Shane Darke, Sharlene Kaye & Johan Duflou

Cocaine-related fatalities in New South Wales, Australia, 1993-2002

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COCAINE-RELATED FATALITIES IN NEW SOUTH WALES, AUSTRALIA 1993-2002

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EXECUTIVE SUMMARY

The coronial records of all cocaine-related deaths that occurred in New South Wales between 1 January 1993 and 31 December 2002 were reviewed. The study examined trends in the number of such deaths, demographic characteristics, circumstances of death, toxicological findings, and major autopsy findings.

Number of cocaine-related fatalities, 1993-2002

A total of 146 cases were identified. Cocaine was a direct cause of death in 86% of cases, an antecedent cause in 8% and a significant contributing condition in a further 7%. The number of cocaine-related fatalities increased substantially over the 1998-2001 period, peaking in 1998 and 2001.

Geographic distribution

All but three fatalities occurred within the Sydney metropolitan area. Sixty percent of fatalities occurred in the City/Eastern Suburbs region of Sydney. The most frequent suburbs in which cocaine-related deaths occurred were Kings Cross (26 cases), Darlinghurst (14 cases), Surry Hills (5 cases) and Redfern (5 cases). Overall, 37% of cases occurred within the 2010/2011 postcode region centred on Kings Cross.

Demographics

The mean age of decedents was 34.1yrs, and 84% were male. Half of the sample was employed, with 26% being employed professionals at the time of death. Three quarters of decedents were married or in defacto relationships, and three quarters were Australian born. Eighty nine percent of decedents were not enrolled in drug treatment at the time of death.

Circumstances of death

The predominant form of cocaine administration was injection (86%). Non-parenteral routes were employed in 16% of cases. Nasal (8%), oral (3%), smoking (1%) and anal administration (1%) were all recorded. A disproportionate number of deaths occurred on weekends (57%).

The most common location for death in all metropolitan regions was a private home (53%). A significantly greater proportion of deaths occurred in hotels in the

City/Eastern Sydney region than in other regions (25% v 3%). No intervention occurred prior to death in the 82% of cases. An ambulance was called prior to death in 15% of cases, and 10% of cases were hospitalised.

Toxicology

Blood cocaine was detected in 64% of cases, with a median blood cocaine concentration of 0.10mg/L (range 0.01->8.00mg/L). Benzoylecgonine was detected in all but one case, with a median blood benzoylecgonine concentration of 0.40mg/L (range 0.00->20.00mg/L).

Decedents had a mean of 3.5 (range 1-7) drugs present at time of death, and in only 4% of cases was cocaine the only drug detected. The most common co-occurring drug was morphine (79% of cases). Alcohol was detected in 36% of cases, with a median blood alcohol concentration of 0.07g/100ml (range 0.01-0.30g/100ml). Cannabis was detected in 32% of cases, but blood THC in only 6 cases.

Major autopsy findings

Cardiac pathology was noted in 57% of cases. The most common pathology was coronary artery atherosclerosis (39% of cases), which was much more common among males (45% v 9%). In 15% of cases, all of which were male, moderate or severe arterial occlusion due to atheroma was noted. Cardiac hypertrophy was noted in 14% of cases, all of whom were male. Cerebrovascular pathology was noted in 22% of cases. The most commonly reported pathology was cerebrovascular atherosclerosis (10%), most commonly of the basal vessels of the brain (6%).

1.0 INTRODUCTION

Over the preceding two decades cocaine has emerged as a major cause of morbidity and mortality, particularly in the United States[1-5]. Approximately 70% of fatal overdose cases in the United States are attributable to cocaine[1,5], as are a third of drug-related emergency department presentations[6]. Cocaine-related deaths have also increased in the United Kingdom and Europe[3,4]. The majority of cases are males, aged in their twenties and thirties[1,2,4,5,7]. Furthermore, a quarter of fatal accident cases in New York had cocaine detected in their blood or urine[8].

Until the late 1990s the prevalence and frequency of cocaine use among Australian drug users was estimated to be low, and the problems associated with cocaine use appeared mild[9,10]. Since 1998, however, cocaine use has arisen as a major drug problem in Australia, and in Sydney in particular[11]. Sharp increases in the use of the drug were recorded in 1998 and 2001[11], primarily among injecting drug users (IDU), and heroin injectors in particular[11]. This trend was particularly pronounced after the sharp decline in the availability of heroin in Australia in 2001, with many heroin users switching to cocaine[12]. It should be noted that cocaine use in Australia is overwhelmingly of cocaine hydrochloride powder, with crack use rare[11].

Cocaine use in Australia is not restricted to IDU. Previous research has also indicated a separate group of higher socio-economic non-injecting cocaine users[13]. This group is characterised as an employed, "functional" group of cocaine users, in contrast to the characterisation of lower socio-economic, primarily unemployed, drug entrenched IDU[13]. The use of cocaine would also appeared to have increased amongst this group since 1998[14]. To date, cocaine use appears to be primarily restricted to New South Wales (NSW), and to Sydney in particular[11,15].

Multiple drugs are typically detected among cocaine-related fatalities[1,5,16], and among cocaine-users who present to clinicians[17]. The two most commonly associated drugs are heroin and alcohol[1,5]. It has been argued that the combination of cocaine and heroin is more dangerous than when either drug is used alone, as cocaine potentiates the tendency of opioids to depress respiration[18,19]. Consistent with the hypothesised increased risk of the cocaine/heroin combination, in the United States non-fatal overdoses are more often associated with the concomitant use of these two drugs than

with either drug alone[20]. In addition, the concomitant ingestion of cocaine and alcohol produces cocaethylene, an active metabolite of cocaine that enhances and extends the effects of cocaine[17,21]. The role of polydrug use in cocaine and other drug-related mortality is illustrated by a recent study of accidental drug overdoses in New York City[1]. Changes in the rates of both cocaine and heroin overdoses were related to changes in the rate of polydrug deaths, whilst the rate of single drug deaths remained relatively stable.

Many adverse effects of cocaine use relate to route of administration. Cocaine injecting has been associated with more frequent injections, more frequent needle sharing, increased sexual risk-taking, more frequent use of shooting galleries, poorer health, a higher HIV seroprevalence and increased levels of criminality[19,22-25]. Regular intranasal use of cocaine is associated with nasal congestion, rhinitis, ulceration and perforation of the nasal septum[19]. Cocaine smoking is associated with pulmonary and respiratory complications, including coughing, bloody sputum, chest pains, wheezing and shortness of breath[19]. The regular use of cocaine by all routes of administration, however, has been associated with serious psychiatric sequelae, including paranoia, anxiety, depression and severe weight loss, and excited delirium[26]. In particular, heavy use may result in "cocaine psychosis", a schizophreniform paranoid psychosis[26].

