Risk factors for workplace intoxications: a case-control study on data from the Poison Control Center of Policlinico Umberto I in Rome

Fattori di rischio per intossicazioni sul luogo di lavoro: uno studio caso-controllo sui dati del Centro Antiveleni del Policlinico Umberto I di Roma

Giuseppe La Torre,[1] Mattia Marte,[1] Nicola Zotti,[1] Michele Stanislaw Milella,[2] Francesco Pugliese,[3] Gabriella Vivino,[2] Maria Caterina Grassi[2]

[1]Department of Public Health and Infectious Diseases, Sapienza University of Rome; [2]Clinical Toxicology Unit – Poison Control Center and Drug Addiction Unit, Hospital Policlinico Umberto I, Rome; [3]Department of Emergency, Admission, Critical Care, and Trauma, Hospital Policlinico Umberto I, Rome, Italy

ABSTRACT

Background. The term intoxication refers to the disease, acute or chronic, caused by harmful substances or those made harmful due to factors such as high concentration or impaired immune defenses. These substances can cause reversible or irreversible changes in tissues and organs, including oncogenic and mutagenic effects. In response to the need for treatment and prevention services for intoxication and chemical impacts, poison control centers (PCCs) have emerged worldwide. This study aimed to verify the link between the type of intoxication detected by the PCC of the Policlinico Umberto I of Rome and occupational exposure.

Methods. The study employed a retrospective case-control design. Cases and controls were identified from the archive of the Clinical Toxicology Unit – Poison Control and Anti-Drug Center at Policlinico Umberto I, which included individuals who had contacted the PCC between 2009 and 2018. The case group comprised patients whose intoxication occurred at the workplace and/or was accidental and work-related. Controls were randomly selected from the PCC database using EpiCalc2000, excluding those who met the case criteria.

Results. A total of 448 patients were included (202 cases, 246 controls). The most involved agents were drugs (44.7% controls, 3.5% cases), caustic cleaning products (19.7% controls, 27.7% cases), fuels, solvents, paints, oils (2.5% controls, 22.8% cases), and pesticides (5.3% controls, 12.9% cases). Ingestion was the primary exposure route among cases (68.6%), while inhalation prevailed among controls (46.5%). Multivariate analysis revealed that occupational intoxication was strongly associated with exposure to other toxic substances (OR 55.19), fuels, solvents, paints, oils (OR 48.36), and pesticides (OR 12.61). Conversely, the association with risk factors such as drugs (OR 0.06), substances of abuse (OR 0.10), and mushrooms (OR 0.10) was found to be protective.

Conclusions. The primary routes of exposure to toxic substances in the workplace were inhalation in approximately half of the cases and ingestion in just over a quarter of the cases. The substances most commonly involved were caustic cleaning products and fuels, solvents, paints, and oils. These results may facilitate the development of specific prevention strategies.

Key words: case-control study, intoxication, workplace, poison control center.

RIASSUNTO

Contesto. Il termine intossicazione si riferisce a una patologia, acuta o cronica, causata da sostanze nocive o rese tali da fattori come l'elevata concentrazione o le compromesse difese immunitarie dell'organismo. Queste sostanze possono provocare alterazioni reversibili o irreversibili nei tessuti e negli organi, inclusi effetti oncogeni e mutageni. In risposta alla necessità di servizi di trattamento e prevenzione dell'intossicazione e degli impatti chimici, sono sorti in tutto il mondo i centri antiveleni (CAV). Questo studio si propone di verificare l'associazione tra il tipo di intossicazione rilevato dal CAV del Policlinico Umberto I di Roma e l'esposizione professionale.

Metodi. Lo studio è stato condotto utilizzando un disegno caso-controllo retrospettivo. I casi e i controlli sono stati identificati tramite l'archivio dell'Unità Operativa Dipartimentale "Tossicologia Clinica – Centro Antiveleni e Centro Antidroga" del Policlinico Umberto I, includendo i soggetti che hanno contattato il CAV tra il 2009 e il 2018. Il gruppo dei casi comprendeva pazienti con intossicazioni avvenute sul luogo di lavoro e/o di natura accidentale a carattere professionale. I controlli sono stati selezionati in modo casuale dal database del CAV mediante EpiCalc2000, escludendo i soggetti che rispondevano ai criteri per essere classificati come casi.

