



Exploring the risk matrix of drug overdose deaths of young people: Drug use patterns, individual characteristics, circumstances, and environment

Sanna Rönkä^{a,*}, Heta Konttinen^a, Pirkko Kriikku^{a,b}, Pekka Hakkarainen^a,
Margareeta Häkkinen^{a,c,d}, Karoliina Karjalainen^a

^a Finnish Institute for Health and Welfare (THL), P.O. Box 30, 00271 Helsinki, Finland

^b University of Helsinki, Department of Forensic Medicine, P.O. Box 21, 00014 University of Helsinki, Finland

^c University of Turku, Faculty of Medicine, Department of Clinical Medicine, Psychiatry, Kiinamyllynkatu 13, 20520 Turku, Finland

^d Western Uusimaa Wellbeing Services County, Mental health and substance use treatment services, P.O. BOX 33, 02033 Western Uusimaa Wellbeing Services County, Finland

ARTICLE INFO

Keywords:

Drug overdose deaths
Dual diagnosis
Substance use disorder treatment
Situational factors
Structural determinants
Harm reduction
Prevention

ABSTRACT

Background: The number of drug-induced deaths among young people has increased in Finland in recent years, and their proportion of all drug-induced deaths is among the highest in Europe. The aim of the multidisciplinary study was to explore individual, situational and environmental factors contributing to drug overdoses of young people in a non-heroin use setting.

Methods: All drug overdose deaths (N = 300) of under 30-year-olds in Finland between 2019 and 2021 were investigated. The research material included police investigation reports, forensic autopsy reports, post-mortem toxicological reports, and death certificates. Public statistical indicators were used as secondary data.

Results: Of the deaths, 86.7 % were unintentional and 88.0 % were caused by poly-drug toxicity. In 53.7 %, substance use was recorded in the background documents, and 4.0 % had been in opioid agonist treatment at the time of death. The deceased had mental disorders in 51.6 % of the cases. Only 13.7 % were resuscitated by emergency care, as in most cases the person was either unresponsive or was found dead. The deceased lived in areas that are socially and economically disadvantaged compared to the average.

Conclusion: Overdose deaths of young people result from a complex matrix of risk factors. It appears that, the treatment system has not effectively addressed the needs of the deceased, and the retention of health and social care has been inadequate. Additionally, help seems to have been called too late. Tailored interventions that acknowledge the known risks of drug overdoses are needed as well as political decisions that enable harm-reduction measures.

1. Introduction

Drug overdose deaths have increased in Finland in the past decades, as is also the case in Northern America and in several other European countries. In Finland especially worrying has been the increase of overdose deaths among young people. The number of drug-induced deaths of under 30-year-olds has tripled in Finland since 2015 (Statistics Finland 2025a). The proportion of under 25-year-olds dying of drug-induced causes is one of the highest in Europe (EMCDDA, 2024). These deaths are either accidents or suicides, and therefore preventable deaths. In addition to their profound social impact, they represent a

substantial loss of potential life-years. The situation has prompted considerable public debate, but the government did not respond until quite recently, when it allocated additional funding for the prevention of drug-related deaths of young people (MSAH, 2025). Finnish drug policy has been described as dual-track policy, in which it is predominantly punitive but has some elements of harm reduction (Hakkarainen et al., 2007). There have been no major reforms to Finnish drug policy in the 21st century.

Only a little research is available on the overdose of young people and related factors so far. Most of the deaths of under 25-year-olds in Finland were caused by opioids, most often buprenorphine, and mainly

* Corresponding author.

E-mail addresses: sanna.ronka@thl.fi (S. Rönkä), pirkko.kriikku@thl.fi (P. Kriikku), pekka.hakkarainen@thl.fi (P. Hakkarainen), margareeta.hakkinen@thl.fi (M. Häkkinen), karoliina.karjalainen@thl.fi (K. Karjalainen).

<https://doi.org/10.1016/j.drugalcdep.2025.112757>

Received 18 February 2025; Received in revised form 30 May 2025; Accepted 8 June 2025

Available online 14 June 2025

0376-8716/© 2025 The Authors. Published by Elsevier B.V. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

together with other substances (Mariottini et al., 2021). It is also known that amphetamines, benzodiazepines, and the combination of buprenorphine and amphetamines were significantly more frequently implicated in the cause of death in adolescents than in older groups (Kriikku et al., 2022). According to a systematic literature review, risk factors for drug overdose in young people include injection drug use, opioid and tranquilizer use, polysubstance use, psychopathology, unstable housing, and witnessing an overdose (Lyons et al., 2019).

Nevertheless, most studies have focused on drug overdoses in general, not specifically on young people. A systematic review found that psychosocial factors associated with overdoses include housing instability, incarceration, and traumatic experiences (Byrne et al., 2024). Situational factors of the deaths may provide crucial information when planning preventive measures. The literature shows that most overdoses occur in the company of other people but only in a minority of cases is an ambulance called (Powis et al., 1999; Darke and Hall, 2003). In a Danish forensic study (Andersen et al., 2024) 83 % of fatal opioid overdoses occurred in private residences, 64 % of the deceased were alone when death occurred, and 68 % were sleeping or going to bed before being found lifeless.

Studies on situational factors, however, have been conducted in settings in which mainly heroin is injected. Less is known of contextual factors of overdoses in polydrug use settings in which non-heroin opioids are injected the most. Of these, e.g., buprenorphine is not as potent as heroin, and it is thus used with benzodiazepines, other medication, and alcohol to boost its effect. Heroin overdoses happen almost instantly as a heroin injection causes a rapid drop in oxygen saturation (Strang, 2015), whereas polydrug overdoses associated with buprenorphine happen slowly (Häkkinen et al., 2012; Mariottini et al., 2021). Due to this delayed onset, situational factors can differ in overdoses in these polydrug use settings compared to those related to heroin. More research is needed concerning drug overdoses of young people, as well as on the contexts of overdose deaths in non-heroin and polydrug use settings, to plan suitable and effective responsive measures.