Two of the most serious sequelae of cocaine use, cardiovascular and cerebrovascular complications, can occur regardless of route of administration[27]. In the United States chest pains and palpitations are among the most common complaints among cocaine users presenting to accident and emergency departments[28-31]. Both injecting and non-injecting cocaine users report palpitations and other cardiac symptoms as being the most common physical side effects they experience[32]. Cocaine can cause myocardial ischaemia and infarction via several mechanisms: an increase in myocardial oxygen demand, vasoconstriction of the coronary arteries and coronary thrombosis[18,29,30,33-37]. Cocaine-induced cerebrovascular accidents are also well recognised[38,39]. A recent study reported a 14-fold increase in the risk of ischaemic or haemorrhagic stroke among cocaine users compared to matched controls[39].

Although cocaine can induce cardiovascular complications in users with normal coronary arteries[30,40-42], underlying atherosclerosis (particularly of the left coronary arteries) has been consistently demonstrated in studies of both living and deceased cocaine users[27,29,33,34,36,37,40-43]. The premature and accelerated development of coronary artery atherosclerosis, which increases the risk of cocaine-induced myocardial infarction, has been associated with the chronic use of cocaine[18,29,30,34,37,40,44]. Chronic cocaine use has also been associated with cardiac hypertrophy, a condition that can predispose to cocaine-induced myocardial ischaemia and/or arrhythmia[18,27,44-46].

While dose and frequency of use may influence the likelihood of coronary and cerebrovascular complications, the threshold over which potentially fatal reactions occur can vary widely between individuals. Toxic reactions can occur irrespective of dose, frequency of use, or route of administration, and have been reported with small amounts of cocaine and on the first occasion of use[19,27,30,47]. The absence of a strong dose-related response among cocaine fatalities is argued to be due to the cardiotoxic effects of cocaine[27]. It is worth noting that, in the United States, cocaine deaths occur more frequently in hot weather, in which extra demands are placed upon the cardiovascular system[48].

To date, few medico-legal autopsy studies have examined cocaine-related fatalities[27], and none have been conducted in Australia. In contrast, the demographics, circumstances and toxicology of heroin-related deaths are well-documented[49]. As noted above, there has been a prevalent view in Australia that there are few major problems associated with cocaine use in this country[9,10] and, consequently, cocaine-related fatalities in this country have not been examined. In order to determine the extent and nature of cocaine-related fatalities, the current study examined cocaine-related deaths in NSW, the Australian state in which most cocaine use occurs. The study aimed to determined the number of deaths, their demographic characteristics, the circumstances of death, toxicological results and major autopsy findings. In particular, the study aimed to ascertain the levels of cardiac pathology detected among cases.

1.1 *Study Aims*

1. To determine the number and demographic characteristics of cocaine-related fatalities that occurred between 1 January 1993 and 31 December 2002;
2. To describe the circumstances of cocaine-related fatalities;
3. To determine the toxicological findings from cocaine-related fatalities; and
4. To describe the major autopsy findings from cocaine-related fatalities.

2.0 METHODS

2.1 *Case identification*

Permission was received from the NSW State Coroner to access the coronial records of all cocaine-related deaths that occurred in New South Wales between 1 January 1993 and 31 December 2002. A list was compiled by the NSW Coroner's Office of all cases in which cocaine was determined to have been a direct cause of death, an antecedent cause of death, or a significant associated condition that contributed to death. In New South Wales a case must be reported to the Coroner in cases where:

1. A person dies a violent or unnatural death;
2. A person dies suddenly and the cause is unknown;
3. A medical practitioner has not issued a death certificate stating the cause of death;
4. The deceased was not attended by a medical practitioner in the three months prior to death;
5. The person died within 24 hours of having been administered an anaesthetic;
6. The person died within a year and a day of an accident to which the cause of death may be attributable;
7. The person died whilst in the care of a psychiatric hospital, or a variety other institutions administering care or treatment (e.g. child care centres);
8. The death occurs whilst the person was in police custody.

2.2 *Data collection form*

Information on cause of death, demographic characteristics, drug use history, circumstances of death, toxicological findings and major autopsy findings was retrieved from the coronial files. Documents of particular relevance were: police reports, ambulance officer statements, witness statements, toxicological analyses, autopsy reports, and transcripts of coronial inquests (where conducted). The data collection form used in previous coronial studies conducted by the authors was employed[50,51].

2.2.1 Cause of death

Cause of death is determined by the forensic pathologist on the basis of circumstances of death, a comprehensive autopsy and toxicological analyses. Causes of death are categorised as:

1. Direct cause: disease or condition directly leading to death;
2. Antecedent causes: morbid conditions giving rise to the direct cause; and
3. Significant associated conditions contributing to death.

In cases where an inquest was held, cause of death as determined by the Coroner was recorded.

2.2.2 Demographic characteristics

Demographic data obtained were: age, sex, marital status, employment, country of birth, location of residence, drug treatment status, and recent prison history. Occupational status was classified using the Australian Standard Classification of Occupations published by the Australian Bureau of Statistics[52]. Classifications range from 1(Managers) to 9 (Labourer). In addition, occupational skill levels are classified, ranging from 1 (Bachelor degree level or above) to 5 (up to secondary education).

2.2.3 History of drug use

Information was sought on the history of drug use. Histories of known use of cocaine, heroin, benzodiazepines, heavy alcohol use, and the use of other drugs were obtained from witness and police statements, where reported. Information was also sought on recent drug treatment history.

As in previous studies[50,51], an attempt was made to categorise the extent of drug dependence into dependent or recreational use. For the purposes of the study, a classification of "dependent" was not restricted to physiological dependence. A subject was defined as "dependent" if the coronial file provided evidence of the centrality of drug use in the deceased's life. The following criteria were considered suggestive of heavy drug involvement: known history of regular cocaine or heroin use, partner or friends known to be drug users, history of drug overdose or treatment for drug dependence, a criminal record for drug-related offences. Cases which did not meet the criteria for inclusion in the "dependent" category were defined as "recreational" drug users.

2.2.4 Circumstances of death

Information was obtained on the time, day and month of death, route of final cocaine administration, suburb/town in which death occurred, physical location of death (e.g. home, street, public toilet), time of death, presence of other persons, interventions administered prior to death, and whether the death was due to suicide. Case locations were categorised into broad geographical regions: Sydney City/Eastern Suburbs (e.g. Kings Cross), Sydney Inner Western Suburbs (e.g. Stanmore), Sydney Western Suburbs (e.g. Liverpool), Sydney Southern Suburbs (e.g. Cronulla), Sydney Northern Suburbs (e.g. St Ives) and locations outside the Sydney metropolitan area.

2.2.5 Toxicological results

Information on results of toxicological analysis was obtained from reports of laboratory analyses performed by the Division of Analytical Laboratories (Western Sydney Area Health Service) on blood and other specimens taken at autopsy. All cases referred to the Coroner have full quantitative toxicological analyses performed, and these reports are contained within the coronial files. Recent cocaine administration is determined by the presence of cocaine itself and/or the presence of benzoylecgonine, the major metabolite of cocaine. Morphine (the major metabolite of heroin) and blood alcohol concentrations were also recorded. As it was not possible in some cases to ascertain whether the presence of two or more benzodiazepines detected at autopsy represented the administration of two drugs or the original drug and its metabolite, all individually detected benzodiazepines were grouped into the single drug class "benzodiazepines". Analyses to detect cocaethylene are not routinely

conducted in NSW, so no data are available on this metabolite. To determine if posthumous processes affected blood concentrations of benzoylecgonine, morphine and alcohol, the period between estimated time of death and autopsy was recorded for each case.

