



POISONING DEATHS IN POLAND: TYPES AND FREQUENCIES REPORTED IN ŁÓDŹ, KRAKÓW, SOSNOWIEC, GDAŃSK, WROCŁAW AND POZNAŃ DURING 2009–2013

ANNA KRAKOWIAK¹, ANNA PIEKARSKA-WIJATKOWSKA², KATARZYNA KOBZA-SINDLEWSKA²,
ANNA ROGACZEWSKA², PIOTR POLITAŃSKI³, PIOTR HYDZIK⁴, BEATA SZKOLNICKA⁵,
TOMASZ KŁOPOTOWSKI⁶, SEBASTIAN PICHETA⁶, BARBARA PORĘBSKA⁷, ANDRZEJ ANTOŃCZYK⁷,
WOJCIECH WALDMAN^{8,9}, JACEK SEIN ANAND^{8,9}, ERYK MATUSZKIEWICZ^{10,11},
and MAGDALENA ŁUKASIK-GŁĘBOCKA^{10,11}

¹ Nofer Institute of Occupational Medicine, Łódź, Poland
Department of Toxicology, Toxicology Unit

² Nofer Institute of Occupational Medicine, Łódź, Poland
Department of Toxicology, Poison Information Centre

³ Nofer Institute of Occupational Medicine, Łódź, Poland
Department of Radiological Protection

⁴ Jagiellonian University Medical College, Kraków, Poland
Department of Clinical Toxicology

⁵ Jagiellonian University Medical College, Kraków, Poland
Poison Information Centre

⁶ Institute of Occupational Medicine and Environmental Health, Sosnowiec, Poland
Regional Poisons Control Centre

⁷ T. Marciniak Lower Silesian Specialized Hospital – Emergency Medicine Centre, Wrocław, Poland

⁸ Pomeranian Center of Toxicology, Gdańsk, Poland

⁹ Medical University of Gdańsk, Gdańsk, Poland
Department of Clinical Toxicology

¹⁰ University of Medical Sciences, Poznań, Poland
Department of Emergency Medicine

¹¹ Raszeja Hospital in Poznań, Poznań, Poland
Department of Toxicology

Funding: the article was funded by a grant from the Nofer Institute of Occupational Medicine (IMP No. 13.3: “Creating and updating of databases in the Poison Information Centre”). Grant manager: Anna Piekarska-Wijatowska, Ph.D.

Received: July 6, 2016. Accepted: November 9, 2016.

Corresponding author: A. Krakowiak, Nofer Institute of Occupational Medicine, Department of Toxicology, św. Teresy 8, 91-348 Łódź, Poland (e-mail: annakrak@imp.lodz.pl).

Abstract

Objectives: The aim of this study has been to assess the characteristics of acute poisoning deaths in Poland over a period of time 2009–2013. **Material and Methods:** The analysis was based on the data obtained from the patient records stored in toxicology departments in 6 cities – Łódź, Kraków, Sosnowiec, Gdańsk, Wrocław and Poznań. Toxicological analyses were routinely performed in blood and/or urine. Major toxic substances were classified to one of the following categories: pharmaceuticals, alcohol group poisonings (ethanol and other alcohols), gases, solvents, drugs of abuse, pesticides, metals, mushrooms, others. Cases were analyzed according to the following criteria: year, age and gender of analyzed patients, toxic substance category and type of poisoning. The recorded fatal poisonings were classified according to the International Classification of Diseases. **Results:** The record of 261 deaths were retrospectively reviewed. There were 187 males (71.64%) and 74 females (28.36%) and the male to female ratio was 2.52. Alcohol group poisonings were more frequently responsible for deaths in men compared to all poisonings, 91.1% vs. 71.6%, respectively ($p < 0.05$), and pharmaceutical agents were more frequently responsible for deaths in women, 47.4% vs. 28.4%, ($p < 0.05$). Methanol was the most common agent in the alcohol group poisonings, accounting for 43.75% ($N = 49$), followed by ethylene glycol, 39.29% ($N = 44$), and ethanol, 16.96% ($N = 19$). **Conclusions:** Epidemiological profile data from investigation of poisoning deaths in Poland may be very useful for the development of preventive programs. *Int J Occup Med Environ Health* 2017;30(6):897–908

Key words:

Poland, Epidemiology, Mortality, Retrospective study, Poisoning death, Fatal poisonings

INTRODUCTION

Poisonings are responsible for a significant part of hospital admissions and therefore, but also due to the associated mortality, they are considered as a major health problem. Epidemiology patterns of poisoning differs from country to country [1–3]. According to data published by Sein Anand and Świdorska [1], there were 85 398 acute intoxications in Poland in 2009. In the same year there were 491 deaths because of acute intoxications, accounting for 1.13% of all hospitalizations. In the above mentioned publication, ethanol and anticoagulants were the most common cause of death among females, while ethanol, ethylene glycol and unspecified alcohol were the most common xenobiotics involved in fatal poisonings among men.