Social and economic factors of increasing drug-related mortality have been studied mainly in the U.S. It has been questioned if the U.S. overdose crisis is solely explained by prescribing practices of opioids and the emergence of new synthetic opioids. Research has found that social and economic determinants are associated with the epidemic as well (Dasgupta et al., 2018). Studies have for example showed that fatal overdoses have been higher in counties with larger income inequality (Kariisa, 2022; Rangachari et al., 2022). Intergenerational income mobility has been found to be the strongest predictor of overdose deaths in the U.S. Midwest (Heyman et al., 2024). In Finland, drug-related deaths are also associated with social disadvantage (Rönkä et al., 2017), but overdose deaths have not yet been examined at the local level.

The starting point of the study was social autopsy, the idea ‘–that excess mortality is socially patterned and that political and social factors put some individuals and communities at higher risk of premature death’ (Timmermans and Prickett, 2023). We scrutinized all individual cases and identified common risk patterns around the deaths. By employing the concept of the ‘risk environment’ framework ‘in which a variety of factors interact to increase the chances of harm occurring’ (Rhodes, 2002), we explored the physical, social, and economic environment in which the deaths take place. The concept of a ‘risk environment’ stems from the notion that Western harm reduction interventions focus mainly on risk behaviour and individual change, while wider environmental factors—whether structural, social, or political—are overlooked. In order to prevent harm successfully, a more holistic perspective is needed. We looked at “how different factors come together in space and time” (Rhodes, 2009). The study design was influenced by Duke et al. (2024) who studied factors contributing to drug-related deaths in prisons by examining the risk matrix of substances, individual characteristics, situational features and the wider environment.

The aim of the multidisciplinary study was to explore individual, situational and environmental factors contributing to the drug overdoses of young people by scrutinizing the cause of death investigation documents. We examined the substances implicated in the deaths, the individuals and their behaviour prior to death, and the circumstances of the deaths. In addition, we examined economic factors at the local level.

2. Material and methods

2.1. Primary data and methods

The Finnish police are required to launch a medico-legal investigation into the cause of death when a death is sudden and unexpected (Act on Determining the Cause of Death 459/1973). As a part of these investigations the Finnish Institute for Health and Welfare (THL) conducts all the necessary medico-legal autopsies and related investigations nationwide. Both the police investigation and the medico-legal investigation produce administrative documents that contain information of varying extent regarding the background of the deceased, circumstances of the death, and the results of the investigations. The Forensic Medicine Unit of THL manages an archive including all the documents—both the police and the medico-legal documents—for each death case.

For this study, all drug overdose deaths of under 30-year-olds in 2019–2021 in Finland (N = 300) were identified and all the related documents for each case were extracted from the archive. The dataset is not a sample but a complete enumeration of individuals of the target population. The cut-off point of 30 years was chosen to reflect contemporary social and cultural shifts, as key life transitions such as completing education, entering stable employment, and starting a family often occur later in life than in previous generations. All these deaths met the criteria of a drug-induced death as defined by the European Union Drug Agency (EUDA) for special registries such as forensic registries: “Cases are counted when the death is due to poisoning (by accident, suicide, homicide or of undetermined intent), and when the death is due to opiates, amphetamines, cocaine (or crack), cannabis, hallucinogens, solvents, or synthetic designer drugs such as amphetamine derivatives.” (EMCDDA, 2010). In each case, the acquired documents included a police investigation report, a forensic pathologist’s statement, a toxicology report, and a death certificate. If available, also other healthcare reports, such as emergency medical reports, were included.

The data was received in PDF format (appr. 1300 documents). After analysing the content carefully, an SPSS data matrix of the observations was created. The findings were examined at several levels: the basic data on deaths, events immediately before and after the time of death, and conditions the night or day before the death, as well as other noteworthy events one month before the death, and some aspects during the lifetime of the deceased.

Regarding the data quality and coverage, it is commonly estimated that all drug-induced deaths are detected and registered in Finland. A medico-legal investigation is always initiated when a death is sudden, and overdose deaths fall into this category. All medico-legal investigations related to overdoses also include comprehensive post-mortem toxicology. The toxicological analyses include screening and quantification of hundreds of drugs and poisons by quality-assured methods in an accredited laboratory.

2.2. Secondary data

As secondary data to examine possible local differences, we used statistical indicators provided by Statistics Finland and THL, both of which produce official Finnish statistics. These indicators are available by region in public databases (StatFin and Sotkanet). To analyse key socioeconomic and well-being indicators, we selected statistical indicators on income and unemployment by postcode from the StatFin database (Statistics Finland 2025b; 2025c), and indicators on social

support and mental health visits by municipality from the Sotkanet database (Finnish Institute for Health and Welfare 2025a; 2025b; 2025c). We aimed to achieve the most localized level possible, but not all indicators were available at the postcode level. For each indicator, we compared the postcode areas or municipalities where the deceased had lived with the average Finnish postcode areas or municipalities.

2.3. Research ethics

Data permission was granted for the use of administrative documents for research purposes from the National Police Board and the THL. This study is a part of the project ‘Out of Despair—providing solutions to break the pathways leading to violent, suicidal and drug-induced deaths of young people’ which has received ethical approval from Institutional review board (IRB) of THL. The results are reported so that individual cases cannot be identified.

3. Results

3.1. Risky drug use patterns

Regarding the manner of death, the vast majority (86.7 %) of the 300 deaths were accidental. 5.0 % were suicides, and in 8.3 % of the cases the intent was undetermined.

