

# Drug Related Deaths in the Split-Dalmatia County 1997–2007

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## ABSTRACT

*Drug overdoses are a major cause of mortality for drug users and, in many countries, are the leading cause of death in this group. The aim of the present study is to explore the frequency of all drug related deaths in the Split-Dalmatia County in the period between 1997 and 2007 and to analyze some of the characteristics of these deaths to help target preventive policies. The data on drug related deaths were collected using records from the Department of Forensic Medicine, Clinical Hospital Centre Split, University of Split, School of Medicine. There were 190 drug related deaths in the observed period of 11 years. Statistically significant difference ( $p=0.004$ ,  $\chi^2$ -test for trend) was found in the number of deaths in 1997 in comparison with the number of deaths in 2007. The majority of 105 (55%) the decedents were 25–34 years old, and 92.1% (175) of them were male. There was a 94% higher probability of mortality in the 25–34 years group ( $\chi^2=5.55$ ,  $p=0.064$ ). Average age of all dead people was  $31.01\pm 7.59$  years (median 31.0 years; range 18–49). Almost three quarters of the decedents were single and more than three fifths hadn't been employed. The most common location of death was at home. Approximately, 80% were autopsied followed by full histological and toxicological analyses. Out of all examined cases, the majority of drug related deaths (93 or 60.8%) were attributed to heroin. Heroin was the sole cause of death in 35 (22.9%) cases. Methadone was cause of death in 24 (15.7%) cases. 3,4-methylenedioxy-methamphetamine (MDMA) deaths were rare (3.3%). Cocaine deaths were also rare (1.3%). Three fifths (55.6%) of the cases involved includes multi-substance use. During the investigation there was an evident trend towards multi-substance abuse patterns. These data suggest that interventions to prevent drug related mortality should address the use of drugs such as heroin and alcohol in combination.*

**Key words:** drug related death, epidemiology, forensic autopsy, heroin, alcohol, toxicology

## Introduction

Drug users are at substantially higher risk of morbidity and mortality than non-drug users<sup>1</sup>. Drug overdose is a major cause of mortality for drug users and, in many countries, the leading cause of death in this group<sup>2–4</sup>. Studies in the United States and Europe show that drug users have a mortality rate six to 30 times higher than a similar aged general population, and a substantial portion of that excess mortality is due to drug overdose<sup>2–6</sup>. During the period 1990–2006, between 6,400 and 8,500 drug related deaths were reported each year by the EU Member States, Croatia, Norway and Turkey, adding up to more than 135,000 deaths. Population mortality rates due to drug related deaths vary widely between countries, ranging from 3 to over 85 deaths *per* million in the population aged 15–64 years<sup>7</sup>. Although there is varia-

tion between countries, the number of drug related deaths throughout the world has risen markedly in recent years<sup>8–11</sup>.

As well as many others countries, Croatia and its parts, including the Split-Dalmatia County share this running public health problem. Also, Croatia is located on one of the major drug trafficking routes (known as »Balkan Route«). The last war in Croatia and the unfavourable social economic situation in the region contributed to the increase of this problem. In addition, the capital of the Split-Dalmatia County, Split, the second largest town in Croatia, is a large harbour. All the aforementioned factors are making the County potentially vulnerable to drug trafficking and drug associated harms.

Medico-legal autopsies, including toxicological examinations, are the most useful sources of information on drug related deaths. Continuous collection and evaluation of such information reveals trends in fatal drug intoxication and may be used to evaluate the risk of drugs used in society and to formulate governmental drug-approval policies<sup>12</sup>. The number of deaths is an important parameter in the evaluation of the drug problem in a country<sup>9–11</sup>.

The aim of this study is to explore the frequency of all drug related deaths (directly linked to the use of drug »overdoses« or »poisoning«) in the Split-Dalmatia County between 1997 and 2007 and to analyze characteristics of these deaths to help target preventive policies.

## Materials and Methods

The medical files of the Department of Forensic Medicine, Split, Croatia, on all drug related deaths recorded in the Split-Dalmatia County in the period 1997–2007 were examined.

Social heteroanamnestic data were compiled by reviewing the autopsy reports, deaths certificates and clinical records.

There were 190 death cases in the observed period. Out of them, 153 (80.5%) accidents were autopsied with full histological and toxicological examination, done only upon the County State Attorney/Court order. In the cases where autopsies were not done, the data were compiled from death certificates based on the police records.

