Forensic Science International 248 (2015) 172–180

Contents lists available at ScienceDirect

Forensic Science International

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

Fatal poisoning in drug addicts in the Nordic countries in 2012

K. Wiese Simonsen [a,*], H.M.E. Edvardsen [b], G. Thelander [c], I. Ojanperä [d], S. Thordardottir [e], L.V. Andersen [f], P. Kriikku [d], V. Vindenes [b], D. Christoffersen [g], G.J.M. Delaveris [b,h], J. Frost [i]

[a] Section of Forensic Chemistry, Department of Forensic Medicine, Faculty of Health Sciences, University of Copenhagen, Frederik V's vej 11, 3, DK-2100 Copenhagen, Denmark
[b] Norwegian Institute of Public Health, Division of Forensic Sciences, PO Box 4404 Nydalen, N-0403 Oslo, Norway
[c] Department of Forensic Genetics and Forensic Toxicology, National Board of Forensic Medicine, Artillerigatan 12, SE-587 58 Linköping, Sweden
[d] Department of Forensic Medicine, University of Helsinki, PL 40 (Kytösuontie 11), FI-00014 Helsinki, Finland
[e] Department of Pharmacology and Toxicology, University of Iceland, Hagi-Hofsvallagata 53, IS-107 Reykjavik, Iceland
[f] Department of Forensic Medicine, University of Aarhus, Brendstrupgaardsvej 100, DK-8200 Aarhus, Denmark
[g] Institute of Forensic Medicine, University of Southern Denmark, Winsløwparken 17B, DK-5000 Odense, Denmark
[h] Institute of Forensic Medicine, University of Oslo, N-0027 Oslo, Norway
[i] Department of Clinical Pharmacology, St. Olavs Hospital – Trondheim University Hospital, Professor Brochs gate 6, N-7030 Trondheim, Norway

ARTICLE INFO

Article history:
Received 6 October 2014
Received in revised form 17 December 2014
Accepted 3 January 2015
Available online 13 January 2015

Keywords:
Fatal poisonings
Drug addict deaths
Nordic countries
Medicinal opioids
New psychoactive substances

ABSTRACT

This report is a follow-up to a study on fatal poisoning in drug addicts conducted in 2012 by a Nordic working group. Here we analyse data from the five Nordic countries: Denmark, Finland, Iceland, Norway and Sweden. Data on sex, number of deaths, places of death, age, main intoxicants and other drugs detected in the blood were recorded. National data are presented and compared between the Nordic countries and with data from similar studies conducted in 1991, 1997, 2002 and 2007.

The death rates (number of deaths per 100,000 inhabitants) increased in drug addicts in Finland, Iceland and Sweden but decreased in Norway compared to the rates in earlier studies. The death rate was stable in Denmark from 1991 to 2012. The death rate remained highest in Norway (5.79) followed by Denmark (5.19) and Iceland (5.16). The differences between the countries diminished compared to earlier studies, with death rates in Finland (4.61) and Sweden (4.17) approaching the levels in the other countries. Women accounted for 15–27% of the fatal poisonings. The median age of the deceased drug addicts was still highest in Denmark, and deaths of addicts >45 years old increased in all countries.

Opioids remained the main cause of death, but medicinal opioids like methadone, buprenorphine, fentanyl and tramadol mainly replaced heroin. Methadone was the main intoxicant in Denmark and Sweden, whereas heroin/morphine caused the most deaths in Norway. Finland differed from the other Nordic countries in that buprenorphine was the main intoxicant with only a few heroin/morphine and methadone deaths. Deaths from methadone, buprenorphine and fentanyl increased immensely in Sweden compared to 2007.

Poly-drug use was widespread in all countries. The median number of drugs per case varied from 4 to 5. Heroin/morphine, medicinal opioids, cocaine, amphetamines, benzodiazepines and alcohol were the main abused drugs. However, less widely used drugs, like gamma-hydroxybutyric acid (GHB), methylphenidate, fentanyl and pregabalin, appeared in all countries. New psychotropic substances emerged in all countries, with the largest selection, including MDPV, alpha-PVP and 5-IT, seen in Finland and Sweden.

1. Introduction

There have been considerable changes in matters related to drugs of abuse over the last decade. One major worldwide trend is an increase in the diversity and abuse of prescription drugs, particularly opioids [1–3]. This trend has been especially prominent in North America due to the high availability and consumption of medicinal opioids, lack of regulation, and the generous prescription and marketing of psychotropic drugs [4]. Notably, however, although supply-based reductions in prescription opioids can reduce harm, addicted individuals may switch to other opioids, such as heroin, that are more readily available [5]. Indeed, changes in the demographic composition of heroin users have already been seen as prescription drug policies become more stringent [6].

* Corresponding author. Tel.: +45 3532 6278; fax: +45 3532 6085.
E-mail address: kirsten.wiese@sund.ku.dk (K.W. Simonsen).

http://dx.doi.org/10.1016/j.forsciint.2015.01.003
0379-0738/

Another change that has been noticeable in recent years in the illicit drug market is the emergence of designer drugs, now more appropriately called new psychoactive substances (NPS) [7]. These substances are usually not new molecules per se but rather are novel in the sense that they have recently entered the illicit drug market. Many NPS are marketed on the internet as 'legal highs' despite being labelled "not for human consumption" to avoid regulation. Alterations of the basic chemical structure of substances create entirely new drugs that are no longer regulated by current laws and that possess an ever-changing panoply of clinical effects [8]. Many NPS are derivatives of synthetic cannabinoids or synthetic cathinones, phenethylamines, tryptamines and piperazines.

