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Article

Ketamine-Related Deaths Registered in Scotland 2013–2024

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Abstract: Background: Ketamine, a dissociative anaesthetic and non-competitive NMDA receptor antagonist, has legitimate medical applications. However, rising illicit use across the United Kingdom (UK) has been accompanied by growing reports of toxicity, dependence, and deaths. These have led to renewed policy discussions. Rationale and Aim: Previous national studies have reported ketamine-related deaths elsewhere in the UK, but not in Scotland. This study examined all Scottish deaths (2013–2024) where ketamine was implicated, to provide a comprehensive evidence base for UK-wide policy discussions. Methods: Data were derived from anonymised National Records of Scotland records. All cases where ketamine was implicated in death were identified. Descriptive and comparative analyses were undertaken by year, sex, age, manner, and substances co-implicated. Results: Eighty-eight deaths were identified (≈0.5% of cases), with a steady increase over time. Most decedents were male (81.8%); mean age was 35 years. Most (84%) were accidental and involved polysubstance use—typically opioids (58%), stimulants (55%), benzodiazepines (48%), gabapentinoids (25%), and alcohol (22%). Acute drug use was the principal cause of death in 85% of cases. Discussion: The marked upward trend parallels that observed elsewhere in the UK. Polysubstance involvement, especially combinations of ketamine with opioids or benzodiazepines, substantially increases fatal risk through additive central nervous system depression. These findings reinforce the need for clearer public health messaging, targeted harm-reduction interventions, and careful monitoring of misuse, prescribing and diversion trends. Conclusions: Scottish ketamine-related deaths increased twentyfold in a decade. Most are preventable, highlighting the need for continued targeted education, intervention, and epidemiological monitoring.

Keywords: ketamine; deaths; Scotland; demographics; causes; trends

1. Introduction

Ketamine or 2-(2-chlorophenyl)-2-(methylamino)cyclohexanone, known commonly as ‘K’ or ‘Special K’, is a non-competitive glutamate N-methyl-d-aspartate (NDMA) receptor antagonist which induces dissociative anaesthetic effects [1] leading to cataleptic trance-like states presenting as amnesia, deep analgesia or even unconsciousness [2]. Its medical uses include anaesthesia, pain relief, and even treatment for depression [3,4] and post-traumatic stress disorder (PTSD) [5]. Indeed, illicit forms or diverted supplies of ketamine are taken by individuals to self-medicate symptoms associated with such conditions [6].

Ketamine was controlled under the Medicines Act 1968 and the Medicines for Human Use 1994 legislation until the mid-2000s. As a result of concerns about large quantities of it being seized en route from India to the United Kingdom (UK) and its potential for harm, the Advisory Council on the Misuse of Drugs (ACMD) undertook a review. The Council’s Technical Committee advised that ketamine should be placed in Class C of the

Misuse of Drugs Act 1971 and in Schedule 4 Part 1 of the Misuse of Drugs Regulations 2001 [7]. The UK Government accepted these recommendations which came into effect on 1 January 2006 [8].

In the years that followed, evidence increased regarding ketamine's misuse and harms, particularly about chronic toxicity, notably including bladder and other renal tract damage. In March 2012, the then Home Secretary asked the ACMD to review the evidence concerning these issues [9]. The ACMD recommended that ketamine be controlled as a Class B substance and be placed in Schedule 2 of the Misuse of Drugs Regulations 2001 [10]. This advice was welcomed by the Home Office in February 2014 [11]. Secondary legislation was enacted which came into effect on 10 June 2014 [12].

The ongoing trends of rising prevalence, use, and harms have now prompted new policy discussions to consider further tightening of controls on ketamine, including reclassifying it as a Class A substance [13].

Ketamine can be easily obtained from online sources, on the street or via diversion from legitimate sources [14]. In 2023 the price of 1 g of ketamine was in the range £20–£40 [15]. The following year, the range was £20–£30, but this year (2025) has seen the range fall to £10–£30 [15–17]. Ketamine is cheaper than cocaine or MDMA [18].

There is limited information available regarding the other key ketamine drug indicators for the United Kingdom (UK) as whole, but especially for Scotland. A brief overview, derived from routinely published statistical sources, is provided below. [For a fuller historical description see Corkery et al. [19].