Histological examinations of target organs (injecting site, lungs, liver, kidneys, brain) using a hematoxylin-eosin (HE) staining were done to verify the lesions (acute and chronic changes) and complications related to drug abuse.

Toxicological analyses were performed at the Institute of Forensic Medicine, University of Zagreb, School of Medicine and at the Department of Forensic Medicine, Split University Hospital Centre, University of Split, School of Medicine, using the methods of gas chromatography/mass spectrometry (GC/MS).

The death rate was calculated as the number of deaths *per* 100,000 inhabitants in the 15–49 years age group (because all the analyzed deaths occurred in that age group). Mortality rates were calculated in three age groups: 15–24 years, 25–34 years and 35–44 years.

Statistical analysis included descriptive statistics and  $\chi^2$ -test. *p* value <0.05 was considered statistically significant.

The Statistica Program 7.0 for Windows was used for data processing. The frequency of different features is shown graphically.

## Results

In the period 1997 to 2007, there were 190 recorded drug related deaths (Table 1, Figure 1). The mortality

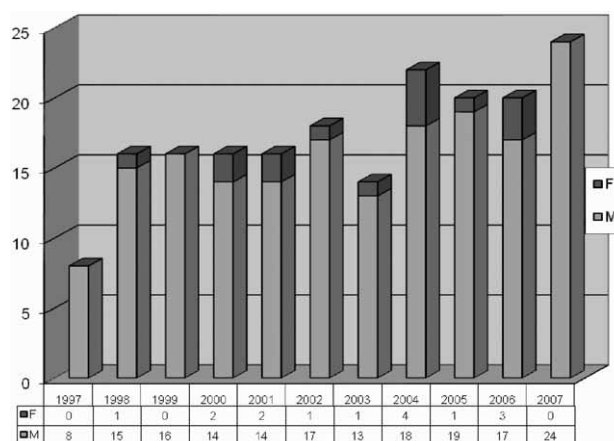


Fig. 1. Gender distribution of deaths by years (1997–2007).

rate (*per* 100,000 of population aged from 15 to 49 years) increased from 3.4 (95% CI: 0, 6.3) in 1997 to 10.6 in 2007 (95% CI: 5.5, 15.6) (Table 2, Figure 2). Comparison of the number of deaths in 1997 with the number of deaths in 2007 showed statistically significant difference ( $p=0.004$ ,  $\chi^2$ -test for trend). The rate specified by sex wasn't calculated because the overdose deaths were very rare in female population. The most (105 or 55%) decedents were 25–34 years old and the majority (175 or 92%) were male (Table 1, Figure 3). There was a 94% higher probability of mortality in the 25–34 years group ( $\chi^2=5.55$ ,  $p=0.064$ ). The average age of all the dead was  $31.01\pm 7.59$  years (median 31.0 years; range 18–49).

TABLE 1  
THE DISTRIBUTION OF AGE GROUPS, GENDER, MARITAL AND EMPLOYMENT STATUS

Characteristics	No. Of Deaths	% of Deaths
Age groups (years)		
15–19	5	2.6
20–24	32	16.8
25–29	52	27.4
30–34	53	27.9
35–39	20	10.5
40–44	17	8.9
>44	11	5.9
Gender		
Male	175	92.1
Female	15	7.9
Marital status		
Single	135	71.0
Divorced/separated/widowed	34	18.0
Married	21	11.0
Employment status		
Not Working	129	68.0
Working	61	32.0
TOTAL:	190	100.0

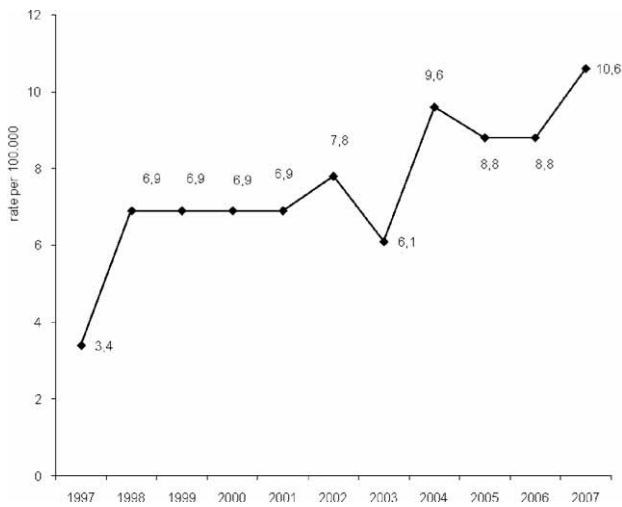


Fig. 2. Drug related mortality rate.