In another publication, Czerczak and Jaraczewska [2], concerning fatal poisonings in Poland, the mortality rate was found to increase from 1.5% in 1989 to 1.8% in 1990. Gambassi et al. [3], who analyzed retrospectively poisoning-related deaths that occurred in patients admitted for acute poisoning between 1970 and 2014 to the Toxicology Unit in Florence, reported that fatal cases were attributable mainly to the intake of drugs and ingestion the *Amanita phalloides* mushroom species. Other data evaluating fatal poisoning in Estonia 2002–2013 revealed increased mortality for illicit drugs (100 vs. 118, $p < 0.001$)

and decreased mortality for both ethanol (140 vs. 72, $p < 0.001$) and carbon monoxide poisoning (109 vs. 37, $p < 0.001$) [4]. In data concerning chemicals involved in fatal poisoning in England and Wales during 2000–2011, the authors noticed that the annual number of deaths fell from 3092 (2000) to 2749 (2010), before increasing to 3341 in 2011 [5].

There has been no officially reported data regarding the incidence and prevalence of poisoning deaths in Poland.

This study shows epidemiology of poisoning deaths in a few regions of Poland during 2009–2013. The authors show the frequency of poisonings and their distribution referred to particular groups of toxic agents, patient's gender and age.

MATERIAL AND METHODS

In 1967, pursuant to a decision of the Minister of Health and Social Care, 9 Centers of Toxicology (CT) were established in the following provincial cities in Poland: Łódź, Kraków, Sosnowiec, Gdańsk, Wrocław, Poznań, Lublin, Warszawa, and Rzeszów. Each centre, established by virtue of law, consists of a Toxicology Department (TD) and a Poison Information Centre. Diagnostic laboratory facilities were made accessible to each of the Centres of Toxicology.

This retrospective study was initiated by CT in Łódź, situated in the geographical centre of Poland. Five (Kraków, Sosnowiec, Wrocław, Gdańsk and Poznań) centers declared their willingness to participate in the project. The populations served by individual centers include approximately: Sosnowiec – 6 million inhabitants, Gdańsk – 5.8 million, Łódź – 4.6 million, Kraków – 4.6 million, Wrocław – 3.9 million, and Poznań – 3.5 million. All patients with suspected acute poisoning, relevant to patient's residence, are referred to one of the toxicology departments (TDs), where pre-admission diagnoses of poisoning are confirmed or rejected by a team of professionals.

Clinical toxicologists, based on physical examination, an interview with the patient and/or witnesses to the event and the results of laboratory tests assess patient's condition and the severity of poisoning according to the four-point Poisoning Severity Score (PSS) IPCS/EAPCCT [6], in the following way: none (0) – no symptoms or signs related to poisoning; minor (1) – mild, transient and spontaneously resolving symptoms; moderate (2) – pronounced or prolonged symptoms; severe (3) – severe or life-threatening symptoms; fatal (4) – death.

At admission to TD, each patient is subjected to the quantitative determination of ethanol concentration in blood and to the toxicological analysis of urine and/or blood to detect other poisoning agents. Toxicological analyses were performed in all hospitalized patients.

Medical documentation of patients hospitalized in TDs from 1 January 2009 to 31 December 2013 was used as the material of the study. Data analysis was performed by Poison Information Centre teams constituting integral parts of the Centers participating in the study, and the collected data were sent to the Łódź Centre. Variables recorded in a specially developed database include: gender, age, place of hospitalization, type of poisoning, name of the toxic agent responsible for the poisoning, route of exposure, time of admission to the TD and patient's condition at admission.

The categorization of toxic agents was made during the study using the International Statistical Classification of Diseases and Related Health Problems, ICD-10. Poisoning by drugs, pharmacological and biological substances was coded using T36–T50 codes. Codes T51–T65 were used for encoding intoxication by non-pharmacological substances (alcohols, solvents, caustics, detergents, metals, gases, drugs of abuse, pesticides, plants and animal venoms).

Alcohols include: ethanol, methanol and ethylene glycol. Pharmaceuticals include: benzodiazepines, phenothiazine derivatives, barbiturates, antiepileptics, tricyclic antidepressants, selective serotonin reuptake inhibitors, typical neuroleptics, other sleep-inducing drugs and sedatives, analgesics, oral antihyperglycemic drugs, hormones, cardiovascular drugs, drugs of abuse, respiratory drugs and digestive drugs. The poisoning cases were also classified as: intentional (suicidal or demonstrative), unintentional (therapeutic error, abuse or overdose) and accidental (e.g., chemical accident, occupational exposure).

Patients were divided in 4 quartile groups aged: up to 42, 43–53, 54–63 and over 64 years old.

