Forensic Science International 253 (2015) 112–118

Contents lists available at ScienceDirect

Forensic Science International

journal homepage: www.elsevier.com/locate/forsciint

Carbon monoxide poisoning as a cause of death in Wuhan, China: A retrospective six-year epidemiological study (2009–2014)

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ARTICLE INFO

Article history:
Received 4 March 2015
Received in revised form 29 May 2015
Accepted 7 June 2015
Available online 15 June 2015

Keywords:
Carbon monoxide poisoning
Suicide
Accident
Homicide
Livor mortis
COHb

ABSTRACT

Carbon monoxide (CO) poisoning is a common cause of death globally, and case reports and empirical studies on CO poisoning are widely examined. However, to the authors' knowledge, CO poisoning deaths in the mainland China are scarcely studied. Therefore, this study aims to explore the incidence trend of CO poisoning deaths that occurred in Wuhan – a mega city in Central China – for a six-year period (2009–2014). This arguably is the first comprehensive study to provide an overall analysis of CO poisoning deaths that sampled the mainland Chinese population. Using the data provided by the legal physicians who are employed in nine districts of Wuhan, a total of 131 cases of CO poisoning that resulted in the death of 156 victims are collected. Out of the total, 76 cases (97 deaths) are classified as accidents, 49 cases (51 deaths) are suicides, three cases (four deaths) are homicides, one case (three deaths) is homicide–suicide, and one case (one death) is classified as undetermined. Male victims are found to be the dominant sex group (53.5%; $N = 83$); with a mean age of 44.9 years, while female victims averagely aged 46.1 years. The highest death occurring month is in January, and followed by February and December. Coal or charcoal burning is found to be the major cause of suicide CO poisoning death (66.7%), while fire accident is the major cause of accidental CO poisoning death (60.8%) in Wuhan during the six-year period.

1. Introduction

In general, carbon monoxide (here onwards referred to as CO) is a gas produced by the incomplete combustion of carbon-based materials [1]. It has a 200 to 270-time greater affinity for hemoglobin than oxygen [1–3]. Improperly installed heaters, motor vehicles, appliances that use carbon fuels, and household fires are the main sources for CO gas [4]. CO poisoning is the cause of death for approximately 2700 deaths annually in the United States alone [5]. The CO poisoning cases are well reported in empirical studies and case reports that sampled Western populations. The manners of CO poisoning deaths, derived from the Western samples, can be classified as either accident or suicide; with homicide is rarely reported [3,6–12]. In the East Asia, CO poisoning deaths are reported in South Korea, Hong Kong, and Taiwan in the form of empirical studies and case reports [13–17].

However, publications concerning the CO poisoning deaths that occurred in the mainland China are scarce. There are only two articles on topics related to the death due to poisoning are published in English journals within the last decade. The first study conducted by Zhou et al. [18] on 212 cases of poisoning in Hubei province in a 10-year period reported that 36 cases are declared as CO poisoning. The second study conducted by Zhang et al. [19] on 565 cases of poisoning in Heilongjiang province between 2000 and 2010 found that there are 91 cases are CO poisoning. Nevertheless, these studies examined all poisoning deaths; with detailed analyses on CO poisoning deaths are not performed.

Although most CO poisoning deaths reported in the mainland China are published in Chinese journals ($N = 28$), a large majority of them are published in the form of case reports ($N = 24$) [20–43]. Only four empirically-oriented retrospective reviews are published [44–47] (refer to Table 1 for details). Most of these case reports, including suicidal and accidental CO poisoning deaths, are reported by different police departments in different provinces, with causes of death include fire accidents, mining or industrial accidents, coal or charcoal burning, and liquefied gas heater

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http://dx.doi.org/10.1016/j.forsciint.2015.06.007
0379-0738/

Table 1
Case reports and retrospective studies of CO poisoning death as reported in the Chinese literature.