2.2.6 Autopsy findings

Information was recorded on all major pathologies noted in autopsy reports. Information of particular relevance were: findings on cardiac pathology, cerebrovascular pathology, pulmonary pathology and hepatic pathology. Coronary atherosclerosis was classified as mild, moderate or severe on the basis of comment by the forensic pathologist in the autopsy report, or by arterial occlusion ranges of 10-50% (mild),>50-75% (moderate) and >75% (severe).

2.3 *Statistical analyses*

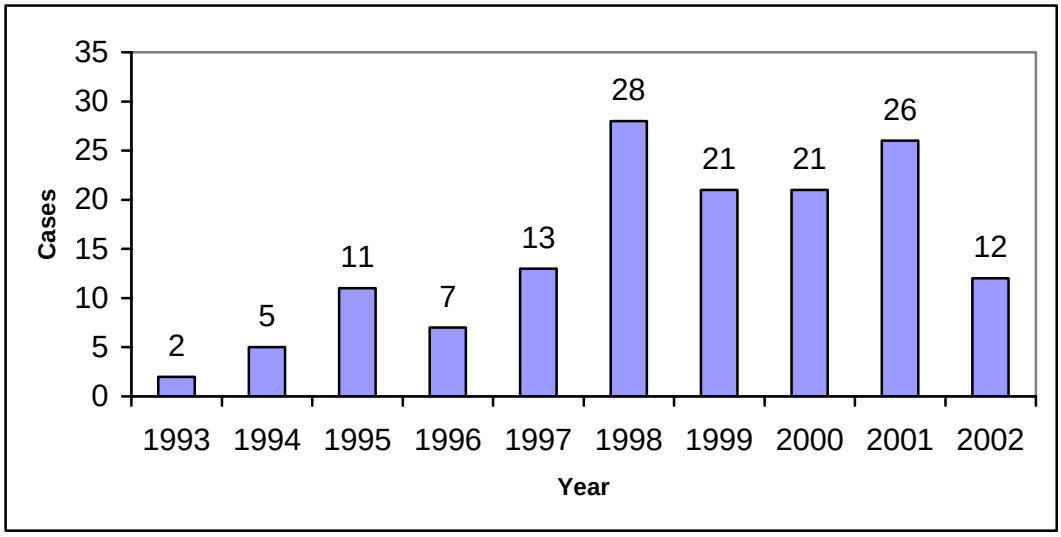
T-tests were used for continuous data. Where distributions were highly skewed, medians were reported, and analysed using the Mann-Whitney U statistic. For dichotomous categorical variables, Odds Ratios (OR) and 95% Confidence Intervals (95% CI) were reported. The chi-square statistic was reported for other categorical data. Spearman rank order correlations were used to correlate skewed distributions. All analyses were conducted using SPSS for Windows (release 11.0)[53].

3.0 RESULTS

3.1 *Number of cocaine-related fatalities, 1993-2002*

A total of 146 cases were identified over the study period (Figure 1). Cocaine was involved as a direct cause of death in 86% (n=125) of cases, an antecedent cause in 8% (n=11) and a significant contributing condition in a further 7% (n=10). The number of cases increased substantially over the 1998-2001 period, peaking in 1998 and 2001

Figure 1: Number of cocaine-related fatalities, 1993-2002



3.2 *Pathology conclusions on cause of death*

Drug toxicity was the direct cause of death in 86% of cases (Table 1). Death was attributed solely to cocaine toxicity in 5% of cases. In 81% of cases death was due to combined drug toxicity, with opioids the most common co-occurring drugs (77% of cases). Alcohol (15%) and benzodiazepines (14%) were the next most common drugs associated with cocaine as a cause of death.

In 16 cases (11%) death was attributed to either myocardial ischaemia/infarction, pneumonia, cerebrovascular accidents or multiple organ failure, due to or exacerbated by cocaine use. There were three cases (2%) of hanging in which cocaine was a significant associated condition. Two of these cases were suicides, and one was an autoerotic asphyxial act. In two other cases of suicide (carbon monoxide poisoning, gunshot to head) cocaine intoxication was considered to be a significant contributing

condition. In two cases death was due to multiple injuries sustained from falls whilst intoxicated with cocaine. A coronial inquest was held in 4% of cases (n=6).

Table 1: Forensic pathology conclusions of direct cause of death

Cause of death	**Males (n=123) %**	**Females (n=23) %**	**All (n=146) %**
Cocaine toxicity	5	4	5
Combined drug toxicity	81	74	81
Drugs in combination with cocaine			
Opioids	79	70	77
Alcohol	16	9	15
Benzodiazepines	12	22	14
Amphetamines	7	0	6
Other drugs	9	22	11
Cardiac	4	0	3
Pulmonary	3	4	3
Cerebral	3	4	3
Hanging	2	4	2
Multiple organ failure	0	4	1
Injury	1	4	1
Gunshot	1	0	1
Carbon monoxide poisoning	1	0	1

3.3 *Geographic distribution of cases*

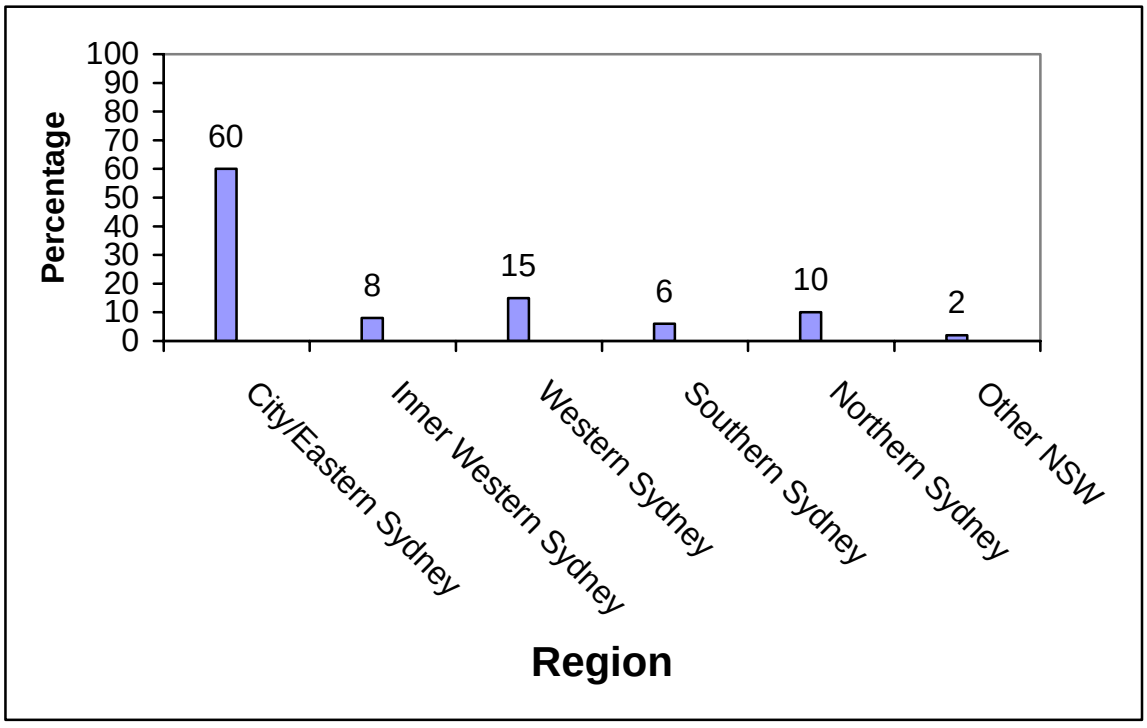
Sixty percent of fatalities (n=87) occurred in the City/Eastern Suburbs region of Sydney (Figure 2). The most frequent suburbs in which cocaine-related deaths occurred were Kings Cross (26 cases), Darlinghurst (14 cases), Surry Hills (5 cases) and Redfern (5 cases). Overall, 37% of cases (n=54) occurred within the 2010/2011 postcode region centred on Kings Cross. By comparison, the combined population of