Risultati. Sono stati inclusi in totale 448 pazienti (202 casi, 246 controlli). Le sostanze più coinvolte sono risultate essere farmaci (44.7% controlli, 3.5% casi), prodotti caustici per la pulizia (19.7% controlli, 27.7% casi), combustibili, solventi, vernici, oli (2.5% controlli, 22.8% casi) e pesticidi (5.3% controlli, 12.9% casi). L'ingestione è risultata la principale via di esposizione tra i casi (68.6%), mentre tra i controlli è stata più comune l'inalazione (46.5%). L'analisi multivariata ha evidenziato una forte associazione tra intossicazione professionale ed esposizione ad altre sostanze tossiche (OR 55.19), combustibili, solventi, vernici, oli (OR 48.36) e pesticidi (OR 12.61). Al contrario, l'esposizione a farmaci (OR 0.06), *sostanze d'abuso (OR 0.10) e funghi (OR 0.10) è risultata associata a un rischio professionale significativamente inferiore.*

Conclusioni. Le principali vie di esposizione a sostanze tossiche in ambito lavorativo si sono rivelate essere l'inalazione in circa la metà dei casi e l'ingestione in poco più di un quarto. Le sostanze più frequentemente coinvolte sono state i prodotti caustici per la pulizia e i combustibili, solventi, vernici e oli. Questi risultati potrebbero contribuire allo sviluppo di strategie preventive specifiche.

Parole chiave: studio caso-controllo, intossicazione, ambiente di lavoro, centro antiveleni.

Introduction

The term intoxication refers to an acute or chronic morbid condition caused by the action of substances that are inherently harmful or become harmful due to particular conditions, such as high concentration or a decrease in the body's normal defense mechanisms. These substances can induce reversible or irreversible alterations in tissues and organs, including oncogenic and mutagenic effects.[1]

Intoxications encompass a vast array of pathologies with varying degrees of severity, resulting from exposure through different routes and modes to a wide range of causal agents. According to the World Health Organization (WHO), in 2014, accidental poisoning was responsible for approximately 346,000 deaths worldwide.[2] Specifically, accidental pesticide exposure is estimated to cause around 11,000 deaths per year globally.[3]

The clinical presentations of intoxications vary significantly and often pose diagnostic and therapeutic challenges. This phenomenon affects the entire emergency sector, from local emergency services to emergency departments, intensive care units, and critical care. However, in some hospitals, due to specific organizational aspects, intoxicated patients may be admitted and treated in general medicine and surgery departments or specialized units for specific monitoring and assistance needs.[4]

To address the need for dedicated services for the treatment and prevention of intoxications and adverse effects of chemicals, including substances of abuse, poison control centers (PCCs) have been established worldwide. These centers specialize in managing intoxications and their adverse effects, employing medical professionals trained in diagnosing and treating toxicological conditions. According to WHO guidelines and standards, PCCs provide toxicological information and consultation to the community. Additionally, they handle intoxication cases, conduct toxicological analyses, engage in surveillance and alert activities, promote scientific research, and offer education and training in the prevention, diagnosis, and treatment of intoxications.[5]

A study conducted in the United States highlights various benefits of PCCs, including a significant impact on reducing healthcare costs, disease detection and monitoring, public and professional education aimed at promoting correct behaviors in the population, and providing valuable sources of information and data.[6]

Regarding Italian PCCs, it is estimated that they receive approximately 100,000 requests for toxicological consultations annually, covering various types of agents.[7] The number of consultations varies greatly depending on the center, with around 60% handled by the PCC in Milan, 24% by the three PCCs in Rome, 5% by the PCC in Naples, 5% by the National Center for Toxicological Information in Pavia, and the remaining 6% managed by other active centers in Italy.[8]

The objective of this study was to assess, through an epidemiological case-control design, the association between the types of intoxications recorded by the PCC of the Policlinico Umberto I of Rome and occupational events.