Similarly, in the vast majority of the cases (88.0 %) the cause of death was polydrug toxicity, as solely in 12.0 % of the cases was only one substance implicated in the cause of death. The number of different substance groups in combinations implicated in the cause of death was mainly 2–4 (83.3 % of the cases). The substances implicated in the cause of death consisted mainly of opioids (87.0 %) and benzodiazepines (73.3 %) (Table 1). Additionally, gabapentinoids (35.0 %),

Table 1

Substances implicated in cause of death among those under 30-year-olds who died of drug overdoses in 2019–2021 (N = 300).

	%	N
Opioids	87.0	261
Buprenorphine	59.3	178
Oxycodone	11.0	33
Tramadol	10.0	30
Methadone	8.0	24
Codeine	4.0	12
Fentanyl (1)	2.3	7
Heroin	0.7	2
Morphine	0.7	2
Benzodiazepines (inc. ‘Z medicines’ zopiclone and zolpidem)	73.3	220
Alprazolam	42.3	127
Clonazepam	35.0	105
Diazepam	8.7	26
Oxazepam	3.7	11
New psychoactive benzodiazepines (2)	5.1	15
Other benzodiazepines	1.7	5
Gabapentinoids	35.0	105
Pregabalin	27.0	81
Gabapentin	10.7	32
Amphetamines	28.3	85
Amphetamine	23.7	71
MDMA	8.3	25
Methamphetamine	1.3	4
Alpha-PVP & Alpha-PHP (2)	1.7	5
Alcohol	15.7	47
Cocaine	4.7	14
THC	8.0	24
GHB & GBL	4.0	12
Other substances (3)	10.0	30

1) In two cases Fentanyl formulation consisted of medicinal fentanyl patches, in one case crossed and diluted tablets injected and in four cases the form was not mentioned.

2) New psychoactive substances.

3) Pharmaceuticals typically prescribed for mental health disorders.

amphetamines (28.3 %) and alcohol (15.7 %) were commonly implicated. Opioid, benzodiazepine, and gabapentinoid groups constituted mainly of prescription pharmaceuticals with a few exceptions (heroin 0.7 %, new psychoactive benzodiazepines 5.1 %). Opioids and benzodiazepines together were involved in 67.7 % of fatal substance combinations and opioids in 86.0 % of the combinations (Fig. 1).

Examination of the documents revealed that the use of more than one substance was known by other people in present prior to death in 40.3 % of all cases.

3.2. Individuals at risk

Table 2 shows that majority of those who died were male (80.3 %). However, for under 18-year-olds the male-female-ratio was more even (55.0 % vs. 45.0 %). Of the deceased, 63.7 % were under the age of 25 and 6.7 % were minors. The youngest were 15 years old.

In 36.0 % of cases, it was found that substance use, either alcohol, illicit drug, or prescription drug use, had been identified in healthcare (Table 3a). This may have been a diagnosis or only an indication of a known substance use in health reports. In addition, in 17.7 % of cases, the substance use disorder had not only been identified, but the person had also received treatment for drug use. Thus, according to the documents, a half of the deceased (53.7 %) had been covered by health services at some point so that the substance use disorder was known.

Of the deceased, 4.0 % had been in opioid agonist treatment at the time of death (Table 3a). In addition, there were some individuals who had previously been in opioid agonist treatment (OAT) or were currently on a waiting list for OAT.

Almost three quarters also had other mental or physical health disorders in addition to substance use disorders, as only in 26.0 % of cases no other medical conditions were mentioned in the reports (Table 3b). The majority of those with documented medical conditions, had either a mental disorder, neuropsychiatric disorder, and/or a somatic disease. More than half of the deceased (51.6 %) had mental disorders.

Among the deceased, 8.0 % had previous suicide attempts. These attempts were associated with all categories of overdose deaths, including suicides, accidents, and those with an undetermined manner of death.

3.3. Risky circumstances

Regarding homelessness, 96.0 % of the individuals had an address in the population information system, 3.3 % did not have an address, and 0.7 % were not registered residents of Finland.

Of the deaths 86.0 % occurred in private residences, either in their own (41.3 %), in a friend’s (39.0 %) or in a family member’s (5.7 %) (Table 4a). 4.7 % of deaths occurred in assisted living or in a dormitory. Only 1.7 % of the deaths occurred outdoors.

At the time of immediate death 39.0 % of the deceased were alone (Table 4b). In the remaining cases, other people were involved or at least present at the same residence, most often there were one or more friends (39.3 %) or a partner (11.7 %) or a family member (5.0 %) present. In some cases, a new acquaintance was found shortly before death, and the person present at the time of death was not an old friend.

When examining the company present at the time of death by gender, both men and women were almost equally likely to be with a friend or friends. However, women were more often accompanied solely by a partner, while men were more likely to die alone. When analysed by age group, individuals under 25 were less likely to die alone compared to the older age group.

Regarding observations of sleeping or symptoms of overdose, only those deaths where the deceased were in the company of others at the time of death (N = 190) were included. Most of the deceased (80.0 %) and their companions (69.5 %) were asleep at the time of the death event (Table 4c). A higher proportion of women than men were asleep at the time of death (73.2 % vs. 81.9 %). The companions of deceased men