these two postcode areas represent 1% of the population of Sydney and 0.7% that of NSW.

Fifteen percent (n=22) of deaths occurred in western Sydney and 8% (n=11) in the inner western suburbs. There were only 4 fatalities in Cabramatta.

All but three fatalities occurred within the Sydney metropolitan area. Single deaths occurred in northern NSW, the southern tablelands, and southern NSW. In one case, cocaine administration occurred in northern NSW, but the person was subsequently airlifted to Sydney for treatment. Specific details of individual geographical locations of death are presented in Appendix 1.

Figure 2: Geographic locations of deaths

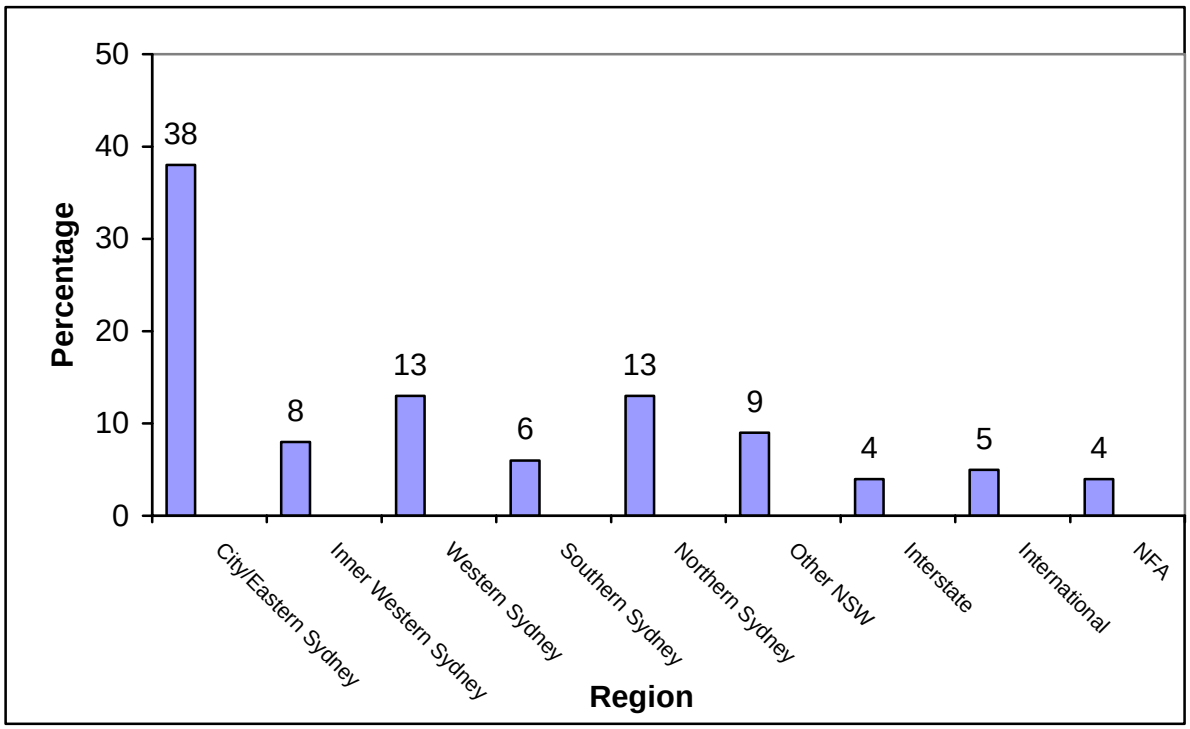


Places of residence at time of death are presented in Figure 3. The City/Eastern Sydney region (38%) was the most common region of residence. Overall, 43% of cases who died in the City/Eastern Sydney region did not reside there.

Whilst only 3 deaths occurred outside Sydney, a notable proportion (26/146, 18%) of decedents resided outside Sydney at time of death. Nine percent of cases were from

other areas of NSW, 4% from inter-state, and a further 5% were foreign residents. Four percent of decedents had no fixed address.

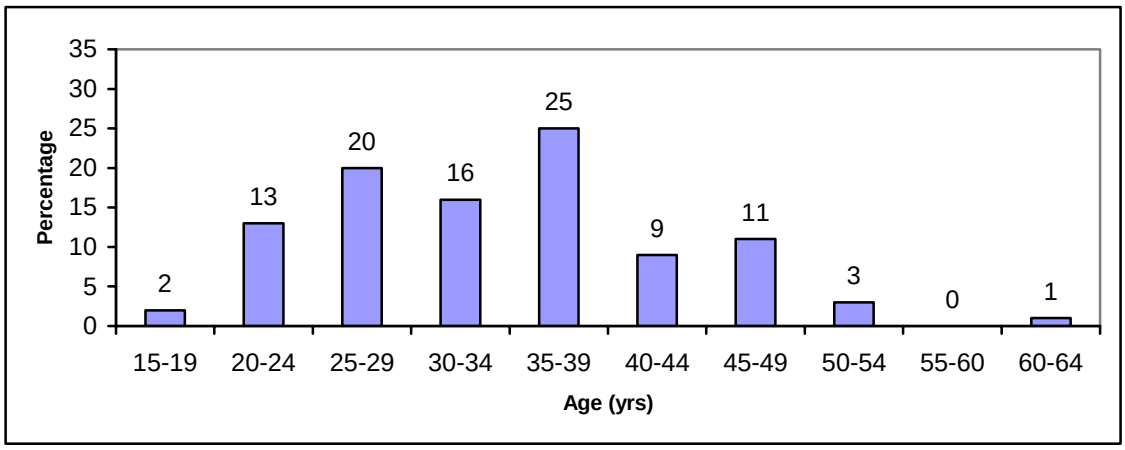
Figure 3: Geographic distribution of place residence



3.4 *Demographic characteristics*

The mean age of decedents was 34.1yrs (SD 9.0, range 17-63yrs), and 84% were male. Males were, on average, five years older than females (34.9 v 29.4yrs, t_{144}=2.8, p<.01) (Table 2). The age distribution of cases is presented in Figure 4. Most cases (74%) were aged in either their 20s or 30s. Only 2% (3 cases) were younger than 20 years. It is noteworthy that 4% of cases were aged 50 or older, and two decedents were aged in their sixties.