The prevalence of last year use of ketamine of those living in households in England and Wales in the financial year ending March 2024 was 0.8% amongst 16–59 year-olds and 2.9% amongst those aged 16–24 years; these rates represent estimated last year ketamine user numbers at 269,000 and 172,000, respectively [20]. These rates and numbers are lower than the record levels seen in the previous year.

Wastewater analysis showed there was an estimated increase of 85% in ketamine consumption across 18 sites in England between January–April 2023 and January–April 2024 [21].

A record number of ketamine seizures (n = 2, 252) were made by Border Force and police in England and Wales in the 2023–2024 financial year. The amount seized in that year was 855 kg, down from 1837 kg and 1434 kg in 2021–2022 and 2022–2023, respectively [22]. The number of ketamine seizures in Northern Ireland rose from 47 in 2022–2023, to 91 in 2023–2024, and 106 in 2024–2025; the amounts seized in the latter two years were 9.7 kg and 18.3 kg, respectively [23]. The number of ketamine seizures in Scotland has varied widely from year to year, as has the quantity confiscated (results from Freedom of Information (FOI) requests made to Police Scotland by the lead author); there are no recent figures in the public domain or available via FOI requests.

There were 4838 adults (1.6% of all clients) receiving treatment in England for ketamine problems in 2023–2024 [24]; the relevant number of young people was 379 (2.6% of all clients) [25].

There have only been three previously published peer-reviewed studies from the UK which have looked at deaths related to ketamine at national levels [19,26,27]. Only the first of these studies covered Scotland. The lead author (JMC) also presented data on ketamine deaths derived from the National Programme on Substance Abuse Deaths (NPSAD) to the ACMD in 2004 [28] and 2013 [10].

The information presented here is derived from an examination of data relating to all Scottish drug poisoning deaths where ketamine was implicated that were registered between 2013 and 2024 by the National Records of Scotland (NRS). Anonymised data are provided by NRS to the lead author (JMC) under an agreement between them for the EU-MADNESS project.

The information provided to the NRS is wider than that received by the Office for National Statistics in that pathologists provide information on the substances involved in death ('poisons') and other substances found in the post-mortem toxicology investigations (but no levels). However, such information is not as detailed as that received by the National Programme on Substance Use Mortality (NPSUM, formerly NPSAD) from coroners, who also provide information on a wider range of variables and from different informants.

2. Rationale and Aims

The ACMD was invited in January 2025 by the then Home Office Minister of State for Policing, Fire and Crime Prevention to "provide an updated harms assessment of ketamine, and advice on reducing harms, in response to emerging evidence, and in particular whether it should be moved to Class A" of the Misuse of Drugs Act 1971 [13].

The ACMD has already been provided with relevant data and analysis on ketamine-related fatalities by the NPSUM. However, that information only covers England, Wales and Northern Ireland.

The aim of this analysis was to complement that already provided to the ACMD for the rest of the UK.

3. Materials and Methods

3.1. Materials

The EU-MADNESS database consists of anonymised case-level data provided by the NRS. These records are derived from information contained on Medical Certificates of Cause of Death. Information from pathologists is also provided on: (a) substances deemed to have be implicated in death—the 'poisons' field; and (b) also present in post-mortem toxicology. Based on these data, cases are then coded to the International Classification of Diseases (10th version)—ICD-10 [29]. Relevant instances were identified by an examination of the 'poisons' field for all 17,000+ records on the EU-MADNESS database for the term 'ketamine'.

3.2. Statistical Analysis

The individual cases thus identified were analysed with Microsoft Excel using frequencies, percentages, descriptive statistics, and the application of relevant statistical tests, i.e., Mann-Whitney U test for mean age, and ratio of proportions for all other variables. The results are presented in graphical and tabular forms. The tabular findings are broken down into two periods—2013–2019 and 2020–2024—to facilitate comparison with similar information presented for England, Wales and Northern Ireland by NPSUM to the ACMD, and also published in Pullen et al. [27].

4. Results

A total of 88 cases (≈0.5% of all EU-MADNESS database cases) were identified. As can be seen in Figure 1, there has been an overall steady increase in deaths occurring over the period 2013–2024. There was a slight dip in 2022.