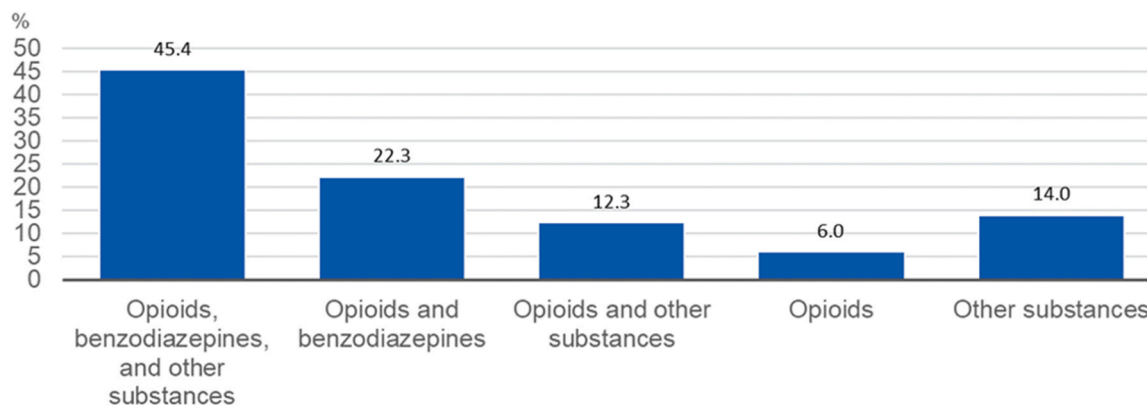


Fig. 1. Substances implicated in the cause of death among under 30-year-olds who died of drug overdoses in 2019–2021 (N = 300), %.

Table 2

Age groups and sex of drug overdose deaths of under 30-year-olds in Finland 2019–2021 (N = 300).

	Male		Female		All (N = 300)	
	N	%	N	%	N	%
Age groups						
Under 18	11	55.0	9	45.0	20	6.7
18–24	139	81.3	32	18.7	171	57.0
25–29	91	83.5	18	16.5	109	36.3
Total	241	80.3	59	19.7	300	100

Table 3

Individual characteristics of drug overdose deaths of under 30-year-olds in Finland 2019–2021 (N = 300).

	N = 300	%
3a. Substance use history and treatment		
Not mentioned in the documents	139	46.3
Substance use disorder identified in health care	108	36.0
Had been in substance use treatment due to drug use	53	17.7
<i>Of which in opioid agonist therapy at the time of death</i>	12	4
Total	300	100
3b. Medical conditions	N = 300	%
Mental disorders only (no other known diseases)	73	24.3
Somatic diseases only (no other known diseases)	49	16.3
Neuropsychiatric disorders only (no other known diseases)	17	5.7
Mental disorders and somatic diseases	58	19.3
Neuropsychiatric disorders and somatic diseases/mental disorders	11	3.6
Mental and neuropsychiatric disorders and somatic diseases	14	4.7
No known diseases	78	26.0
Total	300	100

individuals were more often asleep at the time of death compared to the companions of deceased women (78.0 % vs. 67.1 %).

Snoring or heavy breathing—one of the signs of an opioid overdose—was mentioned in 21.0 % of cases where the deceased had companionship before the time of death (Table 4c). This was more common for men than women (23.5 % vs. 12.2 %). Clear signs of an overdose (vomiting, laboured breathing, blue lips, and passing out suddenly) were noted in 13.6 % of cases in which the victim was not alone at the time of death.

As shown in Table 4d, resuscitation by emergency care was given in 13.7 % of the cases. In 43.3 % of cases, no resuscitation was initiated because the emergency care personnel found the person unresponsive. Emergency medical care was not sent in 43.0 % of cases because the person was found dead. Lay resuscitation was mentioned in 19.7 % of all cases.

3.4. Risky environment

Of the deaths, 12.0 % occurred within 30 days of residing in an institution—either as a client/patient in a health or social care facility,

Table 4

Risky circumstances of drug overdose deaths of under 30-year-olds in Finland 2019–2021 (N = 300).

	N = 300	%
4a. Places of drug overdose deaths		
Own residence	124	41.3
Friend's/acquittance's residence	117	39.0
Parent's/relative's residence	17	5.7
Assisted living/dormitory	14	4.7
Hospital	9	3.0
Outdoors	5	1.7
Hotel room	5	1.7
Other	9	3.0
Total	300	100
4b. Company at the time of death in drug overdose deaths	N = 300	%
One or several friends	118	39.3
Alone at the moment of imminent death	117	39.0
A partner	35	11.7
A family member who was in the same residence	15	5.0
Died in the hospital	9	3.0
Other	6	2.1
Total	300	100
4c. Sleeping of the deceased and death companion and observations of symptoms of poisoning	N = 190	%
Deceased slept (N = 190)	152	80.0
Company slept (N = 190)	132	69.5
Deceased snored/had a heavy breath (N = 190)	40	21.0
Deceased had other symptoms of poisoning (N = 191*)	26	13.6
4d. Resuscitation of emergency care in drug overdose deaths	N = 300	%
No, emergency care personnel found the person unresponsive and did not attempt resuscitation	130	43.3
No, the person was found dead and emergency care was not required at the scene	129	43.0
Yes	41	13.7
Total	300	100

*N = 191, one person was alone at the time of death but had time to call a relative and describe their symptoms.

as a prison inmate, or after being arrested for being intoxicated and disorderly. Of the deceased, 10 were placed in out-of-home care, 12 had recently been hospitalized for psychiatric or somatic disorders, and 10 had recently been in substance use treatment. In addition, there were young people (N = 4) who had recently been released from prison or died in police custody. A half of all the 20 minors in the study population had been in out-of-home care during the time of death. They died either while absent (authorized or unauthorized) from out-of-home care or while alone in their out-of-home care related independence practice residence.

The distribution of deaths was examined regionally, based on the home municipalities of the deceased. The municipalities were categorised according to Statistics Finland (2025d) classification into urban, densely populated, and rural areas. Relative to the population of the same age, there were more deaths in urban municipalities (11.2 per 100,000 inhabitants) and fewer deaths in semi-urban (8.5 per 100,000

inhabitants) and rural areas (5.4 per 100,000 inhabitants).

The drug overdoses deaths of young people occurred more frequently in postal code areas where household income was below the national average and unemployment was more common (Fig. 2). Additionally, fatal overdoses took place in municipalities in which people lived more in households that received income support. It was also found that the rate of mental health care visits per 1000 residents was higher in municipalities with overdose deaths among young people than in Finnish municipalities on average.