Ethical approval

The procedure of the study was approved by the Bioethics Committee at Nofer Institute of Occupational Medicine in Łódź, Poland (Protocol No. 21/2015).

Statistical analysis

Because of the qualitative nature of the analyzed nominal variables, Chi² test was used. A p-value less than the adopted level of significance ($\alpha = 0.05$) was considered statistically significant.

RESULTS

Incidence and trends

From 2009 to 2013, there were 261 deaths caused by poisoning. During the analyzed period, the number of poison-

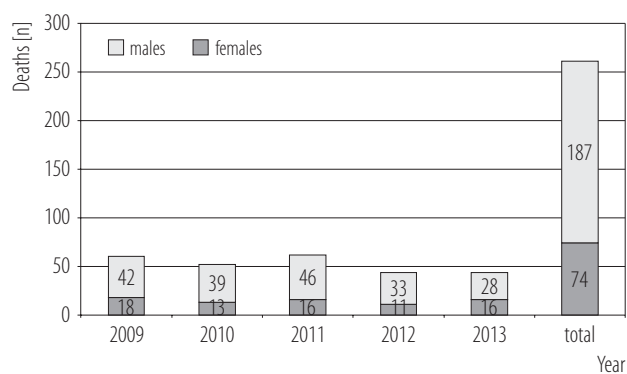
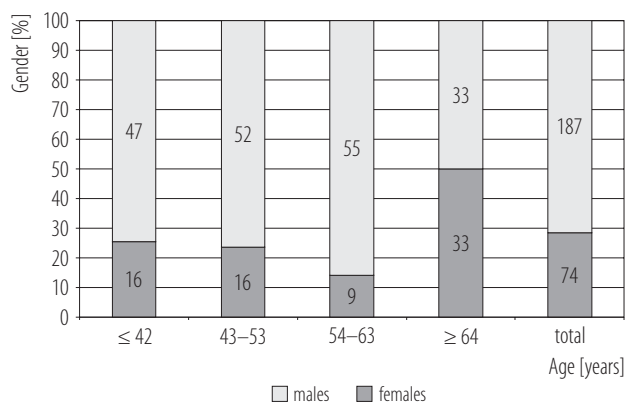


Fig. 1. Acute poisoning deaths by died persons gender and year of death in 6 regions of Poland, 2009–2013

ing deaths in each year ranged from 44 to 60 cases, with an average of 52.2 poisoning deaths per year (Figure 1). During this 5-year period, the number of poisoning deaths in each month ranged from 15 (5.7%) cases in November to 30 (11.5%) in October, with an average of 23.66 (9.06%) poisoning deaths per month. The number of fatal cases noted in each TD participating in the study and the mortality rates are displayed in the Table 1. The highest mortality rates were noted in the TD located in Wrocław, while the highest number of hospitalized patients due to acute poisonings was observed in Łódź.

Table 1. The rate of mortality from acute poisonings in 6 regions of Poland, 2009–2013

Toxicological department	Year					Total
	2009	2010	2011	2012	2013	
Gdańsk						
patients (total) [n]	1 080	1 251	1 370	1 326	1 320	6 347
fatal cases [n]	5	5	7	7	5	29
mortality rate [%]	0.5	0.4	0.5	0.5	0.4	0.5
Poznań						
patients (total) [n]	1 719	1 732	1 553	1 623	1 686	8 313
fatal cases [n]	9	6	7	4	6	32
mortality rate [%]	0.5	0.3	0.5	0.2	0.4	0.4
Kraków						
patients (total) [n]			738	749	739	2 226
fatal cases [n]	8	5	8	8	8	24
mortality rate [%]			1.1	1.1	1.1	1.1
Sosnowiec						
patients (total) [n]	1 082	965	943	834	799	4 623
fatal cases [n]	14	9	9	8	10	50
mortality rate [%]	1.3	0.9	1.0	1.0	1.3	1.1
Łódź						
patients (total) [n]	1 968	2 648	2 362	2 206	2 233	11 417
fatal cases [n]	10	10	14	7	6	47
mortality rate [%]	0.5	0.4	0.6	0.3	0.3	0.4
Wrocław						
patients (total) [n]	1 158	1 260	1 160	1 084	1 121	5 783
fatal cases [n]	14	17	16	10	9	66
mortality rate [%]	1.2	1.3	1.4	0.9	0.8	1.1



* $p < 0.05$.

Fig. 2. Acute poisoning deaths by died persons age and gender in 6 regions of Poland, 2009–2013

Year and gender

In the analyzed group of 261 deaths, there were 74 (28.35%) female and 187 (71.65%) male fatalities. The male to female ratio was 2.52. There was male preponderance in every year of performed analysis.

Statistically more frequent were fatal poisonings of the men aged 54–63 and women aged ≥ 64 years: 85.9% vs. 71.6% and 50% vs. 28.4%, respectively (Figure 2).