Methods

The study employed a retrospective case-control design. Cases and controls were retrieved from the digital archive of the Clinical Toxicology Unit – Poison Control and Anti-Drug Center at Policlinico Umberto I, among individuals who sought assistance at the PCC between 2009 and 2018.

Patients classified as "cases" met the following criteria: i) the workplace was identified as the location of the intoxication; and/or ii) the intoxication was categorized as an accidental occupational event.

The control group was selected using a table of randomly generated numbers through EpiCalc2000 software among individuals in the PCC database who did not meet the criteria for classification as cases. Both cases and controls were aged 18 years or older.

To ensure patient privacy, names and surnames were removed from the database, leaving only medical record numbers for identification.

Variables of interest in the study

Cause of intoxication: medications; caustic agents/caustic cleaning products; foaming cleaning products; fuels, solvents, paints, oils; agrochemicals, pesticides, insecticides; substances of abuse; foods; mushrooms; plants; animals; herbal products; complementary medicine preparations; other toxic agents; non-toxic agents.

Routes of exposure/contact with the toxic agent: ingestion; inhalation; inoculation; animal bite; cutaneous contact; oral mucosa contact; rectal mucosa contact; ocular exposure; auricular exposure.

Intervention measures: hospitalization; clinical observation; specialist consultation; referral to the emergency department; other interventions.

Statistical analysis

The statistical analysis included the generation of frequency and contingency tables. Differences between cases and controls for variables of interest (univariate analysis) were evaluated using the chi-square test. The crude odds ratio (OR) and corresponding 95% confidence interval (CI 95%) were calculated to assess the association between each potential cause and the likelihood of being classified as a case. A multivariate analysis was conducted using three distinct logistic regression models: i) a model calculating the adjusted OR for each potential cause, incorporating four covariates – three constant (age, gender, macroarea) and one corresponding to the specific cause; ii) a stepwise model with backward elimination including all variables that showed $p<0.25$ in the univariate analysis; and iii) a model calculating the adjusted OR for each potential cause derived from the multivariate analysis, including only risk factors (OR>1).

The analysis was performed using IBM®-SPSS® Statistics, version 25.0, with a significance level set at $p<0.05$.

Results

Study participants and sociodemographic characteristics

A total of 448 patients participated in the study, including 202 cases and 246 controls.

Table 1 presents the sociodemographic characteristics of participants, including the year of injury, gender, request type, origin, and macroarea. The macroarea variable was categorized as follows: i) Northern Italy, 2.8% of controls (n=7) and 0.5% of cases (n=1), including the regions: Valle d'Aosta, Piedmont, Lombardy, Trentino-Alto Adige, Friuli-Venezia Giulia, Liguria, Veneto, and Emilia-Romagna; ii) Central Italy, 72.8% of controls (n=179) and 82.2% of cases (n=166), including the regions: Tuscany, Marche, Umbria, Lazio, Abruzzo, and Molise; iii) Southern Italy, 17.1% of controls (n=42) and 14.3% of cases (n=29), including the regions: Puglia, Campania, Basilicata,

Calabria, Sicily, and Sardinia. Missing data for this variable totaled 18 in the control group and 6 in the case group. The year of injury variable had no missing data.

Regarding gender, males accounted for 37.8% of controls (n=93) and 58.9% of cases (n=119), while females represented 59.3% of controls (n=146) and 33.7% of cases (n=68). Missing data were 7 in controls and 15 in cases.

Concerning the request type, no significant differences were found for i) private: 43.1% in controls (n=106) and 41.6% in cases (n=84); ii) physician: 53.6% in controls (n=132) and 54.9% in cases (n=111); and iii) non-physician healthcare worker: 2.4% in controls (n=6) and 3.0% in cases (n=6). Missing data were 2 in controls and 1 in cases.

As for the request origin, it was unspecified for 11.4% (n=28) of controls and 10.9% (n=22) of cases; it originated from municipalities in 39.4% (n=97) of controls and 39.6% (n=80) of cases; from hospitals in 13.0% (n=32) of controls and 10.4% (n=21) of cases; and from emergency rooms in 36.2% (n=89) of controls and 39.1% (n=79) of cases.