The majority of cases were male, both for the overall period (81.8%) and when split by period (Table 1). The mean age at death was 35.1 ± 12.65 (range 16–74) years. Most deaths (84.1%) were deemed accidental in nature.

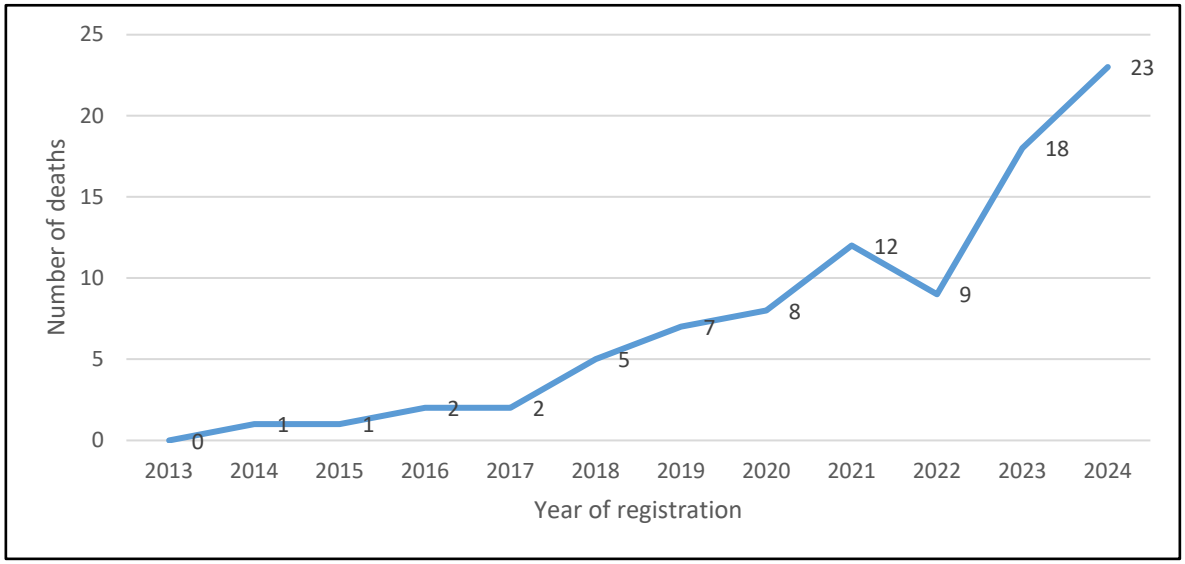

Figure 1. Number of deaths registered, by year of death, 2013–2024.

The majority of deaths involved multiple substances; there were only six (6) cases—all in 2020–2024—where ketamine alone was implicated in death (Table 2). All major chemical classes of substances were implicated in the majority of fatalities, often with several being present. Opiate/opioids (58%) were the most commonly implicated class of drug; heroin being implicated in only one-fifth of all deaths. Stimulants were the second most common group (54.5%) co-implicated, with cocaine being found in half of all deaths—often in combination with ecstasy (MDMA/methylenedioxymethylamphetamine) and/or other amphetamine-type stimulants. Benzodiazepines were implicated in just under a half of cases (47.7%), chiefly novel benzodiazepines such as etizolam and bromazolam rather than 'traditional' ones such as diazepam (21.6% of all deaths). Gabapentinoids (25%) and alcohol (21.6%) were also co-implicated in deaths.

Table 1. Characteristics of fatalities following ketamine use.

Characteristics		Period					
		2013–2019		2020–2024		Total	
		n	%	n	%	n	%
Total		18	100.0	70	100.0	88	100.0
Age (mean ± S.D [range])		35.8 ± 10.99 [19–62]		34.9 ± 13.03 [16–74]		35.1 ± 12.65 [16–74]	
Gender	Male	15	83.3	57	81.4	72	81.8
	Female	3	16.7	13	18.6	16	18.2
Manner of death	Accidental	14	77.8	60	85.7	74	84.1
	Intentional	2	11.1	4	5.7	6	6.8
	Undetermined/ Other	2	11.1	6	8.6	8	9.1

Note: S.D. = Standard deviation.