Place and marriage status

Places of residence for 133 patients (50%) were large agglomerations (Łódź, Kraków, Sosnowiec, Wrocław, Gdańsk and Poznań), 56 (21.5%) patients lived in villages, and 20 (7.7%) cases in small cities. There was no accessible data concerning place of living for 52 (19.9%) cases.

There were: 69 (26.4%) married, 37 (14.2%) single patients, 18 (6.9%) divorced and 16 (6.1%) widowed. For 121 (46.4%) patients, the authors were not able to obtain any information about marital status. The study found also more frequent fatal poisonings amongst widowed women, 62.5% vs. 28.4% ($p < 0.05$).

Time

Data regarding the time interval between toxic agent ingestion and arrival to the TD was accessible for 163

(62.45%) cases; 11.9% of the cases (31 patients) were hospitalized 6–12 h since poison ingestion, 15.7% (41 patients) – after no longer than 6 h, 15.7% (41 patients) – after 24 h, while 19.2% (50 patients) – were referred to the hospital within 12 to 24 h since poison ingestion.

There was no statistically significant difference in the time interval between poisoning ingestion and arrival to TD between males and females.

Clinical condition at the time of admission

At admission, the Poisoning Severity Score (PSS) was minor in 9 (3.4%), moderate in 16 (6.1%), and severe in 236 (90.4%) patients. There was no statistically significant difference in the PSS between males and females.

Route of poisoning

The overall common route of exposure was ingestion: 241 (92.3%); 16 (6.1%) cases were exposed to poison by inhalation, and 2 cases (0.8%) by dermal route (Table 2). There was no statistically significant difference in the route of poisoning between men and women.

Character of poisoning

In 111 (48.9%) the intoxication was unintentional, in 98 (42.2%) the fatal poisonings were intentional and 18 (7.9%) patients were poisoned accidentally. However, we did not note any fatal poisoning due to occupational exposure.

For 34 (13%) patients, the authors were not able to obtain any information about the character of poisoning.

Unintentional poisonings were more frequently noted in men compared to all poisonings (86.5% vs. 70.5%, $p < 0.05$). In turn, intentional (suicidal) poisonings were more frequent for women: 46.9% vs. 29.5%, respectively ($p < 0.05$) (Table 3).

Poisoning agents

During this 5-year period, alcohol group poisonings (ethanol and other alcohols) were responsible for 42.9%

Table 2. Route of exposure for fatalities in 6 regions of Poland, 2009–2013

Exposure route	Fatalities [n (%)]		
	females	males	total
Ingestion	68 (91.9)	173 (92.5)	241 (100)
Inhalation	5 (6.8)	11 (5.9)	16 (100)
Dermal	0 (0)	2 (1.1)	2 (100)
Injection	1 (1.3)	0 (0)	1 (100)
Other (bite or sting)	0 (0)	1 (0.5)	1 (100)
Total	74 (100.0)	187 (100.0)	261 (100)

Table 3. Acute poisoning deaths by intents and died persons gender in 6 regions of Poland, 2009–2013

Intent	Deaths [n (%)]		
	females	males	total
Unintentional	15 (13.5)	96 (86.5)*	111 (100)
Intentional/suicidal	46 (46.9)	52 (53.1)*	98 (100)
Unknown	7 (20.58)	27 (79.42)	34 (100)
Accidental	6 (33.3)	12 (66.7)	18 (100)
Total	74 (28.4)	187 (71.6)	261 (100)

* $p < 0.05$.

($N = 112$) fatal cases followed, in the descending order, by pharmaceutical agents – 36.4% ($N = 95$), gases (including CO) – 5.7% ($N = 15$), drugs of abuse – 3.8% ($N = 10$), mushrooms (*Amanita phalloides*) – 3.1% ($N = 8$), and pesticides – 3.1% ($N = 8$). The substances responsible for poisoning are shown in the Table 4. One single agent was involved in 209 (80.1%) cases. The remaining cases were intoxicated with 2 or more agents.

Methanol was the most common agent in the alcohol group, accounting for 43.75% ($N = 49$) cases, followed by ethylene glycol – 39.29% ($N = 44$), and ethanol – 16.96% ($N = 19$) cases.

Alcohol group poisonings were more frequently responsible for deaths in men compared to all poisonings, 91.1% vs. 71.6%, respectively ($p < 0.05$), and pharmaceutical

agents were more frequently responsible for deaths in women, 47.4% vs. 28.4%, respectively ($p < 0.05$) (Table 4). From the alcohol group methanol and ethylene glycol were more frequently responsible for deaths in men than women, 93.9% and 93.2%, respectively vs. 71.6% ($p < 0.05$).

There was no statistically significant difference between men and women in the frequency of poisonings due to the following agents: gases, solvents, drugs of abuse, mushrooms, pesticides, metals and others (Table 4).