In Europe, the annual European Drug Report by the European Monitoring Centre for Drugs and Drug Addiction (EMCDDA) provides useful information about drug-related issues in this central geographic area. The report covers drug supply, drug use and related public health problems as well as drug policy and responses. According to the 2014 issue of the report, heroin now plays a smaller part than in the past, whereas stimulants, NPS, cannabis and medicinal products are becoming more prominent [9]. Concerning NPS, 81 new psychoactive substances were entered into the EMCDDA Early Warning System in 2013, increasing the number of substances being monitored to more than 350. Drug-related deaths are one of the five key epidemiological indicators of EMCDDA. Overall, around 6100 overdose deaths were reported to the EMCDDA in 2012, which was similar to the number reported in 2011 and fewer than the 7100 cases reported in 2009 [9]. However, since information provided by the EMCDDA is obtained from heterogeneous sources, it should be considered to provide a general epidemiological top-level overview of the situation in all of Europe rather than to provide detailed information for forensic toxicology purposes.

The Nordic Countries, namely Denmark, Finland, Iceland, Norway and Sweden, have 25 million inhabitants in an area that is fairly homogeneous in terms of legislative, social and economic qualities and that has a history of mutual co-operation on various aspects of forensic toxicology. In these Nordic countries, the cause-of-death investigations of drug addicts, including postmortem toxicology, is comprehensive and sufficiently uniform for meaningful comparisons of fatal drug poisonings between the countries over the course of time. In the scientific literature, there is an extraordinary series of previously published Nordic studies over the course of 24 years – 1984, 1991, 1997, 2002 and 2007 that use the same definition of the term drug addict [10–14]. These studies revealed, among other things, the established mortality rate and older age groups seen in Denmark, a country with a longer history of drug abuse, compared with other countries, in which drug abuse had emerged more recently and involved younger age groups. Another interesting finding is that in Finland during the 2000s, buprenorphine poisoning almost completely replaced fatal heroin poisoning, while heroin poisoning continued steadily in the other countries [10–14].

The present study adds to this series of investigations by providing a detailed analysis of fatal poisonings in Nordic drug addicts in 2012 along with comparisons to studies conducted in previous years. The data includes poisoning mortality statistics, age distribution, and the drugs of abuse that were involved, with a special emphasis on opioids and the confounding benzodiazepines and NPS.

2. Materials and methods

This study analysed data on fatal poisonings in drug addicts that were submitted for medico-legal autopsy and toxicological analysis in the five Nordic countries in 2012. A few medical autopsies were also included. These data were compared with similar findings in 1991, 1997, 2002 and 2007. A drug addict was defined as "a person who, according to information from the police and/or autopsy report, is known to have abused drugs intravenously and/or abused the drugs listed in the Single Convention on Narcotic drugs 1961, schedule I, and/or the International Convention on Psychotropic Substances 1971, schedules I and II".

In almost all cases, except for a few in which suitable material was not obtained at autopsy, screening was performed for opiates, methadone, other opioids, amphetamines, cocaine, cannabis and benzodiazepines. Additional drugs detected by the screening procedure or at the special request of the police were recorded, and the blood alcohol concentrations (BAC) were routinely determined.

The cause of death according to the autopsy report was systematically recorded along with toxicological findings, police information about the deceased and the circumstances surrounding the death. Drugs and poisons were divided into four groups:

Group I: Drugs listed in the Single Convention on Narcotic Drugs 1961, schedule I (cocaine, fentanyl, heroin/morphine, methadone, oxycodone etc.) and schedule II (codeine, etc.). Tramadol and AH-7921 were included because of their classification as opioids.

Group II: Drugs listed in the International Convention on Psychotropic Substances 1971, schedules I and II (amphetamine, methamphetamine, MDMA (ecstasy), GHB, methylphenidate etc.). Tetrahydrocannabinol (listed in the Single Convention on Narcotic Drugs 1961, schedule I) was included. New psychotropic substances (MDPV, AMT, alpha-PVP, 5-IT, synthetic cannabinoids etc.) were also included in this group.

Group III: Drugs listed in the International Convention on Psychotropic Substances 1971, schedules III and IV (benzodiazepines, buprenorphine, barbiturates, zolpidem etc.). Zopiclone was included because of its classification as a substance related to benzodiazepines.

Group IV: All other drugs and poisons, including ethanol.

Deaths caused by poisoning were recorded according to the drug that a forensic pathologist judged to be the main intoxicant. In cases involving multiple drugs in which the cause of death could not be ascribed to a single substance, the drug with the lowest group number (see above) was considered the main intoxicant. Cases involving two or more drugs in the same group were recorded according to the drug judged to be the main contributor to death.

Heroin is rapidly metabolised to 6-monoacetylmorphine and further to morphine. Consequently, if 6-monoacetylmorphine was not detected, it was impossible to determine on the basis of the analysis whether heroin or morphine was used. However, heroin intake was often indicated in police reports. In the present study, fatal intoxication by heroin/morphine was verified by the presence of morphine in the blood and, in many cases, also by the presence of 6-monoacetylmorphine in a biological specimen (usually blood or urine).

In order to obtain comparable results from the participating laboratories, continuous external quality controls were performed starting in 1991. The external quality control programme consisted of controls with known substances (NORDQUANT) and unknown substances (NORDSCREEN). Each of these controls was sent two times in 2012 to the laboratories.

All findings after primary screening (immunological analysis, gas chromatography, GCMS, liquid chromatography, UPLC–TOF, (UP)LC/MS) were confirmed and quantified by specific (UP)LC- and GC-chromatographic methods.