4. Discussion

4.1. The interpretation of results

This is one of the first studies to explore drug overdose deaths of young people in a non-heroin use setting. The analysis shed light on several individual, situational, and environmental factors related to the drug overdoses of young people. The cases are all unique but common patterns of risks can be identified.

Most drug overdoses of young people were associated with a risky pattern of polydrug use, which is consistent with results from previous studies as summarized in a systematic review by Lyons et al. (2019). As such, using opioids such as buprenorphine is a way of minimising risks as they are less toxic than heroin or fentanyl. Additionally, combining them with other pharmaceutical drugs is one method to overcome the risks of using drugs from illicit production and markets, where the potency and purity of the substances is unknown. However, the co-administration of different substances, either simultaneously or sequentially, is risky as interactions between different substances can

lead to overdoses, even if the amounts of individual substances are not toxic. Additionally, the rise of counterfeit pharmaceuticals in the illicit market poses new risks. Especially non-prescribed benzodiazepines produced abroad have emerged in the Finnish drug market, and it is not always clear if they are real pharmaceuticals or counterfeit. They may contain other substances and a different potency from that indicated on the package. For instance, the opioid U-47700 was detected in counterfeit alprazolam tablets in 2019 (Finnish Customs, 2019). Drug checking services are not available in Finland as the current legislation does not allow drug possession for harm reduction purposes.

In approximately half of the cases, problematic substance use was identified in healthcare prior to death. However, the question of actual treatment and services provided to these patients remains open. A recent audit report highlighted shortcomings in substance use care and services for young people in Finland: substance use services at the specialized medical care level for individuals under 18 are rarely available, transitions from youth to adult services are often unclear, and the integration of mental health and substance use services is weak (National Audit Office of Finland, 2024). Furthermore, our study showed that comorbidity was high involving substance use, mental health disorders, and somatic disorders among the study population, and only 4 per cent were in opioid agonist treatment at the time of death. These findings may indicate that the deceased did not receive appropriate treatment and/or services, despite their substance use disorders being identified. To address these challenges, a national program aimed at preventing drug-induced mortality among youth has been established to enhance the efficiency and integration of substance use and related services targeted at young people (MSAH, 2025).

On the other hand, the findings of the study also reveal that drug use

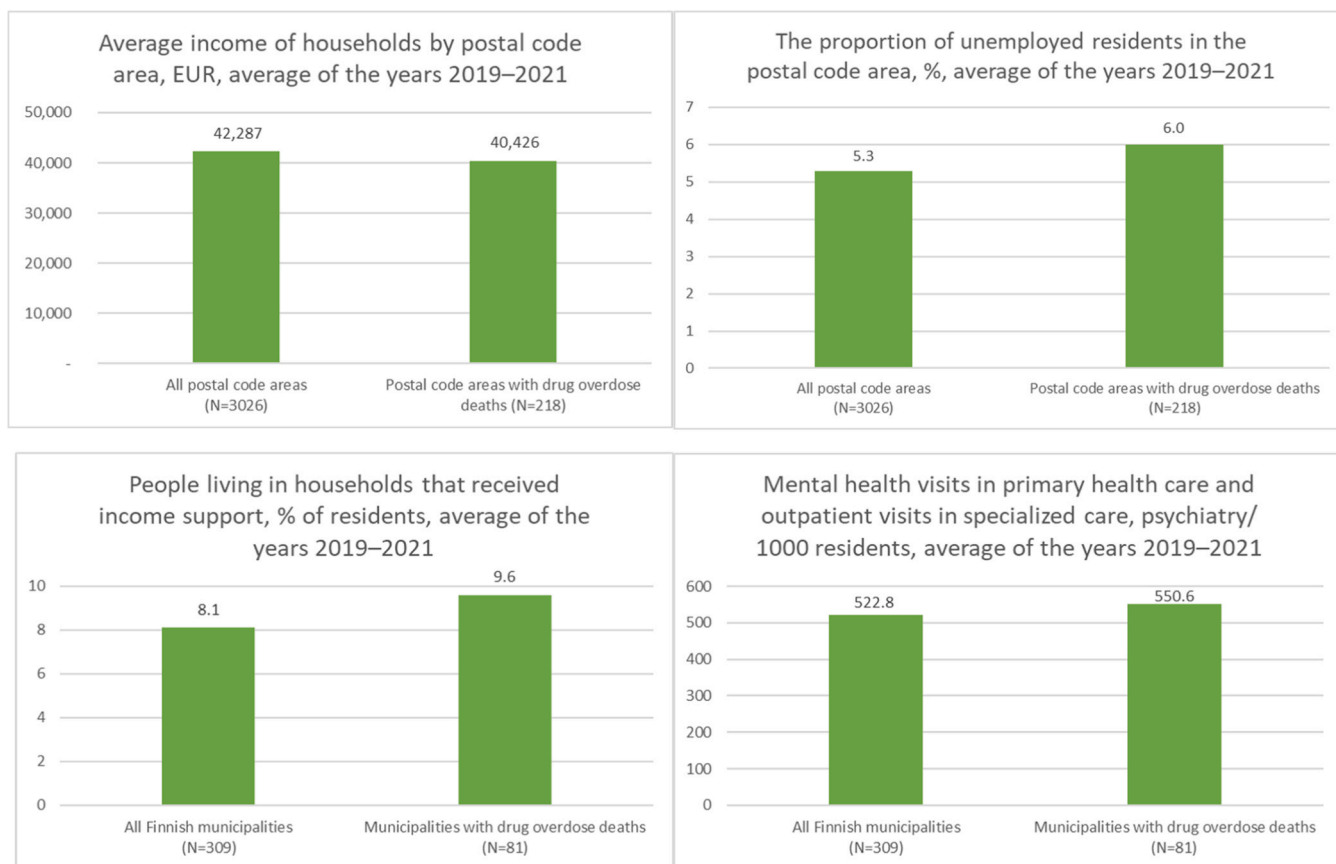


Fig. 2. Social and economic environment of drug overdose deaths of young people at local level (N = 288)¹.