Table 2 outlines the route of exposure/contact with toxic agents and the cause of intoxication, differentiating between absolute values and percentages in both cases and controls. Of the 448 toxic exposures recorded over 10 years, 227 involved oral ingestion, with 168 (68.6%) controls and 59 (29.2%) cases, and 115 involved inhalation, with 21 (8.6%) controls and 94 (46.5%) cases. Less common exposure routes included animal bites or insect stings (22 controls, 9.0%; 8 cases, 4.0%) and cutaneous absorption (7 controls, 2.9%; 20 cases, 9.9%).

The most frequently involved agents were i) medications: 44.7% controls (n=109), 3.5% cases (n=7); ii) caustic cleaning products: 19.7% controls (n=48), 27.7% cases (n=56); iii) fuels, solvents, paints, oils: 2.5% controls (n=6), 22.8% cases (n=46); and iv) pesticides, insecticides: 5.3% controls (n=13), 12.9% cases (n=26). Follow-up data revealed three deaths (1.2%) in the control group. Table 3 presents the interventions taken for cases and controls.

Table 4 summarizes results from the three multivariate analyses, including the crude analysis, the adjusted OR (OR^1) controlling for age, gender, and macroarea, and the adjusted OR (OR^2) focusing on identified risk factors only.

The multivariate analysis identified various risk factors, including other toxic agents (OR 55.19; 18.11-168.17), fuels, solvents, paints, oils (OR 48.36; 18.78-124.54), and pesticides (OR 12.61; 5.76-27.63). The association with risk factors, such as drugs (OR 0.06; 0.03-0.14), substances of abuse (OR 0.10; 0.01-0.80), and mushrooms (OR 0.10; 0.01-0.78), was found to be protective.

Discussion

The notifications received by the PCC of the Policlinico Umberto I mainly originated from Central Italy. In cases of occupational intoxication, the most frequently implicated substances were caustic agents and chemical products such as fuels, solvents, paints, and oils. In contrast, while caustic agents remained prevalent in the control group, medications emerged as the second most common category. The strongest risk factors for workplace intoxications were fuels, solvents, paints, and oils, followed by pesticides. The latter were identified as strongly associated risk factors for acute intoxication events, even in a multivariate analysis conducted on PCC data from São Paulo, Brazil.[9] However, this analysis did not specifically discriminate occupational cases. The most frequent routes of exposure were inges-

Table 1. Descriptive analysis of the study sample.

Variables	Controls n (%)	Cases n (%)	p-value
Total	246	202	
Year of accident			
2009	10 (4.1)	6 (3.0)	0.026
2010	19 (7.7)	32 (15.8)	
2011	34 (13.8)	30 (14.9)	
2012	18 (7.3)	16 (7.9)	
2013	21 (8.5)	9 (4.5)	
2014	10 (4.1)	9 (4.5)	
2015	20 (8.1)	12 (5.9)	
2016	25 (10.2)	20 (9.9)	
2017	41 (16.7)	47 (23.3)	
2018	48 (19.5)	21 (10.4)	
Gender			
Male	93 (37.8)	119 (58.9)	<0.001
Female	146 (59.3)	68 (33.7)	
Type of request			
Private	106 (43.1)	84 (41.6)	0.901
Medical doctor	132 (53.6)	111 (54.9)	
Other healthcare professional	6 (2.4)	6 (3.0)	
Request coming from			
Not specified	28 (11.4)	22 (10.9)	0.821
Municipalities	97 (39.4)	80 (39.6)	
Hospitals	32 (13.0)	21 (10.4)	
Emergency rooms	89 (36.2)	79 (39.1)	
Macroarea			
North	7 (2.8)	1 (0.5)	0.083
Centre	179 (72.8)	166 (82.2)	
South	42 (17.1)	29 (14.3)	

tion and inhalation, aligning with a Chinese retrospective study analyzing data from 2012 to 2016.[10]

According to the 9th annual report (2014) of the *Istituto Superiore di Sanità* (Italy's National Institute of Health),[11] the most frequent route of exposure recorded in Italy was ingestion (73%; n=32,884). The most frequently reported non-drug intoxication came from household cleaning products (19%; n=8,696). Among adult subjects, the most frequent exposures were also household cleaning products (20%; n=3,725), followed by parasiticides (5%; n=900).