Almost three quarters of the decedents were single and more than three fifths hadn't been employed (Table 1).

The most drug abusers (110 or 57.9%) died at home, 31 (16.3%) died at a public place and 49 (25.8%) died somewhere indoors (Table 3).

In 74 cases (38.9%), needles were found on or near the dead corps, including traces of injection on hands, elbow fosses, and arms, indicating that the final drug administration was done by injection.

Toxicological examination was performed in 153 (80.5%) cases and shows that the majority of the drug related deaths (93 or 60.8%) were attributed to heroin. Heroin was the sole cause of death in 35 (22.9%) cases. Three fifths (55.6%) of the cases involved showed simultaneous usage of more than one substance (Table 4).

In all the examined cases, the lungs macroscopically, uniformly, demonstrated signs of severe pulmonary oedema. Histological examination was performed in 174

TABLE 3  
THE DISTRIBUTION OF DEATHS BY THE PLACE

Place	No. of Deaths	% of Deaths
House	110	57.9
Public place (park, street, etc.)	31	16.3
Deserted apartments	9	4.7
Public toilets	2	1.1
Hotel, café	8	4.2
Prison	3	1.6
Car	7	3.7
Emergency station	5	2.6
Hospital	11	5.7
Ship	2	1.1
Work places	2	1.1
TOTAL	190	100.0

(91.6%) cases. Microscopic examination confirmed diffuse alveolar damage, alveolar and interstitial micro haemorrhage and pulmonary oedema.

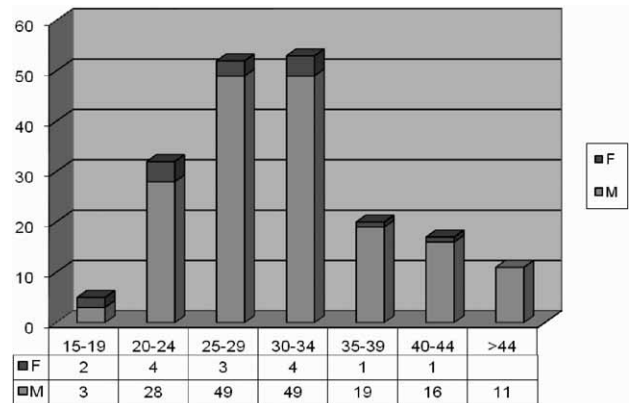


Fig. 3. The distribution of deaths by age groups and gender.

TABLE 2  
NUMBER AND SPECIFIC RATE OF DRUG RELATED DEATHS IN SPLIT-DALMATIA COUNTY DURING THE 1997–2007 PERIOD

Year	Number of Inhabitants*	Total number of drug related deaths	Specific rates of drug related deaths	95 % CI interval
1997	233,479	8	3.4	0–6.3
1998	232,873	16	6.9	2.9–10.9
1999	232,266	16	6.9	2.9–10.9
2000	231,660	16	6.9	2.9–10.9
2001	231,053	16	6.9	2.9–10.9
2002	230,446	18	7.8	3.5–12.1
2003	229,840	14	6.1	2.3–9.9
2004	229,233	22	9.6	4.8–14.4
2005	228,626	20	8.8	4.2–13.3
2006	228,020	20	8.8	4.2–13.3
2007	227,413	24	10.6	5.5–15.6

Source: State Institute of Statistics of the Republic of Croatia; specific rate of drug related overdoses deaths per 100,000 inhabitants  
\*Inhabitants in age group between 15–49 years

**TABLE 4**  
THE DISTRIBUTION OF THE DRUGS DETECTED AT AUTOPSY

Type of Drug	No. of Deaths	% of Deaths
Heroin	35	22.9
Heroin + alcohol	36	23.5
Heroin + benzodiazepines	12	7.8
Heroin + alcohol + benzodiazepines	10	6.5
Methadone	14	9.2
Methadone + alcohol	6	3.9
Methadone+ benzodiazepines	3	2.0
Methadone + alcohol + benzodiazepines	1	0.7
3,4-methylenedioxy-methamphetamine (MDMA)	5	3.3
Cocaine	2	1.3
Undetermined	12	7.8
Other*	17	11.1
TOTAL	153	100.0

\*Combinations four and more substances

## Discussion and Conclusion

The study analyzed all the drug related deaths that occurred in the Split-Dalmatia County in the period between 1997 and 2007. The number of drug related deaths has increased threefold. Increases in death rates may also be explained by the factors such as high availability and easy accessibility of drugs or by the fact that experiences with illicit drugs and psychoactive medications have substantially increased over the past decade in Croatia<sup>13–17</sup>.