There was no statistically significant difference in the frequency of deaths induced by: pharmaceuticals, alcohol group poisonings, solvents, metals, gases, drugs of abuse, pesticides, mushrooms, and other substances between the analyzed years of observation (2009–2013) (Table 5).

Table 4. Acute poisoning deaths by agent and died persons gender, in 6 regions of Poland, 2009–2013

Agent	Deaths [n (%)]		
	females	males	total
Alcohols	10 (8.9)	102 (91.1)*	112 (100.00)
ethanol	3 (15.8)	16 (84.2)	19 (16.96)
methanol	3 (6.1)	47 (93.9)*	49 (43.75)
ethylene glycol	3 (6.8)	41 (93.2)*	44 (39.29)
Pharmaceuticals	45 (47.4)	50 (52.6)*	95 (100.00)
Gases	5 (33.3)	10 (66.7)	15 (100.00)
Drugs of abuse	2 (20.0)	8 (80.0)	10 (100.00)
Mushrooms	4 (50.0)	4 (50.0)	8 (100.00)
Pesticides	2 (25.0)	6 (75.0)	8 (100.00)
Solvents	3 (60.0)	2 (40.0)	5 (100.00)
Other	2 (40.0)	3 (60.0)	5 (100.00)
Metals	1 (33.3)	2 (66.7)	3 (100.00)
Total	74 (28.4)	187 (71.6)	261 (100.00)

* p < 0.05.

Table 5. Acute poisoning deaths by agent and year of death in 6 regions of Poland, 2009–2013

Agent	Year [n (%)]					total
	2009	2010	2011	2012	2013	
Alcohol	22 (19.6)	17 (15.2)	28 (25.0)	20 (17.9)	25 (22.3)	112 (100)
ethanol	7 (11.7)	1 (1.9)	5 (8.2)	4 (9.1)	2 (4.5)	19 (100)
methanol	4 (6.7)	7 (13.5)	11 (8.2)	12 (27.3)	15 (34.1)*	49 (100)
ethylene glycol	11 (18.3)	9 (17.3)	12 (19.7)	4 (9.1)	8 (18.2)	44 (100)
Pharmaceuticals	25 (26.3)	22 (23.2)	20 (21.1)	14 (14.7)	14 (14.7)	95 (100)
Gases	2 (13.3)	4 (26.7)	4 (26.7)	4 (26.7)	1 (6.7)	15 (100)
Drugs of abuse	1 (10.0)	3 (30.0)	2 (20.0)	2 (20.0)	2 (20.0)	10 (100)
Mushrooms	3 (37.5)	2 (25.0)	2 (25.5)	0 (0)	1 (12.5)	8 (100)
Pesticides	5 (62.5)	1 (12.5)	1 (12.5)	1 (12.5)	0 (0)	8 (100)
Solvents	1 (20.0)	1 (20.0)	2 (40.0)	1 (20.0)	0 (0)	5 (100)
Other	1 (20.0)	1 (20.0)	1 (20.0)	1 (20.0)	1 (20.0)	5 (100)
Metals	0 (0)	1 (33.3)	1 (33.3)	1 (33.3)	0 (0)	3 (100)
Total	60 (23.0)	52 (19.9)	61 (23.4)	44 (16.9)	44 (16.9)	261 (100)

* p < 0.05.

Pharmaceuticals were more frequently responsible for intentional (suicidal) and rarer in both unintentional poisonings and those due to accidental causes, 83.1% vs. 43.2%, 15.7% vs. 48.9% and 1.1% vs. 7.9%, respectively ($p < 0.05$).

Benzodiazepines were the commonest agents in the pharmaceuticals group, accounting for 26.32% ($N = 25$), followed by cardiovascular drugs – 22.1% ($N = 21$) and drugs of abuse – 17.89% ($N = 17$).

In the case of some patients methanol and ethylene glycol were also responsible for suicidal poisonings: 3/98 patients (3.1%).

Alcohol group poisonings were in turn more frequently responsible for unintentional poisonings while rarer in intentional poisonings and those due to accidental causes, 90.4% vs. 48.9%, 8.5% vs. 43.2% and 1.1% vs. 7.9%, respectively ($p < 0.05$).

Alcohol group poisonings were more frequently responsible for unintentional deaths – 82/111 (73.87%), followed by pharmaceuticals – 11/111 (9.91%). All other agents were responsible for 8/111 (16.22%) cases.

DISCUSSION

The paper presented the first-hand information on poisoning deaths from independent toxicology departments in Poland.

Similar to some published reports from other countries, males predominated in the number of cases of poisoning, especially in the 54–63 year group [7,8]. It was also shown, that first quartile of the poisoned patient's age was 42 years old. One can suppose that years of age are associated with various deficits not only in health, but also in social status, autonomy, etc., that may result in increased probability of men auto-intoxication. In our study for the last quartile age group (≥ 64) the number of poisonings amongst men and in women equalized, which supports thesis, that for elderly people gender differences in mentioned above deficiencies vanish.

