	2.8	0.29
Rize	0	1	5	4	2	2.4	0.72	Antalya	9	5	8	7	4	6.6	0.29
Ordu	4	5	8	5	4	5.2	0.7	Kirklareli	2	1	0	1	1	1	0.28
Konya	9	14	12	18	22	15	0.7	Adana	0	5	2	15	8	6	0.27
Sinop	3	2	2	0	0	1.4	0.68	Kars	2	1	0	0	1	0.8	0.27
Bursa	24	12	19	20	18	18.6	0.65	Kirsehir	3	0	0	0	0	0.6	0.26
Cankiri	1	1	1	1	2	1.2	0.64	Yalova	0	2	0	0	1	0.6	0.25
Giresun	1	4	3	4	2	2.8	0.64	Tunceli	0	0	0	1	0	0.2	0.23
Gümüşhane	2	0	1	2	0	1	0.63	Adiyaman	1	1	3	1	1	1.4	0.23
Kilis	0	2	1	1	0	0.8	0.61	Düzce	0	1	0	0	3	0.8	0.22
Ardahan	1	1	0	0	1	0.6	0.6	Erzincan	1	1	0	0	0	0.4	0.17
Edirne	3	1	0	4	4	2.4	0.59	Mardin	2	0	0	0	4	1.2	0.15
Artvin	0	1	2	1	1	1	0.59	Mus	0	0	1	2	0	0.6	0.14
Agri	3	1	8	3	1	3.2	0.58	Batman	0	0	1	1	2	0.8	0.14
Denizli	1	6	10	5	7	5.8	0.58	İstanbul	26	13	6	24	24	18.6	0.12
Sivas	1	5	2	4	6	3.6	0.57	Siirt	0	0	0	0	2	0.4	0.12
Mugla	1	5	2	14	4	5.2	0.57	Sanliurfa	2	2	1	2	2	1.8	0.09
Isparta	5	0	2	2	3	2.4	0.56	Kocaeli	3	0	0	4	1	1.6	0.08
Amasya	0	2	4	0	3	1.8	0.55	Karaman	0	1	0	0	0	0.2	0.08
Trabzon	3	7	6	1	3	4	0.51	Van	0	1	0	0	2	0.6	0.05
Kirikkale	4	2	1	0	0	1.4	0.5	Diyarbakir	0	0	0	4	0	0.8	0.04
Eskisehir	4	3	6	5	3	4.2	0.5	Bingöl	0	0	0	0	0	0	0
Osmaniye	2	3	3	3	2	2.6	0.5	Bitlis	0	0	0	0	0	0	0
Yozgat	2	3	2	2	1	2	0.46	Hakkari	0	0	0	0	0	0	0
Hatay	5	7	8	7	8	7	0.45	Sirnak	0	0	0	0	0	0	0
Sakarya	2	13	1	3	1	4	0.41								

*Mortality Rate (1/100,000)

Mortality rate associated with CO poisoning per 100,000 people was calculated for each of the 81 provinces (Table-3).

A map of mortality rates with a colour scale separated into slices of 0.5 showed that the provinces with high risk of mortality were concentrated in the Aegean Region (Figure).

Discussion

The current study found that an average of 379 people lost their lives every year due to non-fire and unintentional CO poisoning. In a study based on WHO data, 84 people reportedly died of CO poisoning in Turkey in 2008.¹⁰ Another national study reported that 39 people died in 2010.³ In a recent national study, death reports related to CO poisoning between 2008 and 2017 were investigated based on media data, and the average annual number of deaths was reported to be 266.7.¹ In 2008, mortality rate due to CO poisoning in Turkey was reported to be 0.11 per 100,000 people,¹⁰ whereas the same rate was 2.24 in the European Region comprising 53 countries; Turkey being one of them in the WHO category. Azerbaijan 0.02 and Georgia 0.04 were reported as the countries with the lowest mortality rates.¹⁰ In the United States, mortality rate associated with non-fire and unintentional CO poisoning between 1999 and 2012 was 0.14 per 100,000 people.¹⁴ In a US report investigating poisoning cases admitted to hospitals between 2003 and 2013, the mortality rate due to CO poisoning was reported to be 0.42.¹⁵ In the present study, the mortality rate associated with CO poisoning in Turkey between 2013 and 2017 was 0.47 per 100,000 people. Our result is higher than the rate of 0.11 reported earlier, but much lower than the rate reported in the European Region.¹⁰ However, lower death rates of Azerbaijan and Georgia underscores the fact that there are steps that can be taken to reduce mortality rates.

It has been observed that mortality rates reported in local sources investigating mortality rate associated with CO poisoning in various provinces of Turkey are higher than the rates found in the current study.⁷⁻⁹ Since previous studies were mostly conducted on autopsy series, mortality rates due to CO poisoning were possibly higher.

The present study found that the Aegean Region had a higher mortality rate compared to those in other geographical regions. This is attributed to the geographical features of the region, causing southwester winds to enter the hinterland and causing CO poisoning by blocking stove fumes leaving the chimneys.¹⁶ A review referred to the relationship between storms and CO poisoning,¹⁷ but no study investigating the relationship

between storms and CO poisoning in Turkey was found in literature.

According to a study covering the period between 2008 and 2017, Central Anatolia was the region with the highest mortality rate due to CO poisoning in Turkey.¹ In the present study, mortality rate in most Central Anatolia cities was lower than the national average despite the provinces with very high mortality rates, such as Nigde and Nevsehir, being located in this region. Mortality rate was 0.37 in the capital city of Ankara and 0.12 in Istanbul, the most developed and densely populated city of Turkey, and these rates were below the national average. The fact that Turkey is gradually transitioning to the use of natural gas as a heating source, and increasing socio-economic levels resulting in citizens preferring more modern structures as living spaces may act as factors that reduce mortality rate due to CO poisoning in these provinces.

The highest mortality associated with CO poisoning was observed in Manisa province in the Aegean Region. This may be due to the presence of coal mines and thermal power plants in Manisa, and households continuing to use fossil fuel as heating sources in rural areas despite the gradual transition to natural gas in 2003.¹⁸ In addition, a mining disaster occurred in the Soma district of Manisa in 2014.¹⁹ The cause of death may have been reported as CO poisoning for some of the victims of this disaster.

Another demographic reality that must be addressed in Turkey is the presence of Syrian refugees. Provinces with the highest number of Syrian refugees compared with local population are Kilis, Hatay, Sanliurfa, Gaziantep and Mersin.²⁰ Although most refugees have a low socio-economic status and poor living conditions, mortality rates due to CO poisoning in these provinces of Turkey were found to be below the national average.

There are certain limitations to the present study. Firstly, national data was used which related to individuals whose death reports were issued according to the diagnostic ICD10 code of T58. In Turkey, diagnosis of death is made by doctors and death reports are filled up by them. These reports may contain missing data or misdiagnoses, but we believe that these are negligible and doctors mostly issue correct death reports. Secondly, no information could be found regarding exposure of victims to the poisoning route. Finally, autopsy information could not be accessed because identities are confidential, and TSI shared limited information.

Conclusion

The mortality rate associated with non-fire and

unintentional CO poisoning in Turkey between 2013 and 2017 was found to be 0.47 per 100,000 people. Mortality rates associated with CO poisoning should be continuously evaluated on the basis of fresh data so that necessary measures may be planned to reduce the risk of mortality.

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Conflict of Interest: None.

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