No.	Author(s)	Year published	Author(s)' affiliation	Data source	Methodology used	Case(s)	No. of death	HbCO content	CO source
1	Zhong et al. [20]	2002	Police department in Heilongjiang	Police cases	Case report	2	5	Examined but not specified	Not specified
2	Deng and Xu [21]	2007	Police department in Liucheng, Guangxi	Police cases	Case report	3	4	Case 1: 50%; Case 2: 45%; and Case 3 40% for male victim, and 60% for female victim	One source of CO is charcoal, and the other two are liquefied petroleum gas showering
3	Wei et al. [22]	2007	Police department and medical college in Shanxi	Police case	Case report	1	2	Victim 1: 63.9%, and Victim 2: 65.6%	Mining accident
4	Zheng et al. [23]	2012	Police department in Jinyun, Zhejiang	Police cases	Case report	2	4	Case 1: 62.9%; and Case 2: 20% for male victim(aged 40), 33.6% for male victim (aged 7), and 44.4% for male victim (aged 5)	Both cases are liquefied petroleum gas showering
5	Tian and Chen [24]	2009	Police department in Shanghai	Police cases	Case report	3	3	Case 1: 57.5%, Case 2: 65.5%, and Case 3: 62.5%	Charcoal burning
6	Liang et al. [25]	2011	Police department and medical college in Hubei	Police case	Case report	1	1	75.65%	Not specified
7	Kong et al. [26]	2011	Police department and medical college in Chonghua	Police case	Case report	1	1	19.80%	Charcoal burning
8	Wu et al. [27]	2013	Police department and police college in Jining	Police case	Case report	1	1	83%	CO replaced oxygen tank
9	Tian and Ma [28]	1996	Industrial company	Industrial accident	Case report	1	1	Not specified	Industrial accident
10	Liu et al. [29]	1996	Medical college in Sichuang	Industrial accident	Case report	1	1	Not specified	Mining accident
11	Shen [30]	1996	Not specified	Vehicle accidents	Case report	5	6	Not specified	Vehicle gas
12	Cai et al. [31]	1998	Police department in Hebei	Police cases	Case report	2	2	Case 1: 62.9% and Case 2: 62%	Coal burning for Case 1 and not specified for Case 2
13	Lan et al. [32]	2013	Police department in Guangdong	Police case	Case report	1	2	Not collected	Liquefied petroleum gas showering
14	Chen et al. [33]	2005	Police department in Shenzhen, Guangdong	Police cases	Case report	2	2	Case 1: 70.2% and Case 2: 60.5%	Both cases are liquefied petroleum gas showering
15	Fu et al. [34]	2013	Police department in Chongqing	Police case	Case report	1	3	Victim 1: 61.2%, Victim 2: 61.57%, and Victim 3: 59.42%	Charcoal burning
16	Zeng et al. [35]	2010	Police department in Maoming, Guangdong	Police case	Case report	1	2	Not specified	Vehicle gas
17	Song [36]	1995	Railway police department	Police case	Case report	1	2	Victim 1: 56% for male victim (aged 35) and Victim 2: 51% for male victim (aged 13)	Coal burning
18	Su et al. [37]	2009	Police department in Lishui, Zhejiang	Police cases	Case report	2	2	Case 1: 58.9% and Case 2: 60%	Both cases are liquefied petroleum gas showering
19	Liu et al. [38]	1999	Police department and medical college in Jilin	Police case	Case report	1	4	All victims with greater than 70%	Vehicle gas
20	Pan and Yu [39]	2009	Police department in Zhangqiu, Shandong	Police case	Case report	1	1	55%	Coal burning
21	Cao and Chen [40]	2014	Police department in Shangrao, Jiangxi	Police case	Case report	1	1	30%	Charcoal burning
22	Song [41]	2000	Railway police department	Police case	Case report	1	2	Victim 1: 56% for male victim (aged 35) and Victim 2: 51% for male victim (aged 13)	Coal burning
23	Zeng et al. [42]	2008	Police department in Longyan,Fujian	Police case	Case report	1	1	43%	Charcoal burning
24	Cheng [43]	1994	Police department in Inner Mongolia	Police case	Case report	1	1	Not specified	Coal burning
25	Wang and Song [44]	1998	Police department of Dongfeng Vehicle	Police cases	Retrospective study	36	58	The range of 18% to 76%, with further details not specified	Accidental leak in 21 cases that resulted in 38 death, suicide in 13 cases that results in 17 death, and homicide in 2 cases that resulted in 4 death