Between the two periods considered here, the proportions of cases where opiates/opioids and benzodiazepines were implicated fell, those involving stimulants and gabapentinoids rose, whereas that for alcohol was stable.

Table 2. Main substance classes implicated in death following ketamine use.

Ketamine and Other Substances Implicated	Period					
	2013–2019		2020–2024		Total	
	n	%	n	%	n	%
Total	18	100.0	70	100.0	88	100.0
With opiate(s)/opioid(s)	12	66.7	39	55.7	51	58.0
Heroin/morphine	4	22.2	14	20.0	18	20.5
With stimulant(s)	8	44.4	40	57.1	48	54.5
Cocaine	7	38.9	37	52.9	44	50.0
With benzodiazepine(s)	9	50.0	33	47.1	42	47.7
Diazepam	6	33.3	13	18.6	19	21.6
With gabapentinoids	2	11.1	20	28.6	22	25.0
With alcohol	4	22.2	15	21.4	19	21.6
Ketamine alone	0	0.0	6	8.6	6	6.8

Nearly nine out of ten deaths had an underlying cause of death recorded as being due to drug use; 85.2% of all deaths involved acute drug use (Table 3). The majority of remaining cases were due to external factors especially traumatic injuries (6.8%), including those incurred through hanging, falls from heights and motor vehicle collisions—several of these instances were intentional/deliberate in nature.

Table 3. Underlying cause in deaths following ketamine use.

Underlying Cause of Death	Period					
	2013–2019		2020–2024		Total	
	n	%	n	%	n	%
Total	18	100.0	70	100.0	88	100.0
Drug use						
Acute	15	83.3	60	85.7	75	85.2
Chronic	1	5.6	2	2.9	3	3.4
Physiological complications						
Urinary			1	1.4	1	1.1
External factors						
Hypothermia	1	5.6	0	0.0	1	1.1
Asphyxia	0	0.0	1	1.4	1	1.1
Trauma	1	5.6	5	7.1	6	6.8
Drowning	0	0.0	1	1.4	1	1.1

Note: Percentages do not sum to 100% because of rounding.

There were no statistically significant differences ($p < 0.05$) between the two periods in respect of any of the characteristics examined here (for details see Appendix A).

5. Discussion

This brief discussion primarily focuses on a comparison with the recent study by Pullen et al. [27], using as similar an approach as possible given the differences in the purpose, sources and coverage between them.

Both the Pullen et al. [27] and the present study demonstrate that there has been, at least, a twenty-fold in the number of cases where ketamine was implicated in death, over the time-periods examined. This increase was established by comparing the number of deaths at the start of the period examined with that for the end of the period on both the NPSUM and EU-MADNESS databases. Figures published for the first time on ketamine-related fatalities in England and Wales show an 8-fold increase, from 7 to 60, between 2015 and 2024 in the number registered [30].

Reporting and coding practices have not changed for either the NRS or the Office for National Statistics (which covers England and Wales) during this period. It is possible that more instances of ketamine-related fatalities may have been reported to NPSUM because of an increased awareness of the misuse and involvement of ketamine in fatalities by coroners. However, at a toxicological screening level there have been no changes; ketamine is routinely screened for by UK toxicology labs [19].

Generally speaking, there has been increased use of ketamine in non-anaesthesia settings [31], and more approvals given for its use in treating depression [32]. However, in the UK context, such use is very limited, typically by private clinics [33]. Indeed, the number of ketamine prescription items dispensed in the UK, including Scotland, decreased over this period—halving between 2019 and 2024 [34–37]. The rise in ketamine-related fatalities observed in Scotland echoes those in the rest of the UK which are mostly likely affected by the nexus of the low price of illicit ketamine, which in turn is driving increased consumption, against a background of clandestine production which is unregulated [27].

The gender breakdown for 2013–2019 (male 83.3%) is very similar to that found by Pullen et al. [27] for the period 1999–2019 for deaths involving illicit ketamine use (male 82.7%); however, Scottish case numbers are relatively low during this period. For the period 2020–2024, the proportion of Scottish male deaths was 81.4%, compared to 85.2% found by Pullen et al. [27].