In this study, males and females did not significantly differ in the seasonal distribution of poisoning deaths. Our study differs from some studies finding seasonality of suicides in females but not in males [9,10]. However, the month with the highest incidence of poisoning deaths in our study was October (autumn). On the other hand, in the study conducted by the World Health Organization (WHO), analyzing seasonality of suicidal attempts collected from thirteen European centers, the largest number of such attempts was found in May.

It is reasonable to assume that the discrepancy is probably due to the different aetiology of poisoning in different countries [11]. In the above mentioned study, the rates for drugs overdoses per 100 000 inhabitants were especially high in Oxford and Helsinki. Szeged stood out because it had strikingly high rates for pesticides and solvents. The rates for alcohol were highest in Odense, Helsinki and Sor-Trodelaag, while they were extremely low in the centers Szeged, Padova and Emilia Romagna.

Our study found also a more frequent fatal poisonings amongst widowed women.

Many studies have also shown that death of one's spouse is one of the major reason to attempt poisoning [12]. However, in the study conducted by the WHO, marriage was among men a factor that protected from suicide, while among women that relationship was not statistically significant [13].

We found that unintentional poisonings were more frequently noted in the case of men compared to all poisoning. The reported data is in accordance with observation concerning poisoning deaths in China published by Liu et al. [8]. In the cited work covering a 10-year period, there was male preponderance in every year except for 2004, and the vast majority of poison exposures were accidental, followed by suicidal poisonings.

We noticed, that intentional (suicidal) poisonings were more frequent for women. According to a study launched by the WHO (Suicide Trends in At-Risk Territories,

WHO START Study) [14], spanning over different parts of the world, women are more likely to attempt suicide than men.

Our study also found that alcohols were the most frequent cause of poisoning deaths during the analyzed period 2009–2013 in Poland. Our data was in accordance with observation concerning epidemiology of poisoning in Łódź, Poland, during 2003–2007 [15].

In the period of time cited above (2003–2007), nine poisoning deaths were recorded. Poisoning with pharmaceuticals constituted the most frequent cause of death in 2003–2005, while alcohols including methanol and ethylene glycol were the major etiologic factor of poisoning mortality during 2006–2007.

Alcohol-related death is one of the major public health problems facing many countries. Ehmke et al. [16] retrospectively reviewed 1455 cases in Pretoria, in which alcohol was taken, of 2344 medico-legal autopsies done in 2009.

We found that alcohols were more frequently responsible for deaths in men. From the alcohol group methanol and ethylene glycol were more frequently responsible for deaths amongst men than woman. Similar data concerning fatal alcohols poisoning in Poland has been reported by Sein Anand and Świdarska [1] as mentioned in the Introduction section of this article. Increased mortality because of methanol poisonings was also reported by Zakharov et al. in 2012 in the Czech Republic [17]. Reported data from the mass methanol poisoning in the Czech Republic presented 121 patients with confirmed methanol poisoning. From a total of 121 intoxicated subjects, 20 died outside the hospital and 101 were hospitalized. Among them, 60 survived without, and 20 with visual/CNS sequelae whereas 21 patients died. The total and hospital mortality rates were 34% and 21%, respectively.

Like in the Czech Republic, methanol in Poland is mixed and bottled outside the facilities of legal producers and then distributed to several illegal sellers. In Poland, till 2013, methanol was also available in the household

products, such as windshield fluids, at concentrations above 3%. The Ordinance of 25 September 2013 issued by the Minister of National Economy, has banned the sales of substances containing methanol at concentrations over 3% by weight and mixtures containing methanol at concentrations over 3% by weight to consumers of methanol throughout the whole territory of Poland [18].

Increased number of fatal poisoning due to alcohol ingestion has also been noted by Handley and Flanagan [5] in 2011 (401 cases) in comparison with the period 2000–2010 (median (Me) = 167, range 113–198 per year) in England and Wales. However, this sudden increase was due to a coding change following the implementation of ICD-10 version 2010 rather than increased production of this toxic agent.

Our study indicates, that pharmaceuticals were more frequently responsible for intentional (suicidal) and rarer in both unintentional poisonings and those due to accidental causes. This is consistent with other studies on poisoning in different age groups [19,20]. The most commonly used drugs were benzodiazepines, responsible for the largest proportion of deaths, which is also confirmed by other studies [7,21–24]. In our opinion, the large recorded number of cases of benzodiazepine poisoning may reflect their extensive sales and overall use [25,26]. In contrast to our data, Handley and Flanagan [5] found that annual deaths due to benzodiazepines were relatively stable until 2006 (Me = 224, range: 177–248), but continued to increase steadily to 293 in 2011. Handley and Flanagan have concluded that the reduction of benzodiazepine poisoning deaths were due to introducing alternative Z-drugs (zopiclone, zolpidem and zaleplone).