The average age of the studied population was 31.01±7.59 (median 31 years), higher than in other studies of drug addiction within the Split-Dalmatia County done earlier<sup>18,19</sup>. Most decedents were 25–34 years old, which concurs with most reports on overdose mortality in the United States, Europe and Australia, where persons in their late twenties and early thirties are generally found to be at highest risk of drug overdose death<sup>20–24</sup>. Many studies besides our own have indicated that a higher risk of death by overdose was found among older heroin abusers<sup>21</sup>.

Although a small portion (2.6%) of deaths occurred with persons younger than 20, the problem of teenage-specific mortality should be emphasized, especially because of its multi-substance pattern, which corresponds with data from other studies<sup>25</sup>.

Drug abuse is widespread among the male population. In this study, females accounted for only 7.9% of the drug related deaths. A rational explanation should probably be based on the traditionalism (strong catholic influence) in this area, where men have more freedom than women. Similar findings were reported in other countries with strong traditionalism and religious influences<sup>26,27</sup>.

The majority of the decedents were single. Being single has several possible implications, including higher risky behaviour, poorer health habits and lower socioeconomic status. Some data show that singles are at significantly higher risk for drug abuse and at higher risk for all mortality causes in demographic studies. Marital status will most likely have an adverse effect<sup>28</sup>.

Unemployment increases the risk of drug related mortality, regardless of other variables. Our results confirmed the previous presenting data that the majority of drug related deaths occurred in the group of unemployed<sup>19</sup>.

The data show that the drug related deaths were occurring in closed areas such as houses, hotel rooms, toilets etc. or public areas like parks, streets. This is in agreement with other studies, although there are some reporting that the majority of deaths have occurred in public settings, with the street environments being the most common<sup>8,10,26</sup>.

It is to be mentioned that two persons died a day after they had been released from prison. Relative to the general population, male prisoners were 29 times more likely to die during the week following the release<sup>29</sup>. Three persons died in prison. Opiate substitution treatment has shown a protective effect in the prison context<sup>30</sup>. The opportunity to start this type of treatment in prison reduces the risk of overdose and death on leaving prison, and reduces re-incarceration rates<sup>31</sup>. It is, however, important that prison health services and community-based treatment providers are appropriately linked to avoid any gaps in the continuity of treatment<sup>7</sup>.

In this study heroin was the single most frequently encountered main intoxicant, highly available and easily accessible. Opiates, mainly heroin or its metabolites, are present in the majority of the drug-related deaths reported in Europe. In the 22 countries providing data, opiates accounted for 35% in almost 100% of all cases, with 11 of these countries reporting portions of over 85%<sup>7</sup>. The second single intoxicant was methadone. Intoxication by methadone varies in the countries around the world, an observation probably linked to different national prescription rules for methadone<sup>9</sup>. Methadone is used in the treatment of drug addicts in Croatia, but controlling measures about dispensing of methadone are often insufficient, and it is traded illicitly. Methadone-related overdose deaths can probably be reduced by increasing control of the way that methadone is prescribed<sup>32</sup>. Cocaine deaths were rare; a reason might be the drug addicts' low purchasing power in the County as well as accessibility of cocaine.

Multi-substance use was found in 85 (55.6%) cases. The combination of alcohol and drug use was high (45.7%) in our research. Similar findings have been reported in the studies from Sydney, New York City and other parts of the world<sup>26,33–35</sup>. Simultaneous use of illicit drugs with alcohol also is known to be a major contributor to drug overdose and subsequent mortality<sup>11</sup>. Alcohol abuse by opiate addicts as well as opiate abuse by alcoholics increases the risk of fatal outcome caused by combined ef-

fects on the central nervous system. Levine at all has found that even a small amount of alcohol with heroin presents a risk factor<sup>36</sup>.

This study shows that opiates and benzodiazepines were generally (17%) taken together. Those combinations are often mentioned as an additional risk factor of fatal outcome caused by depressant effect on the central nervous system. Benzodiazepines were by far the most commonly used drugs. According to some authors, it appears that benzodiazepines have been used without medical supervision, often without a non-medical reason for consumption<sup>13</sup>. The availability probably determines which of them are used, and this is governed more by prescription rules and sales on the illicit market than by the drug addicts' preferences. Heroin users tend to use benzodiazepines to reduce anxiety and agitation caused by both organic and social influences<sup>10</sup>. It has been reported that benzodiazepines enhance the effect of opiates, and this may be the factor that leads people to take benzodiazepines and opiates together<sup>10,27,36</sup>. Our results confirm findings of other studies<sup>8,10,26,33,34</sup>.