¹Of the total 300 deceased, 12 either did not have an address in the population information system or were not registered residents of Finland.

Sources: Income Distribution Statistics, Statistics Finland (2025b); Employment, Statistics Finland (2025c); Register of Social Assistance, Finnish Institute for Health and Welfare (2025a); Primary health care, Finnish Institute for Health and Welfare (2025b); Specialised Healthcare, Finnish Institute for Health and Welfare (2025c).

disorders were not mentioned in almost a half of the case documents. This refers to the fact that substance use disorders of young people are poorly identified in the healthcare services. The figures showing significant comorbidity among the study population further underscore this reality.

The majority of deaths occurred in private residences, which is consistent with other Nordic studies (Gjersing et al., 2013; Andersson et al., 2020; Andersen et al., 2024). Additionally, nearly all the deceased had a registered address, and homelessness was rarely mentioned in the police reports. This reflects Finland's success in reducing homelessness (Pleace et al., 2015). Finland has adopted the Housing First policy, which has significantly reduced long-term and recurring homelessness. However, two-fifths of the deceased died alone, which may refer to risks related to having a private residence and living alone. According to the Housing First policy, housing alone is not sufficient for young people who use substances, who often lack basic living skills, and live with serious mental health disorders. They also need additional support and services (Pleace et al., 2015). More research is needed to explore the types of additional support the deceased received and might have needed.

When other people are present while using drugs, it is theoretically possible for the companion or companions to detect the development of an overdose and to alert emergency services for help, which increases the likelihood of survival. However, in most cases the accompanying person was sleeping, making it difficult to detect the development of the overdose situation. Often, the evening had already come to an end and the toxic state became deadly only after the individual had fallen asleep (see also Andersen et al., 2024). Nevertheless, in a third of the cases the companions had been awake, and it would have been possible to call for help in time (see also Powis et al., 1999; Darke and Hall, 2003). The small proportion of initiated resuscitations by emergency services suggests that help was often called too late. Delays in response may be due to fear of police involvement (Tobin et al., 2005). It is also possible that the companions were intoxicated and missed the overdose symptoms, as reported in a qualitative interview study conducted in South Wales (Holloway et al., 2018).

Besides access to treatment, the continuation of care appears to be a critical weak point in the health and social care system. One-tenth of the deaths occurred in close temporal proximity to social and healthcare or crime control institutions. It is known that while in these facilities, the body's tolerance to drugs decreases. The first weeks after release from prison are particularly critical for overdose deaths, as individuals may administer drugs in the same manner as before imprisonment (Binswanger et al., 2007). After discontinuing opioid replacement therapy, the risk of mortality is elevated for one month (Santo et al., 2021; Sordo et al., 2017). The situation is especially precarious for individuals under 18 who have left out-of-home placements without permission, as they lack adult protection and seek places to stay overnight. Additionally, authorities are not actively searching for these children.

The results revealed that social and economic factors are also related to overdose deaths at the local level, which is consistent with previous literature (e.g. Kariisa, 2022; Rangachari et al., 2022). Although the differences were not particularly large, the deceased tended to live in areas which were more disadvantaged than average in terms of reliance on social support, unemployment, income, and mental healthcare visits. These disparities may be related to differences in the population structure within these municipalities, but it may also indicate that a lack of perspective and despair can spread at the community level.

4.2. Strengths and limitations

The study material consisted of all the registered overdose deaths of under 30-year-olds in 2019–2021 in Finland. According to quality reports, it has been estimated that due to the Finnish legislation and the cause of death investigation process, all overdose deaths are detected

and investigated. The examination of the available documents enabled the deaths to be explored on several levels and various risk factors contributing to the deaths to be identified.

As the documents were created for the administrative purpose of determining the manner and cause of death, they are not necessarily homogenous in the extent of the data. There is also human variation in how comprehensive the reports are and how much experience there is behind the expert assessments.

5. Conclusions

The overdose deaths of young people result from a complex matrix of risk factors. Patterns of polydrug use increase the risk of overdose. The treatment system has not effectively addressed the comorbidities of the deceased at a structural level, and the retention of health and social care has been inadequate. One situational factor is the delayed call for an ambulance, potentially due to fear of police involvement. The deceased lived in areas that are socially and economically disadvantaged compared to the average. Tailored interventions that address the known risks of overdoses are necessary, along with political decisions that support harm-reduction measures.

CRediT authorship contribution statement

Sanna Rönkä: Writing – review & editing, Writing – original draft, Visualization, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Heta Konttinen:** Writing – review & editing, Visualization, Formal analysis, Data curation. **Margareeta Häkkinen:** Writing – review & editing, Data curation. **Karoliina Karjalainen:** Writing – review & editing, Funding acquisition, Conceptualization. **Pirkko Kriikku:** Writing – review & editing, Data curation. **Pekka Hakkarainen:** Writing – review & editing, Funding acquisition, Conceptualization.

Funding

This work was funded by the Strategic Research Council (SRC) established within the Research Council of Finland (grant number 352600). The funding source did not have any role in the study design, data collection, analysis and interpretation of data, writing the report, or the decision to submit the report for publication.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The data are not publicly available due to data confidentiality and the authors do not have permission to share the data. Similar data can be applied from Findata, the Finnish Social and Health Data Permit Authority (<https://findata.fi/en/>).