The order of major substance/drug classes implicated in the Scottish deaths analysed here (i.e., in descending order—opiates/opioids, stimulants, benzodiazepines, gabapentinoids, and alcohol) is different to that found in the rest of the UK. Pullen et al. [27] examined 396 deaths related to illicit ketamine use. This study found that the substances most commonly co-implicated were, in descending order: stimulants (45.5%), cocaine (30.6%); opiates/opioids (38.9%), heroin/morphine (22.0%); benzodiazepines (31.6%), diazepam (19.4%), and alcohol (28.5%), with no significant changes in these prevalences over time (X^2 $p > 0.05$ for all these substance classes 1999–2019 vs. 2020–2024). However, whilst overall co-implication of gabapentinoids was low (10.1%) there was a statically significant increase in their co-implication over time (X^2 $p < 0.05$ 1999–2019 vs. 2020–2024). These differences probably reflect the different patterns of drug use across the different nations comprising the UK [38] and the different case definitions used in these two studies. However, what is common to both sets of results is the fairly dominant presence of cocaine. The role of cocaine in UK drug poisoning deaths has been a dominant feature in recent decades [30,38–40].

There has been an underlying upward trend across all UK drug poisoning deaths in recent decades of multiple substances being implicated [30,38–40]; ketamine is no exception. It is clear from the Scottish data examined that in the majority of cases, in addition to ketamine, there were substances from other central nervous system (CNS) depressing classes—if not indeed from two or three such classes. Using multiple substances from these classes increases the likelihood of overdose or even death.

Polysubstance use may mean that a lower level of ketamine may cause or contribute to death than in cases where it is the sole substance implicated, especially if respiratory depression was a mechanism of death. This is more likely to occur if taken with CNS depressants such as opiates/opioids and benzodiazepines [19]. Polysubstance use itself can heighten the likelihood of death, most likely due to a synergistic effect of the different self-administered drugs [41,42].

Pullen et al. [27] showed that 83.6% of deaths had an underlying cause given as acute drug use during the period 1999–2019; this is very similar to the present study (83.3%). The Pullen et al. study reported that this proportion increased to 88.5% in 2020–2024; the Scottish proportion for the same period was 85.2%—also an increase.

Some limited comparisons can also be made with regard to a recent paper that reported on ketamine deaths in the United States of America (USA) in the period 2019–2023 [43]. A lower proportion were male (71.3%) compared to the UK. However, the 25–34 and 35–44 year age-groups accounted for about 60% of the 912 deaths where ketamine was detected; this is in line with the mean age of 35 years for Scotland. The profile of drugs implicated in the USA fatalities is slightly different, probably reflecting different patterns of drug usage to the UK.

Nearly half (48.2, n = 440) of the USA cases reported ketamine being implicated in death. The main substance classes represented in these cases were: illegally manufactured fentanyls (58.7%); methamphetamine (28.8%); cocaine (27.2%); benzodiazepines (17.8%); prescription opioids (14.1%); and alcohol (13.3%). Ketamine alone was implicated in only 2.6% of cases. Overall, the patterns exhibited in the USA parallel those in the UK; therefore, similar conclusions can be drawn.

These increased numbers of deaths are paralleled by increasing numbers of presentations to treatment services [24,25]. There has also been a significant increase in urological issues amongst chronic ketamine users presenting to clinics; there have been many reports of these problems in terms of both recreational and prescribed ketamine [44]. Indeed, one of the Scottish cases reported on here had urological issues mentioned in the cause of death.

Deaths registered in 2025 and subsequent years may relate to earlier years. Provisional NRS data for death poisoning registrations made in the first half of 2025 indicate at least one additional death occurring in 2024, and at least 14 for 2025. Thus, the figures presented here should be regarded as minimum numbers.

An examination of the 'cause of death' fields shows no indication that any of the cases examined here appear to have resulted from clinical or medical interventions. Whilst three cases had an underlying cause of chronic drug use there is no indication of long-term dependence and or being iatrogenic in origin. Without additional information on each case, it is impossible to state with certainty that all 88 deaths analysed here were due to the recreational use of ketamine. This is especially the case, as there were several deliberate/intentional deaths.