The average number of drugs detected in fatal cases is 3.2 in Norway, 3.9 in Sweden, and more than 3 for the majority of the cases in the United Kingdom<sup>37,38</sup>. Our findings that most drugs related deaths were positive for multi-substance use is congruent with studies in other countries that have demonstrated an association of multi-substance use with drug related deaths.

Deaths that are not associated with positive toxicological results might be partly explained by the fact that heroin is an unstable molecule. Also, in many post-mortem cases, artefacts caused by poor sampling, poor condition of the body and redistribution may limit the inter-

pretation of any analytical results. But, fresh needle marks and/or a syringe containing a narcotic drug found near the deceased indicate that the drug has been injected.

Needle was found in 38.9% cases. These data were required because they helped in the investigation process and presumption of drug related death in circumstances where toxicological analysis was negative.

Hypoxic failure of multiple organ systems, most evident in the lungs (diffuse alveolar damage, severe pulmonary edema, alveolar and interstitial micro hemorrhage – »narcotic lung«) was a constant histological finding, as described elsewhere<sup>39,40</sup>.

As a conclusion, the number of drug related overdose deaths has markedly risen from 1997 to 2007 in the Split-Dalmatia County. Drug overdose decedents are typically male, long-time drug users, single and unemployed and in their late twenties and early thirties, who died alone in an apartment or at abandoned places. Within the research period there were evident trends towards multi-substance abuse patterns. These data suggest that interventions to prevent drug related mortality should address the use of drugs such as heroin, methadone, alcohol, benzodiazepines and their combinations. Better knowledge of the factors increasing the risk of overdose mortality could allow prediction of negative events, hence their prevention.

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## **SMRTI UZROKOVANE ZLOUPORABOM DROGA U SPLITSKO-DALMATINSKOJ ŽUPANIJI U RAZDOBLJU OD 1997. DO 2007. GODINE**

### **S A Ž E T A K**

Predoziranje drogama glavni su uzrok smrtnosti među ovisnicima o drogama i u mnogim zemljama vodeći uzrok smrtnosti u ovoj grupi. Cilj istraživanja bio je utvrditi učestalost i obilježja smrti povezanih sa zlouporabom droga u Splitsko-dalmatinskoj županiji u razdoblju od 1997. do 2007. godine kako bi se pridonijelo kreiranju programa prevencije. Podatci su sakupljeni koristeći se pismohranom Odjela za sudsku medicinu Kliničkog bolničkog centra Split i Medicinskog fakulteta Sveučilišta u Splitu. U promatranom razdoblju od 11 godina bilo je 190 ovakvih smrti. Broj smrti u 2007. godini bio je značajno veći u odnosu na broj smrti u 1997. godini ( $p=0,004$ ). Većina, 105 (55%) umrlih bila je stara između 25 i 34 godina i uglavnom su bili muškarci (175; 92,1%). U dobnoj grupi od 25–34 godine bila je 94% veća vjerojatnost smrtnog događaja ( $\chi^2=5,55$ ,  $p=0,064$ ). Srednja životna dob svih umrlih bila je  $31,01\pm 7,59$  godina (median 31.0 godina; raspon 18–49). Približno tri četvrtine slučajeva bili su samci i više od tri petine je bilo nezaposleno. Najčešće mjesto smrti bilo je u kući. Obdukcija s potpunom histološkom i toksikološkom analizom je učinjena u približno 80% umrlih. Kod svih analiziranih uzrok većine smrti (93; 60,8%) pripisan je heroinu. Heroin samostalno uzrokovao je smrt u 35 (22,9%) slučajeva. Metadon je bio uzrok smrti u 24 (15,7%) slučajeva. 3,4-methylenedioxy-methamphetamine (MDMA) je rijetko nađen kao uzrok smrti (3,3%). Smrti uzrokovane kokainom također su bile rijetke (1,3%). U 12 (7,8%) slučajeva nije otkriven uzrok smrti. Tri petine (55,6%) slučajeva bile su posljedica upotrebe više od jedne droge. Tijekom istraživanja evidentan je trend zlouporabe više tvari. Dobiveni podatci upućuju na to da intervencije koje preveniraju predoziranje drogama treba usmjeriti prema smanjenju uzimanja heroina i alkohola u kombinaciji.