References

- Act on Determining the Cause of Death 459/1973. <https://www.finlex.fi/fi/lainsaadanto/1973/459>.
- Andersen, P.A., Thomsen, A.H., Hasselström, J.B., Andersen, F.D., Thomsen, J.H., Jormil, J.R., Andersen, C.U., 2024. Exploring death scenes and circumstances in fatal opioid poisonings: insights for preventive strategies using forensic autopsy cases in Western Denmark. *Forensic Sci. Int.* 356, 111948. <https://doi.org/10.1016/j.forsciint.2024.111948>.
- Andersson, L., Håkansson, A., Krantz, P., Johnson, B., 2020. Investigating opioid-related fatalities in southern Sweden: contact with care-providing authorities and comparison of substances. *Harm Reduct. J.* 17 (1), 5. <https://doi.org/10.1186/s12954-019-0354-y>.

- Binswanger, I.A., Stern, M.F., Deyo, R.A., Heagerty, P.J., Cheadle, A., Elmore, J.G., Koepsell, T.D., 2007. Release from prison—a high risk of death for former inmates. *N. Engl. J. Med.* 356, 157–165. <https://doi.org/10.1056/NEJMsa064115>.
- Byrne, C.J., Sani, F., Thain, D., Fletcher, E.H., Malaguti, A., 2024. Psychosocial factors associated with overdose subsequent to illicit drug use: a systematic review and narrative synthesis. *Harm. Reduct. J.* 21, 81. <https://doi.org/10.1186/s12954-024-00999-8>.
- Darke, S., Hall, W., 2003. Heroin overdose: research and evidence-based intervention. *J. Urban Health* 80, 189–200. <https://doi.org/10.1093/jurban/jtg022>.
- Dasgupta, N., Beletsky, L., Ciccarone, D., 2018. Opioid crisis: no easy fix to its social and economic determinants. *Am. J. Public Health* 108, 182–186. <https://doi.org/10.2105/AJPH.2017.304187>.
- Duke, K., Gleeson, H., MacGregor, S., Thom, B., 2024. The risk matrix: drug-related deaths in prisons in England and Wales, 2015–2020. *J. Community Psychol.* 52, 1056–1077. <https://doi.org/10.1002/jcop.22989>.
- EMCDDA, 2010. EMCDDA standard protocol to collect data and report figures for the key indicator drug-related deaths (DRD-Standard, version 3.2). (https://www.euda.europa.eu/html.cfm/index107404EN.html_en) (accessed 20 January 2025).
- EMCDDA, 2024. Drug-induced deaths – the current situation in Europe (European Drug Report 2024). (https://www.euda.europa.eu/publications/european-drug-report/2024/drug-induced-deaths_en) (accessed 20 January 2025).
- Finnish Customs, 2019. Finnish Customs warns about life threatening counterfeit pharmaceutical tablets containing opioid. (<https://www.epressi.com/tiedotteet/hallitus-ja-valtio/finnish-customs-warns-about-life-threatening-counterfeit-pharmaceutical-tablets-containing-opioid.html>) (accessed 20 January 2025).
- Finnish Institute for Health and Welfare, 2025a. Register of Social Assistance. Social assistance, recipient persons during year, as % of total population (ind. 493). Sotkanet database. (<https://sotkanet.fi/sotkanet/fi/metadata/indicators/493>) (accessed 17 January 2025).
- Finnish Institute for Health and Welfare, 2025b. Primary health care. Mental health visits in primary health care per 1000 inhabitants (ind. 2458). Sotkanet database. (<https://sotkanet.fi/sotkanet/en/metadata/indicators/2458?>) (accessed 17 January 2025).
- Finnish Institute for Health and Welfare, 2025c. Specialized health care. Outpatient visits in specialised health care, psychiatry, per 1000 persons aged over 18 (ind. 2482). Sotkanet database. (<https://sotkanet.fi/sotkanet/en/metadata/indicators/2482?>) (accessed 17 January 2025).
- Gjersing, L., Jonassen, K.V., Biong, S., Ravndal, E., Waal, H., Bramness, J.G., Clausen, T., 2013. Diversity in causes and characteristics of drug-induced deaths in an urban setting. *Scand. J. Public Health* 41 (2), 119–125. <https://doi.org/10.1177/1403494812472007>.
- Hakkarainen, P., Tigerstedt, C., Tammi, T., 2007. Dual-track drug policy: normalization of the drug problem in Finland. *DRUGEduc. Prev. Policy* 14 (6), 543–558. <https://doi.org/10.1080/09687630701392008>.
- Häkkinen, M., Launiainen, T., Vuori, E., Ojanperä, I., 2012. Benzodiazepines and alcohol are associated with cases of fatal buprenorphine poisoning. *Eur. J. Clin. Pharm.* 68, 301–309. <https://doi.org/10.1007/s00228-011-1122-4>.
- Heyman, G.M., Ryu, E., Brownell, H., 2024. Evidence that intergenerational income mobility is the strongest predictor of drug overdose deaths in U. S. Midwest counties. *Int. J. Drug Policy* 132, 104558. <https://doi.org/10.1016/j.drugpo.2024.104558>.
- Holloway, K., Hills, R., May, T., 2018. Fatal and non-fatal overdose among opiate users in South Wales: a qualitative study of peer responses. *Int. J. Drug Policy* 56, 56–63. <https://doi.org/10.1016/j.drugpo.2018.03.007>.
- Kariisa, M., 2022. Vital signs: drug overdose deaths, by selected sociodemographic and social determinants of health characteristics — 25 states and the district of Columbia, 2019–2020. *MMWR Morb. Mortal. Wkly. Rep.* 71. <https://doi.org/10.15585/mmwr.mm7129e2>.
- Kriikku, P., Tikkanen, J., Ojanperä, I., 2022. Nuoren huumeemyrkytyskuoleman taustalla on useimmiten buprenorfiiniin, bentsodiatsepiiniin ja amfetamiiniin päihdekäyttö. [Drug-related deaths in adolescents are mostly due to the use of buprenorphine, benzodiazepines and amphetamines.]. *Duodecim* 138, 1251–1256.