In our data, gases, including CO, were the third major cause of poisoning deaths. Many Polish dwelling houses have not been provided with a reliable ventilation systems, and in many Polish houses coal gas continues to be a traditional source of domestic gas supply, what partly may explain the contribution of this toxic agent to the overall

number of fatal poisonings. Carbon monoxide was one of the predominant agents in acute poisoning deaths also in England and Wales [27]. Similar, Liu et al. [8] recorded an increase in the proportion of deaths due to CO in the period 1999–2008 compared to the former (1956–1984 and 1983–1998) reports.

There was no statistically significant difference between men and women in the frequency of poisonings due to the following agents: gases, solvents, drugs of abuse, mushrooms, pesticides, metals and others, probably due to low numbers.

In our study, the highest mortality rate was noted for TD located in Wrocław, Poland. The variations observed may probably be explained by regional differences in the treatment procedure practices. Some TDs transfer their patients in critical condition for treatment in other hospitals, so that data recorded in TD files do not reflect the true number of fatal poisonings.

The limitation of the present study is:

- It's retrospective design and missing data from 3 TDs (Warszawa, Lublin and Rzeszów).
- It includes only hospitalized cases in TDs. Further data should be collected, since fatal poisonings occur also outside these departments. Hence, the inclusion of all deaths by acute poisoning will give a more complete picture of toxicological mortality.
- Despite scrutinizing the medical histories and other additional sources of information, it has not been possible to get all relevant information in each case, hence the number of drug poisonings might have been underestimated. However, this is till date the most comprehensive data ever assessing the characteristics of acute poisoning deaths in Poland over a period of time 2009–2013.

CONCLUSIONS

The present study showed that alcohols, pharmaceuticals and gases were the main common agents involved in fatal poisoning cases. In our opinion, epidemiological profile

data from investigation of poisoning deaths in Poland may be very useful for the development of preventive programs connected with intentional poisonings. Such programs should be focused on the role of family doctors in the process of recovery after acute poisoning. They should prescribe medicines in amounts not greater than absolutely necessary and maybe more often recommend psychiatric care for the poisoned patients.

REFERENCES

1. Sein Anand J, Świdarska A. [Selected data concerning acute intoxications with xenobiotics in Poland in the year 2009]. *Przegl Lek.* 2010;67(8):559–65. Polish.
2. Czerczak S, Jaraczewska W. [Mortality in acute poisonings]. *Med Pr.* 1993;44(4):379–83. Polish.
3. Gambassi F, Botti P, Ieri A, Pracucci C, Bertieri L, Mannaioni G. Toxicologic related deaths: A case series from 1970 to 2014. *Clin Toxicol.* 2015;53(4):263, <https://doi.org/10.3109/15563650.2015.1024953>.
4. Paasma R, Tonisson M, Vorno T, Lund C, Hovda KE. Fatal poisonings in Estonia 2002–2013. *Clin Toxicol.* 2015;53(4):263, <https://doi.org/10.3109/15563650.2015.1024953>.
5. Handley SA, Flanagan RJ. Drugs and other chemicals involved in fatal poisoning in England and Wales during 2000–2011. *Clin Toxicol.* 2014;52:1–12, <https://doi.org/10.3109/15563650.2013.872791>.
6. Persson H, Sjöberg G, Haines J, Pronczuk de Garbino J. Poisoning Severity Score: Grading of acute poisoning. *J Toxicol Clin Toxicol.* 1998;36:205–13, <https://doi.org/10.3109/15563659809028940>.
7. Karbakhsh M, Zandi NS. Pattern of poisoning in the elderly: An experience from Tehran. *Clin Toxicol.* 2008;46(3):211–7, <https://doi.org/10.1080/15563650701638982>.
8. Liu Q, Zhou L, Zheng N, Zhuo L, Liu Y, Liu L. Poisoning deaths in China: Type and prevalence detected at the Tongji Forensic Medical Centre in Hubei. *Forensic Sci Int.* 2009;193(1–3):88–94, <https://doi.org/10.1016/j.forsciint.2009.09.013>.