Table 2. Routes of exposure to toxic agents in cases and controls.

	Controls n (%)	Cases n (%)	p-value
Route of exposure	246	202	
Not indicated	16 (6.5)	3 (1.5)	<0.001
Ingestion	168 (68.6)	59 (29.2)	
Inhalation	21 (8.6)	94 (46.5)	
Inoculation	8 (3.3)	5 (2.5)	
Animal bite	22 (9.0)	8 (4.0)	
Cutaneous	7 (2.9)	20 (9.9)	
Oral mucosa	2 (0.8)	3 (1.5)	
Ocular	1 (0.4)	8 (4.0)	
Other	0 (0.0)	2 (1.0)	
Cause of intoxication			
Drugs	109 (44.7)	7 (3.5)	<0.001
Cleaning products: caustic	48 (19.7)	56 (27.7)	
Cleaning products: foaming	6 (2.5)	7 (3.5)	
Fuels, solvents, paints, oils	6 (2.5)	46 (22.8)	
Pesticides (pesticides/insecticides)	13 (5.3)	26 (12.9)	
Illicit drugs	7 (2.9)	1 (0.5)	
Foods	3 (1.2)	6 (3.0)	
Mushrooms	10 (4.1)	1 (0.5)	
Plants (berries)	1 (0.4)	1 (0.5)	
Animals/ticks	29 (11.9)	10 (5.0)	
Herbal products	1 (0.4)	0 (0.0)	
Complementary medicine products	2 (0.8)	0 (0.0)	
Other toxic	4 (1.6)	35 (17.3)	
Non toxic agent	5 (2.0)	6 (3.0)	

Table 3. Measures taken in cases and controls.

	Controls n (%)	Cases n (%)	p-value
Hospitalization			
No	231 (93.9)	192 (95.0)	0.599
Yes	15 (6.1)	10 (5.0)	
Medical observation			
No	145 (58.9)	129 (63.9)	0.288
Yes	101 (41.1)	73 (36.1)	
Consulting			
No	232 (94.3)	193 (95.5)	0.555
Yes	14 (5.7)	9 (4.5)	
Admission to emergency room			
No	221 (89.8)	178 (88.1)	0.562
Yes	25 (10.2)	24 (11.9)	
Other measures			
No	227 (92.3)	177 (87.6)	0.100
Yes	19 (7.7)	25 (12.4)	
No measure			
No	206 (83.7)	164 (81.2)	0.479
Yes	40 (16.3)	38 (18.8)	
Evolution			
Not reported	187 (76.0)	157 (77.7)	0.638
Death	3 (1.2)	0 (0.0)	
Recovery	20 (8.1)	17 (8.4)	
None	33 (13.4)	26 (12.9)	
Health after-effects	1 (0.4)	0 (0.0)	
Hospital admission	2 (0.8)	2 (1.0)	

Table 4. Results of the multivariate analysis. Outcome variable: intoxication due to occupational exposure.

Parameter	Crude OR	Adjusted OR[1]	Adjusted OR[2]
Drug intoxication	0.04 (0.02-0.10)	0.06 (0.03-0.14)	
Caustic	1.59 (1.02-2.46)	1.60 (0.98-2.61)	7.36 (4.18-12.95)
Foaming	1.44 (0.47-4.34)	1.15 (0.35-3.82)	7.36 (2.29-23.62)
Fuels, solvents, paints, oils	11.79 (4.92-28.27)	10.33 (3.93-27.15)	48.36 (18.78-124.54)
Pesticides	2.65 (1.32-5.30)	2.51 (1.17-5.40)	12.61 (5.76-27.63)
Illicit drug	0.17 (0.21-1.39)	0.10 (0.01-0.80)	
Food poisoning	2.48 (0.61-10.04)	1.91 (0.39-9.28)	
Mushroom poisoning	0.12 (0.15-0.92)	0.10 (0.01-0.78)	
Animals/ticks	0.39 (0.18-0.82)	0.41 (0.18-0.91)	
Other toxic	12.68 (4.42-36.34)	21.95 (5.09-94.73)	55.19 (18.11-168.17)
Non-toxic agent	1.48 (0.44-4.91)	1.57 (0.45-5.41)	7.57 (2.15-26.60)

OR, odds ratio; OR[1], odds ratio adjusted for age, gender, and macroarea; OR[2], odds ratio including only risk factors.