Figure 4: Age distribution of cocaine-related deaths



Over half of the sample was employed (Table 2), with females significantly more likely to be so (OR 3.10, 95%CI 1.08-8.89). Thirteen percent of decedents were Skill Level 1 professionals: Managers/Administrators (3%, e.g. company director) and Professionals (10%, e.g. solicitor, accountant). A further 13% were Associate Professionals (skill level 2, e.g. real estate agent, small business owner) (Table 3). Overall, 26% of decedents were employed professionals.

Three quarters of decedents were married or in defacto relationships, and three quarters were Australian born. There were no significant gender differences in either marriage status or country of birth.

Table 2: Demographic characteristics

	Males (n=123)	**Females (n=23)**	**All (n=146)**
Age (yrs)	34.9	29.4	34.1
Employment (%)			
Unemployed	46	22	42
Full-time	51	39	49
Part-time	2	0	1
Student	1	13	3
Sex worker	0	26	4
Marriage status (%)			
Single	75	65	74
Married/Defacto	25	35	26
Country of birth (%)			
Australia	75	69	74
Europe	11	4	10
North America	4	9	5
New Zealand	4	4	4
South East Asia	2	4	3
Middle East	2	0	2
Africa	0	4	1
Unknown	1	4	1

Table 3: Classification of occupations

Classification*	**Males (n=123) %**	**Females (n=23) %**	**All (n=146) %**
Managers (*1,1*)	3	0	3
Professionals (*2,1*)	9	17	10
Associate professionals (*3,2)*	15	4	13
Tradespersons (*4,3*)	10	0	8
Advanced clerical/sales/service (*4,3*)	0	0	0
Intermediate clerical/sales/service (*6,4*)	3	4	3
Intermediate production/transport (*7,4*)	2	0	1
Elementary clerical/sales/service (*8,5*)	6	17	8
Labourer (*9,5*)	6	22	8
Student (*NA*)	1	13	3
Unemployed (*NA*)	46	22	42

**Australian Bureau of Statistics major classifications of occupations. Brackets indicate Major Classification Category (1-9) and Skill Level (1-5). NA=not applicable*

3.5 *History of drug use*

Ten percent of decedents were enrolled in a drug treatment programme at the time of death (Table 4). Seven percent of decedents (10 cases) were enrolled in methadone maintenance, two cases were enrolled in naltrexone maintenance and two in drug free residential communities.

Fifty eight percent of cases were identified by witnesses or police as known cocaine users, with females more likely to be reported as such (OR 3.11 95%CI 1.09-8.91). Two thirds of decedents were noted as known heroin users, a quarter as benzodiazepine users and 37% as heavy alcohol users. Seventy four percent of cases were judged to be dependent drug users. Decedents who were classified as dependent

were ten times more likely to have been unemployed **(**54% v 11%, OR 10.09, 95%CI 3.34-30.47). Conversely, those classified as recreational drug users were three times more likely to be professionals (categories 1-3) **(**45% v 20%, OR 3.24, 95%CI 1.46-7.20**)**. In none of the cases examined did death appear to have followed initial cocaine use. Previous cocaine-related health incidents were noted in the files of 6% of cases, involving a range of cocaine-related sequelae.

Table 4: History of drug use

	Males (n=123) %	**Females (n=23) %**	**All (n=146) %**
Treatment status			
Not in treatment	92	83	90
Methadone	7	9	7
Drug free residential	1	4	1
Naltrexone	1	4	1
History of known drug use			
Cocaine use	54	78	58
Heroin use	66	74	67
Benzodiazepine use	23	35	25
Heavy alcohol use	35	48	37
Dependence status			
Dependent	73	74	74
Recreational	27	26	26
Previous cocaine incidents			
None noted	93	95	94
Incident noted	7	4	6
Symptoms:			
Overdose	2	0	1
Chest pains/palpitations	2	0	1
Convulsive tremors	2	0	1
Severe headaches	1	0	1
Severe weight loss	0	4	1
Severe depression/paranoia	1	0	1
Severe abdominal cramping	1	0	1

3.6 *Circumstances of death*

3.6.1 Route of cocaine administration prior to death

In one case, no information on route of administration was available. Among the remaining cases, the predominant form of administration was injection (86%) (Table 5). In all these cases, injection was confirmed by: the presence of recent puncture

marks (120/124), and/or the presence of injecting equipment (101/124), and/or witnesses to the act of injection (19/124).

Non-parenteral routes were employed in 16% of cases. Nasal, oral, smoking and anal administration were all noted. Nasal administration was confirmed in 8% of cases by nasal swabs taken at autopsy (7/11 cases) and/or witnesses to the act (5/11). Cocaine had been swallowed in 3% of cases, confirmed by the presence of cocaine in the stomach (2/5 cases), witnesses (2/5) or crime scene evidence (1/5).

There were two cases of anal administration, confirmed by the presence of cocaine in the rectum. Neither involved international drug trafficking. One case was of recreational use, whilst the other was of a large amount of cocaine (31gms) stored in the anus after having been stolen by that individual.

In 3 cases, there was evidence that more than one route of administration had been employed shortly prior to death: injection+nasal, injection+smoking and oral+smoking. In 3% of cases, route could not be definitively established beyond the exclusion of injection as a route of administration, due to the absence of puncture marks, injection equipment or an injecting drug use history.

Table 5: Route of cocaine administration prior to death

	Males (n=122) %	**Females (n=23) %**	**All (n=145) %**
Injection	87	78	86
Nasal	7	13	8
Oral	3	4	3
Smoked	2	0	1
Anal	2	0	1
Unspecified non-parenteral*	3	4	3

** Route unspecified, but not by injection*

3.6.2 Suicide

Eight percent of cases (n=11, males=6, females=5) were due to suicide. Females were significantly more likely than males to have completed suicide (22% v 5%, OR 5.42, 95% CI 1.50-19.61). Seven of these cases were injectors and four non-injectors. In six cases suicide was by deliberate drug overdose. In four cases, suicide was by violent means: hanging (2), gunshot (1), jumping from a height (1). In one case, death was from carbon monoxide poisoning. In all five non-overdose suicides, cocaine intoxication was deemed to be a significant contributing condition.