9. Masterton G. Monthly and seasonal variation in parasuicide. A sex difference. *Br J Psychiatry*. 1991;158:155–7, <https://doi.org/10.1192/bjp.158.2.155>.
10. Polewka A, Szkolnicka B, Targosz D, Groszek B, Kroch S, Chrostek-Maj J, et al. [Fluctuations and seasonality in suicidal attempts]. *Przegl Lek*. 2004;61(4):269–73. Polish.
11. World Health Organization, Department of Mental Health. Figures and facts about suicide [Internet]. Geneva: The Organization; 1999 [cited 2016 May 10]. Available from: http://apps.who.int/iris/bitstream/10665/66097/1/WHO_MNH_MBD_99.1.pdf.
12. Erlangsen A, Bille-Brahe U, Jeune B. Differences in suicide between the old and the oldest old. *J Gerontol*. 2003;58B(5):314–22, <https://doi.org/10.1093/geronb/58.5.S314>.
13. World Health Organization, Department of Mental Health, Mental and Behavioral Disorders. Preventing suicide. A resource for general physicians [Internet]. Geneva: The Organization; 2000 [cited 2016 May 10]. Available from: http://apps.who.int/iris/bitstream/10665/67165/1/WHO_MNH_MBD_00.1.pdf.
14. De Leo D, Milner A, Fleischmann A, Bertolotto J, Collins S, Amadeo S, et al. The WHO START Study: Suicidal behaviors across different areas of the world. *Crisis*. 2013;34(3):156–63.
15. Krakowiak A, Kotwica M, Śliwkiewicz K, Piekarska-Wiatkowska A. Epidemiology of acute poisonings during 2003–2007 in Toxicology Unit, Department of Occupational Medicine and Toxicology, Nofer Institute of Occupational Medicine, Łódź, Poland. *Int J Occup Med Environ Health*. 2011;24(2):199–207, <https://doi.org/10.2478/s13382-011-0016-0>.
16. Ehmke U, Toit-Prinsloo LD, Saayman G. A retrospective analysis of alcohol in medico-legal autopsied deaths in Pretoria over a 1 year period. *Forensic Sci Int*. 2014;245:7–11, <https://doi.org/10.1016/j.forsciint.2014.09.009>.
17. Zakharov S, Pelcova D, Urban P, Navratil T, Diblik P, Kuthan P, et al. Czech mass methanol outbreak 2012: Epidemiology, challenges and clinical features. *Clin Toxicol*. 2014;52:1013–24, <https://doi.org/10.3109/15563650.2014.974106>.
18. [Ordinance of 25 September, 2013 issued by the Minister of National Economy, amending the ordinance on the control of production, marketing and use of dangerous or hazardous substances and mixtures, and marketing or use of products containing such substances or mixtures]. Warszawa: The Minister; 2013 [cited 2016 May 10]. Available from: <http://isap.sejm.gov.pl/DetailsServlet?id=WDU20130001173>. Polish.
19. Afshari R, Majdzadeh R, Balali-Mood M. Pattern of acute poisoning in Mashhad, Iran 1993–2000. *J Toxicol Clin Toxicol*. 2004;42(7):965–75, <https://doi.org/10.1081/CLT-200042550>.
20. Abdollahi M, Jalali N, Sabzevari O, Hoseini R, Ghanea T. A retrospective study of poisoning in Tehran. *J Toxicol Clin Toxicol*. 1997;35(4):387–93, <https://doi.org/10.3109/15563659709043371>.
21. Michel K, Ballinari P, Bille-Brahe U, Bjerke T, Crepet P, de Leo D, et al. Methods used for parasuicide: Results of the WHO/EURO Multicentre Study on Parasuicide. *Soc Psych Psych Epid*. 2000;35(4):156–63, <https://doi.org/10.1007/s001270050198>.
22. Yang CC. Acute poisoning in the elderly: An increasingly recognized but still overlooked problem. *J Chin Med Assoc*. 2010;73(4):183–5, [https://doi.org/10.1016/S1726-4901\(10\)70037-X](https://doi.org/10.1016/S1726-4901(10)70037-X).
23. Sorodoc V, Jaba IM, Lionte C, Mungiu OC, Sorodoc L. Epidemiology of acute drug poisoning in a tertiary center from Iasi County, Romania. *Hum Exp Toxicol*. 2011;30(12):1896–903, <https://doi.org/10.1177/0960327111403172>.
24. Jönsson AK, Spigest O, Tjäderborn M, Druid H, Hahh S. Fatal drug poisonings in a Swedish general population. *BMC Clin Pharmacol*. 2009;9(7):1–5, <https://doi.org/10.1186/1472-6904-9-7>.
25. Lahti RA, Vuori E. Fatal drugs poisonings: Medico-legal reports and mortality statistics. *Forensic Sci Int*. 2003;136(1–3):35–46.

26. Vermes A, Roelofsen EE, Sabadi G, van den Berg B, de Quelerij M, Vulto AG. Intoxication with therapeutic and illicit drug substances and hospital admission to a Dutch university hospital. *Neth J Med.* 2003;61(5):168–72.
27. Flanagan RJ, Rooney C. Recording acute poisoning deaths. *Forensic Sci Int.* 2002;128(1–2):3–19, [https://doi.org/10.1016/S0379-0738\(02\)00158-5](https://doi.org/10.1016/S0379-0738(02)00158-5).