Regarding pharmaceutical intoxications in adults (>19 years), the most frequently reported were mainly sedatives, hypnotics, antipsychotics (20%; n=3,701), antidepressants (10%; n=1,737), and analgesics (6%; n=1,172).

Between February 1 and March 31, 2006, Lombard PCCs (Milan, Pavia, and Bergamo) collaborated on an integrated surveillance system implemented for the Piedmont region during the 2006 Winter Olympics.[12] During this period, 697 human exposure cases were examined.

Among all reported exposures, 70% (n=488) were unintentional, 27% (n=189) were intentional, 93% occurred at the victim's residence (n=646), and 2% occurred in the workplace (n=16).

This study highlights that non-pharmaceutical agents were involved in approximately 55% of exposure cases (n=387), while pharmaceutical agents accounted for 41% (n=288).

The most frequently reported non-pharmaceutical agents were household detergents (115 cases), fumes, gases, or vapors (63 cases), cosmetics or personal care products (36 cases), toys or foreign objects (30 cases), and food and beverages (22 cases).

The highest reported pharmaceutical intoxications came from sedatives, hypnotics, and antipsychotics, with 53 cases, 74% of which were intentional. Approximately 79% of these cases involved adults (≥19 years or older). Other high-exposure pharmaceutical categories were analgesics (32 cases) and gastrointestinal preparations (15 cases).

An additional study analyzing annual reports from various Italian PCCs between 1991 and 1998 found that non-pharmaceutical chemicals were the most frequent cause of intoxications (45.7%), followed by pharmaceutical agents (37.4%).[10] However, when chemical substances were further categorized, pharmaceutical agents became the leading cause, with subdivisions into pesticides, cosmetics, industrial products, and household products.

Regarding the location of intoxication, workplace-related cases accounted for 6.0% of total cases, showing a declining trend from 9.1% in 1993 to 3.9% in 1998.[13]

This study has several limitations. First, missing data could not be completely eliminated, and the control-to-case ratio was only slightly greater than 1:1. Furthermore, the random selection of the control group prevented adequate matching with the characteristics of the case group. Lastly, the heterogeneous nature of the substances classified under "other toxic agents" complicated the analysis due to the high variability in their composition and associated effects.

Conclusions

This study provides an initial informative basis for identifying the main types of occupational intoxications reported at the PCC of Policlinico Umberto I.

At workplaces, the primary routes of exposure were inhalation (accounting for nearly half of cases) and ingestion (a little over a quarter of cases). For ingestion, possible causes may include failure to follow hygiene and safety measures (*e.g.*, using unlabeled containers) or improper product mixing and application during work activities.[14] Cleaning products (caustic agents and foaming cleaners) were found to be major causes of non-drug intoxications. Fuel, solvent, paint, and oil intoxications accounted for approximately one-quarter of cases, ranking as one of the strongest risk factors with a multivariate analysis-derived OR of 48.36 (18.78-124.54). In contrast, medications did not emerge as a significant occupational risk, indicating that effective management of pharmaceutical substances is in place within health services and the pharmaceutical industry. Pesticides (12.9%), including fungicides, herbicides, and insecticides, remain a major risk factor,[15] with a multivariate analysis-derived OR of 12.61 (5.76-27.63). Their extensive use in Italian agriculture contributes to their risk potential.

Unlike road accidents or drowning, there are no internationally recognized interventions proven to address occupational intoxications effectively.[16] This study's findings highlight the need to develop targeted prevention strategies to reduce toxic exposures in the workplace.