It is not possible to provide analyses as detailed as those by for the rest of the UK [27] due to the restricted information available to the NRS, primarily the information recorded on the Medical Certificate of Cause of Death and limited information provided to them by pathologists.

Clearly, it will be necessary to continue monitoring ketamine-related fatalities in Scotland and across the United Kingdom as a whole to see what happens, not only in terms of natural evolution but also to assess the impact—if any—of any changes in legislation (i.e., to make ketamine a Class A substance) or any other policy or practice interventions. The feasibility of looking at deprivation levels based on the death registration district could also be looked at, to see if there is a relationship between that and the patterns of deaths observed.

6. Conclusions

This is the first detailed analysis of fatalities registered in Scotland where ketamine was implicated in death. Ketamine-related deaths have increased at least twenty-fold over a decade, paralleling what is happening in the rest of the United Kingdom. Most deaths are polysubstance, involving other CNS depressants. Most involve males, occur due to acute drug use and are accidental in nature. Most ketamine-related deaths are, therefore, avoidable and preventable.

Recreational users of ketamine need to be reminded of the nature of the drug's effects, and how these can be exacerbated by the action of other CNS depressant substances (including opiates/opioids, benzodiazepines and alcohol) and also by co-administration of stimulants (especially cocaine, ecstasy and amphetamines) and gabapentinoids (gabapentin and pregabalin).

Author Contributions

J.M.C.: conceptualisation, methodology, data curation, writing—original draft preparation, reviewing and editing; A.G. and F.S.: clinical assessment, writing—reviewing and editing. All authors have read and agreed to the publishing of the manuscript.

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Institutional Review Board Statement

In the United Kingdom, research on deceased individuals, based on routinely collected information, does not require ethical approval.

Informed Consent Statement

Not applicable.

Data Availability Statement

Under the EU-MADNESS agreement between the National Records of Scotland and the lead author, no data can be shared with third parties.

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Conflicts of Interest

J.M.C. is a co-opted member of the United Kingdom's Advisory Council on the Misuse of Drugs (ACMD) Technical and Novel Psychoactive Substances committees. He is a member of the ACMD's Ketamine Working Group, and was a member of the ACMD's Ketamine Sub-committee in 2004. A.G. is a full ACMD Council member and member of the ACMD's Ketamine Working Group. F.S. was a full ACMD Council member when it reviewed ketamine in 2012–2013.

Use of AI and AI-Assisted Technologies

No AI tools were utilised for this paper.

Appendix A

Table A1. Results of statistical tests ($p < 0.05$).

Characteristic	Statistical Test	*z*-Score	*p*-Value
Socio-demographics			
Mean age	Mann-Whitney U (test value 588)	−0.4293	0.66720
Male gender	Ratio of proportions (two tailed)	0.1869	0.84930
Accidental in nature	Ratio of proportions (two tailed)	−0.8211	0.41222
Substance implicated			
Opiates/opioids implicated	Ratio of proportions (two tailed)	0.8396	0.40090
Heroin/morphine implicated	Ratio of proportions (two tailed)	0.2085	0.83366
Stimulants implicated	Ratio of proportions (two tailed)	−0.9650	0.33706
Cocaine implicated	Ratio of proportions (two tailed)	−1.0571	0.28914
Benzodiazepines implicated	Ratio of proportions (two tailed)	0.2164	0.82588
Diazepam implicated	Ratio of proportions (two tailed)	1.3576	0.17384
Gabapentinoids implicated	Ratio of proportions (two tailed)	−1.5258	0.12602
Alcohol implicated	Ratio of proportions (two tailed)	0.0730	0.94420
Ketamine alone implicated	Ratio of proportions (two tailed)	−1.2868	0.19706
Underlying cause of death			
Drug use	Ratio of proportions (two tailed)	0.0379	0.96810
Acute drug use	Ratio of proportions (two tailed)	−0.2539	0.80258
External cause	Ratio of proportions (two-tailed)	0.1388	0.88866
External cause-trauma	Ratio of proportions (two tailed)	−0.2383	0.81034

There were no statistically significant differences ($p < 0.05$) between the two periods in respect of any of the characteristics examined here.

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