- Lyons, R.M., Yule, A.M., Schiff, D., Bagley, S.M., Wilens, T.E., 2019. Risk factors for drug overdose in young people: a systematic review of the literature. *J. Child Adolesc. Psychopharmacol.* 29, 487–497. <https://doi.org/10.1089/cap.2019.0013>.
- Mariottini, C., Kriikku, P., Ojanperä, I., 2021. Concomitant drugs with buprenorphine user deaths. *Drug Alcohol Depend.* 218, 108345. <https://doi.org/10.1016/j.drugalcdep.2020.108345>.
- MSAH, 2025. Hallitus käynnistää ohjelman nuorten huumekuolemien ehkäisemiseksi [The Government Launches a Program to Prevent Drug-Related Deaths Among Youth]. (<https://stm.fi/-/hallitus-kaynnistaa-ohjelman-nuorten-huumekuolemien-ehkaisyseksi>) (accessed 9 May 2025).
- National Audit Office of Finland, 2024. Mental health and substance abuse services for young people in wellbeing services counties – Service availability, accessibility and coordination. Conclusions and Recommendations 15/2014. (<https://www.vtv.fi/app/uploads/2024/12/NAOF-recommendations-15-2024-Mental-health-and-substance-abuse-services-for-young-people-in-wellbeing-services-counties.pdf>) (accessed 20 January 2025).
- Pleace, N., Culhane, D., Granfelt, R., & Knutagard, M., 2015. The Finnish homelessness strategy: An international review. Research report. Ministry of the Environment, Finland. (<https://eprints.whiterose.ac.uk/213242/>).
- Powis, B., Strang, J., Griffiths, P., Taylor, C., Williamson, S., Fountain, J., Gossop, M., 1999. Self-reported overdose among injecting drug users in London: extent and nature of the problem. *Addiction* 94, 471–478.
- Rangachari, P., Govindarajan, A., Mehta, R., Seehusen, D., Rethemeyer, R.K., 2022. The relationship between Social Determinants of Health (SDoH) and death from cardiovascular disease or opioid use in counties across the United States (2009–2018). *BMC Public Health* 22, 236. <https://doi.org/10.1186/s12889-022-12653-8>.
- Rhodes, T., 2002. The ‘risk environment’: a framework for understanding and reducing drug-related harm. *Int. J. Drug Policy* 13, 85–94. [https://doi.org/10.1016/S0955-3959\(02\)00007-5](https://doi.org/10.1016/S0955-3959(02)00007-5).
- Rhodes, T., 2009. Risk environments and drug harms: a social science for harm reduction approach. *Int. J. Drug Policy Risk Environ. Drug Harms* 20, 193–201. <https://doi.org/10.1016/j.drugpo.2008.10.003>.
- Rönkä, S., Karjalainen, K., Martikainen, P., Mäkelä, P., 2017. Social determinants of drug-related mortality in a general population. *Drug Alcohol Depend.* 181, 37–43. <https://doi.org/10.1016/j.drugalcdep.2017.09.005>.
- Santo, T., Jr, Clark, B., Hickman, M., Grebely, J., Campbell, G., Sordo, L., Chen, A., Tran, L.T., Bharat, C., Padmanathan, P., Cousins, G., Dupouy, J., Kely, E., Muga, R., Nosyk, B., Min, J., Pavarin, R., Farrell, M., Degenhardt, L., 2021. Association of opioid agonist treatment with all-cause mortality and specific causes of death among people with opioid dependence: a systematic review and meta-analysis. *JAMA Psychiatry* 78, 979–993. <https://doi.org/10.1001/jamapsychiatry.2021.0976>.
- Sordo, L., Barrio, G., Bravo, M.J., Indave, B.I., Degenhardt, L., Wiessing, L., Ferri, M., Pastor-Barrisio, R., 2017. Mortality risk during and after opioid substitution treatment: systematic review and meta-analysis of cohort studies. *BMJ* 357 j1550. <https://doi.org/10.1136/bmj.j1550>.
- Statistics Finland, 2025a. Causes of death. Drug-related deaths (Selection B) by underlying cause of death, age and sex, 2006–2023. (https://pxdata.stat.fi/PxWeb/pxweb/en/StatFin/StatFin_ksyyt/statfin_ksyyt_pxt_12d9.px/) (accessed 9 May 2025).
- Statistics Finland, 2025b. Income Distribution Statistics. Households' disposable monetary income, 2010–2023: Average income of Households. (https://pxdata.stat.fi/PxWeb/pxweb/en/Postinumeroalueittainen_avoin_tieto/Postinumeroalueittainen_avoin_tieto_uusin/paavo_pxt_12f3.px/) (accessed 17 January 2025).
- Statistics Finland, 2025c. Employment. Main type of activity, 2010–2023: Unemployed. (https://pxdata.stat.fi/PxWeb/pxweb/en/Postinumeroalueittainen_avoin_tieto/Postinumeroalueittainen_avoin_tieto_uusin/paavo_pxt_12f6.px/) (accessed 17 January 2025).
- Statistics Finland, 2025d. Statistical grouping of municipalities. (https://stat.fi/en/luokitukset/kuntaryhitys/kuntaryhitys_1_20250101) (accessed 17 January 2025).
- Strang, J., 2015. Death matters: understanding heroin/opiate overdose risk and testing potential to prevent deaths. *Addiction* 110, 27–35. <https://doi.org/10.1111/add.12904>.
- Timmermans, S., Prickett, P.J., 2023. The social autopsy. *Sociol. Methods Res.* 52, 1681–1706. <https://doi.org/10.1177/00491241211036163>.
- Tobin, K.E., Davey, M.A., Latkin, C.A., 2005. Calling emergency medical services during drug overdose: an examination of individual, social and setting correlates. *Addiction* 100, 397–404. <https://doi.org/10.1111/j.1360-0443.2005.00975.x>.