References

1. Ongaro G, Malizia E. Enciclopedia Treccani. Universo del corpo (2000). Available from: http://www.treccani.it/enciclopedia/intossicazione_%28Universo-del-Corpo%29/
2. Boerma JT, Fat DM, Mathers C, and World Health Organization. The Global Burden of Disease: Update. [Geneva, Switzerland: World Health Organization, ©, 2008]. Available from: https://www.loc.gov/item/2021763110/
3. Boedeker W, Watts M, Clausing P, Marquez E. The global distribution of acute unintentional pesticide poisoning: estimations based on a systematic review. BMC Public Health 2020;20:1875.
4. Locatelli C, Buscaglia E, Petrolini VM, et al. Antidoti 2016-2017. Guida all'uso clinico e all'approvvigionamento. Centro

Antiveleni di Pavia Centro Nazionale di Informazione Tossicologica Ospedale Istituto Scientifico di Pavia. 2016.
5. Accordo ai sensi dell'art. 4 del Decreto Legislativo 28 agosto 1997, n. 281. Repertorio Atti n. 56/CSR, 28 Feb 2008. Accordo tra il Governo, le Regioni e le Province autonome di Trento e di Bolzano concernente la definizione di attività ed i requisiti basilari di funzionamento dei Centri Antiveleni.
6. Spiller HA, Griffith JRK. The Value and Evolving Role of the U.S. Poison Control Center System. Public Health Rep 2009;124:359-63.
7. Barelli A, Biondi I, Tafani C, et al. Un database relazionale per l'archiviazione delle chiamate ad un Centro antiveleni. Ann Ist Super Sanità 2006;42:310-7.
8. Davanzo F, Settimi L, Faraoni L, et al. Intossicazioni acute da antiparassitari di uso agricolo in Italia: i casi esaminati dal Centro antiveleni di Milano nel 2000 e 2001. Epidemiol Prev 2004;28:330-7.
9. Eller S, Zucoloto AD, De Oliveira CDR, et al. Multivariate analysis applied in dataset of Poison Control Center of São Paulo, Brazil. Sci Rep 2020;11;10:9498.
10. Zhang Y, Yu B, Wang N, et al. Acute poisoning in Shenyang, China: a retrospective and descriptive study from 2012 to 2016. BMJ Open 2018;8:e021881.
11. Settimi L, Davanzo F, Bacis G, et al. Sistema informativo nazionale per la sorveglianza delle esposizioni pericolose e delle intossicazioni: casi rilevati nel 2014. Nono rapporto annuale. Roma: Istituto Superiore di Sanità. 2018; Rapporti ISTISAN 18/6.
12. Settimi L, Davanzo F, Carbone P, et al. Surveillance of toxic exposures: the pilot experience of the Poison Control Centers of Milan, Pavia, and Bergamo in 2006. Ann Ist Super Sanita 2007;43:287-94.
13. Mucci N, Alessi M, Binetti R, et al. Profilo delle intossicazioni acute in Italia. Analisi dei dati registrati dai centri antiveleni. Ann Ist Super Sanita 2006;42:268-76.
14. Centers for Disease Control and Prevention (CDC). Pesticide-related illnesses associated with the use of a plant growth regulator-Italy, 2001. MMWR Morb Mortal Wkly Rep 2001; 50:845-7.
15. Gentilini P. Esposizione a pesticidi e rischi per la salute umana. Rivista medico-scientifica dell'Ordine dei Medici, Chirurghi e degli Odontoiatri della Provincia di Arezzo. Cesalpino 2012;32:14-5.
16. Vecino-Ortiz AI, Jafri A, Hyder AA. Effective interventions for unintentional injuries: a systematic review and mortality impact assessment among the poorest billion. Lancet Glob Health 2018;6:e523-34.

Correspondence: Prof. Giuseppe La Torre, Department of Public Health and Infectious Diseases, Sapienza University of Rome, Piazzale Aldo Moro 5, 00185 Rome, Italy. E-mail: giuseppe.latorre@uniroma1.it

Conflict of interest: the authors have no conflict of interest to declare.

Ethics approval and consent to participate: not required.

Availability of data and materials: the datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Received: 13 May 2025. Accepted: 4 June 2025.

Giornale Italiano di Medicina del Lavoro ed Ergonomia 2025; 47:722. doi:10.4081/gimle.2025.722