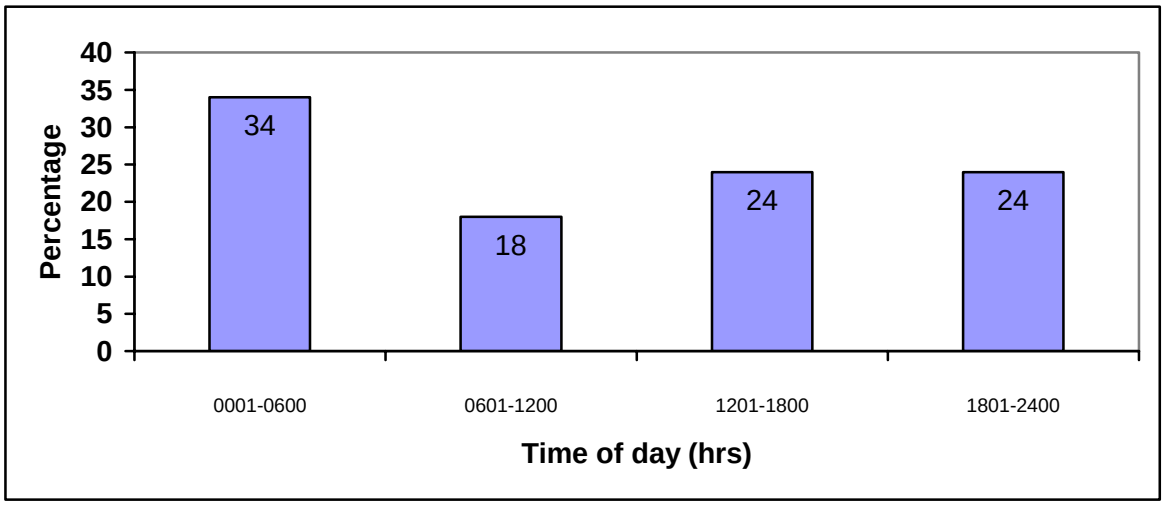
3.6.3 Prison

Six percent of cases (n=8, males=7, females=1) were released from prison in the month prior to death. Of these 8 cases, 2 died on the day of release and a further five died within a week. In seven of these cases cocaine was determined to be a direct cause of death. All these cases involved cocaine in combination with morphine. In one case, the direct cause of death was hypoxic encephalopathy, caused by opiate and cocaine toxicity.

3.6.4 Time of death

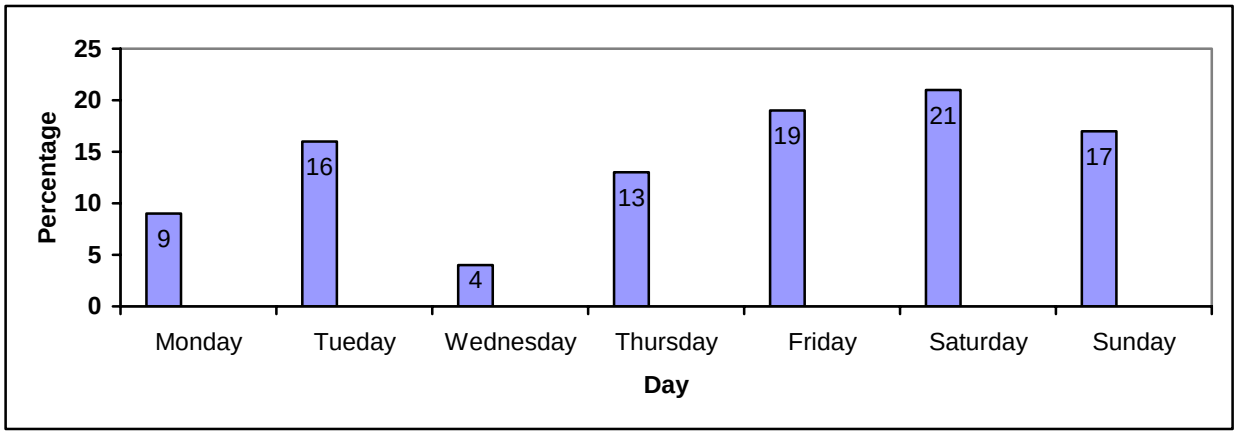
Time of death within 6 hour periods was determined in 114 cases (78%) (Figure 5). These deaths were distributed throughout the day, with no significant difference between the number of deaths that occurred within each time period.

Figure 5: Time of death



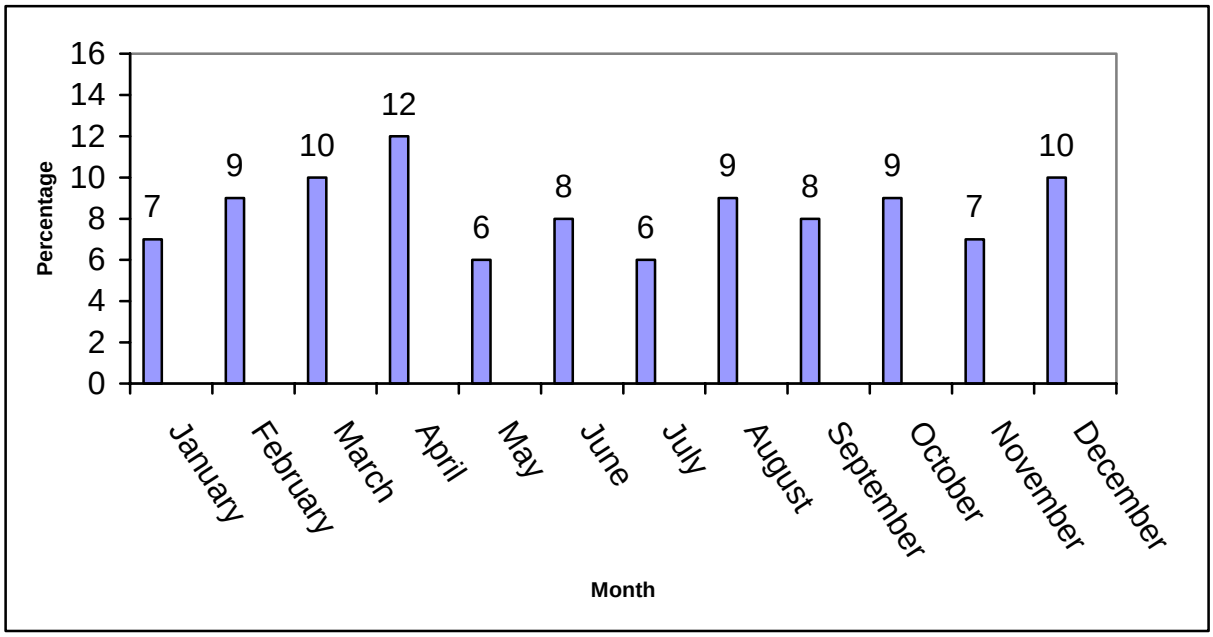
Day of death was determined in 135 cases. Deaths were not uniformly distributed throughout the week (χ^2_{6df}= 19.4, p<.005), with a disproportionate number of deaths occurring on weekends (Friday, Saturday, Sundays) (Figure 6). Fifty seven percent of deaths occurred on these days, compared to an expected 43% (OR 1.76, 95%CI 1.09-2.85).

Figure 6: Day of death



The proportion of cases that occurred in each month is presented in Figure 7. There was no significant difference between the number of deaths that occurred across months. Specifically, there was no summer peak in cocaine-related deaths.

Figure 7: Month of death



3.6.5 Location of death

By far the most common location for death to occur was a private home (53%) (Table 6). A significantly greater proportion of females died in a home environment (73% v 49%, OR 2.98 95%CI 1.10-8.05). Forty four percent of cases died in their own home, the single most common location of death. Only 6% of deaths occurred in a street or park, and 1% in a public toilet. A significantly greater proportion of deaths occurred in hotels in the City/Eastern Sydney region than in other regions (25% v 3%, OR 9.65 95%CI 2.17-42.83). Of the 24 fatalities that occurred in hotels, 22 occurred in the City/Eastern Suburbs region. Of the deaths that occurred in hotels in the City/Eastern suburbs, 16 decedents were from outside the region, including 4 international residents. It should be noted that the category "hotels" specifically excluded shooting gallery/paid sex locations.

Table 6: Location of death

	Males (n=123) %	**Females (n=23) %**	**All (n=146) %**
Private home	49	73	53
Own home	39	65	44
Friend's home	9	4	8
Family home	0	4	1
Hotel	20	0	16
Hospital	9	13	10
Street/park	6	9	6
Car	7	0	6
Shooting gallery	4	4	4
Public toilet	2	0	1
Pub/Club	1	0	1
Other	3	0	3

3.6.6 Interventions

No intervention occurred prior to death in the overwhelming majority of cases (82%) (Table 7). An ambulance was called prior to death in 15% of cases, and 10% of cases were hospitalised.

Table 7: Interventions prior to death

	Males (n=123) %	**Females (n=23) %**	**All (n=146) %**
None	81	83	82
Ambulance	16	9	15
Hospital	9	13	10
Bystander CPR	3	5	3

**Note: Multiple interventions occurred in some cases*

Equal proportions of cases died alone, or with others present (Table 8). Eighteen percent died segregated from others (e.g. in a different room). There were no significant gender differences regarding the proportions who were in the presence of others at death. No intervention prior to death occurred in 34 of the 60 cases (57%) where others were present.

Table 8: Presence of others at time of death

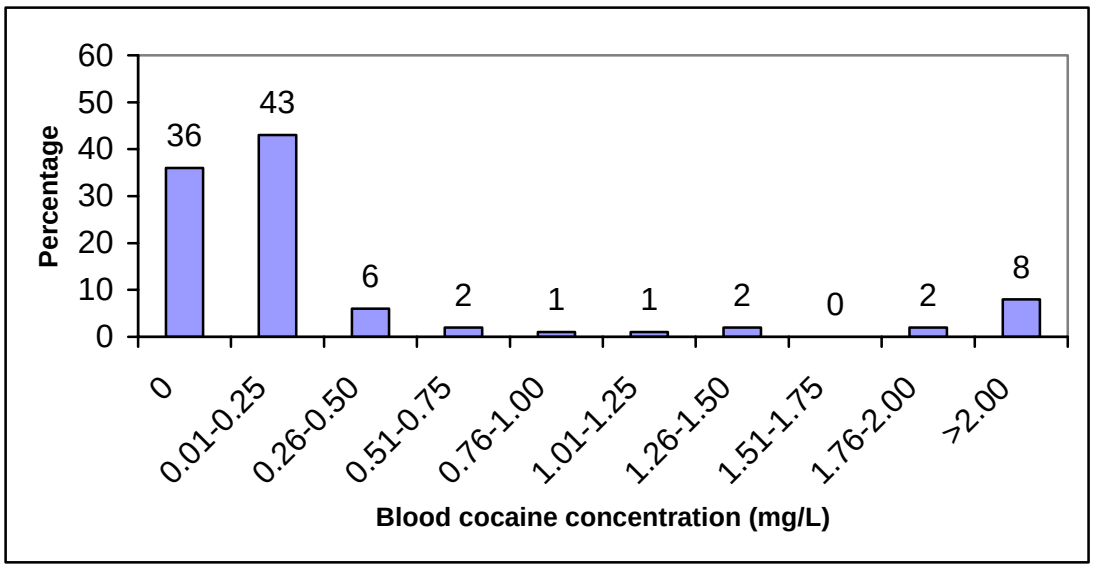
	Males (n=123) %	**Females (n=23) %**	**All (n=146) %**
Died alone	43	30	41
Others in presence	42	39	41
Segregated from others	15	30	18

3.7 *Toxicology*

3.7.1 Blood cocaine concentrations

Blood toxicology results were available for cocaine and benzodiazepine in 140 cases, and for other drugs in 142 cases. Blood cocaine was detected in 64% of cases (Figure 8). Among these cases, the median blood cocaine concentration was 0.10mg/L (range 0.01->8.00mg/L). Males and females did not differ significantly in the proportion in whom cocaine was detected (64% v 68%), or in median blood cocaine concentrations (0.12 v 0.06mg/L).

Figure 8: Blood cocaine concentrations

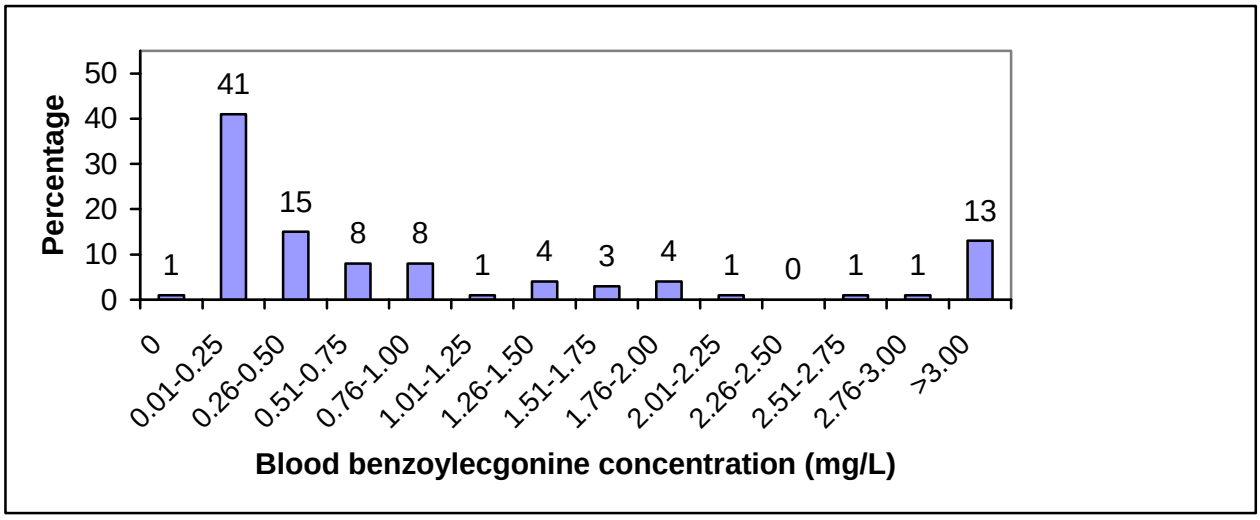


3.7.2 Blood benzoylecgonine concentrations

The median blood benzoylecgonine concentration was 0.40mg/L (range 0.00->20.00mg/L). Males and females did not significantly differ in median benzoylecgonine concentrations (0.30 v 0.55mg/L).

Time between death and autopsy was not significantly correlated with blood benzoylecgonine concentration (rho=-0.12, p>.20).

Figure 9: Blood benzoylecgonine concentrations



3.7.3 Presence of other drugs

While blood toxicology results were available for 142/146 cases, other results indicating the presence of drugs in the body (e.g. liver, urine) were available for all cases. In 5% of cases cocaine and/or its metabolite benzoylecgonine was the only drug detected (females 13%, males 3%). Cases had a mean of 3.5 (SD 1.3, range 1-7) drugs present at time of death, with no difference between males and females (3.5 v 3.1).

The most common co-occurring drug was morphine, detected in 79% of cases (Table 9). The median blood morphine concentration of cases in which morphine was present was 0.52mg/L (range 0.01-12.0 mg/L). Time between death and autopsy was not significantly correlated with blood morphine concentration (rho=-0.01, p>.90). There was a significant positive correlation between blood morphine and blood benzoylecgonine concentrations (rho=0.18, p<.05). Codeine was detected in 56% of cases. However, in most cases this was a consequence of heroin administration: the median blood codeine concentration was low (0.05 mg/L), and in almost all these cases (78/81) morphine was also detected.

Alcohol was detected in 36% of cases, with a median blood alcohol concentration of 0.07g/100ml (range 0.01-0.30g/100ml). As noted previously, analyses to detect

cocaethylene are not routinely conducted in NSW. Time between death and autopsy was not significantly correlated with blood alcohol concentrations (rho=-0.11, p>.20). There was a significant negative correlation between blood benzoylecgonine and blood alcohol concentrations (rho=-0.22, p<.01). Whilst cannabis was detected in 32% of cases, blood THC was detected in only 6 cases.

Table 9: Presence of other drugs

Drug*	**Males (n=123) %**	**Females (n=23) %**	**All (n=146) %**
Morphine	80	77	79
Codeine	55	61	56
Alcohol	37	30	36
Cannabis	36	13	32
Benzodiazepines	25	26	25
Amphetamines	21	0	18
Methadone	10	13	10
Antidepressants	6	13	7
Antipsychotics	3	0	3
MDMA ("ecstasy")	3	0	3
Other drugs	15	9	14
Acetaminophen	6	9	6
Phenytoin	2	0	2
Doxylamine	1	0	1
Aspirin	0	4	<1
Benztropine	1	0	<1
Digoxin	1	0	<1
Diphenhydramine	0	4	<1
Metronidazole	0	4	<1
Naltrexone	1	0	<1
Promethazine	0	4	<1
Propoxyphene	2	0	<1
Quinine	1	0	<1
Sildefanil	1	0	<1

* Detected in blood, urine or liver

3.8 *Major autopsy findings*

3.8.1 Cardiovascular pathology

Autopsy reports were available for 145 cases (122 males, 23 females). No autopsy was conducted in one case. Cardiovascular pathology was noted in 57% of cases (Table 10). Decedents in which cardiovascular pathology was noted were significantly older (36.5 v 31.1 yrs, t_{143}=3.7, p<.001) and more likely to be male (62% v 26%, OR 4.68, 95% CI 1.72-12.73).

The most common pathology was coronary artery atherosclerosis (39% of cases). There was a large difference between the proportions of males and females in which atherosclerosis was detected (45% v 9%, OR 8.62, 95%CI 1.94-38.38). In 15% of cases, all of which were male, moderate or severe arterial occlusion due to atheroma was noted. The most common sites of atheroma were the aorta (26% of cases) and the left coronary arteries (23%). Cardiac hypertrophy was noted in 14% of cases, all of whom were male.

Table 10: Cardiovascular pathology noted at autopsy

	Males (n=122) %	**Females (n=23) %**	**All (n=145) %**
Atherosclerosis			
Severe	11	0	9
Moderate	7	0	6
Mild	25	9	23
Unspecified	2	0	1
None	55	91	61
Sites of atherosclerosis			
Left coronary arteries	26	4	23
Right coronary arteries	17	4	15
Aorta	30	4	26
Unspecified	9	0	8
Cardiac hypertrophy	16	0	14
Any cardiac pathology	62	26	57

3.8.2 Cerebrovascular pathology

Cerebrovascular pathology was noted in 22% of cases (Table 11). There were no differences in age or gender between cases in which cerebrovascular was noted and other cases. The most commonly reported pathology was cerebrovascular atherosclerosis (10%), most commonly of the basal vessels of the brain (6%). All cases in which cerebrovascular atherosclerosis was noted were males. In 8 cases some other form of cerebrovascular pathology was noted, including extensive head injuries from a fall, venous cuffing, venous angioma, tumour on the thalamus and a benign lipoma.

Table 11: Cerebrovascular pathology noted at autopsy

	Males (n=122) %	**Females (n=23) %**	**All (n=145) %**
Atherosclerosis	12	0	10
Basal vessels	7	0	6
Carotid arteries	5	0	4
Circle of Willis	2	0	1
Hippocampus	1	0	1
Hypoxic damage	2	4	4
Old cortical damage	1	0	1
Haemorrhage	2	0	1
Other pathology	4	13	6
Any cerebrovascular pathology	23	17	22

3.8.3 Pulmonary pathology

The most commonly reported pathological observations were pulmonary congestion (81%) and pulmonary oedema (61%). Pulmonary pathology was noted in 27% of cases, with no difference between males and females, or in the age of those with and without pulmonary pathology (33.9 v 34.2 yrs) (Table 12)**.** Bronchopneumonia was noted in 13% of cases, and bronchitis in a further 3%. In 6 cases some other form of pulmonary pathology was noted, including individual cases of atheroma of the pulmonary arteries, foreign body embolism, pulmonary thrombosis and emphysema.

Table 12: Pulmonary pathology noted at autopsy

	Males (n=122) %	Females (n=23) %	All (n=145) %
Bronchopneumonia	13	13	13
Haemorrhage	7	4	6
Fibrous adhesions	3	4	3
Bronchitis	3	4	3
Other pathology	4	4	4
Any pulmonary pathology	28	22	27

3.8.4 Hepatic pathology

Congestion of the liver was noted in 21% of cases. Hepatic pathology was noted in 40% of cases, with no difference between males and females, or between the ages of those with and without hepatic pathology (35.2 v 33.4 yrs) (Table 13). The most common finding was of hepatitis C (HCV) related hepatic changes. Steatosis (fatty degeneration) was noted in 15% of cases, and cirrhosis in 3%. There was one case of hepatic failure. Pathology other than those noted above were reported in 2% of cases, and included hepatic necrosis and sepsis.

Table 13: Hepatic pathology noted at autopsy

	Males (n=122) %	Females (n=23) %	All (n=145) %
HCV pathology	21	26	22
Steatosis	17	4	15
Cirrhosis	3	4	3
Lymphocyte infiltration	4	0	4
Hepatic failure	0	4	1
Other pathology	2	4	2
Any hepatic pathology	39	35	39

3.8.5 Other pathology

Congestion of the spleen was noted in 12% of cases, and of the kidneys in 11%. Pathology other than those listed in the sections above was noted in 19% of cases (Table 14), with no significant difference between males and females. The most common organs in which other pathology was noted were the kidneys (6%). Renal pathology included atherosclerosis (4 cases), renal hypertension (2 cases),

shrunken/scarred kidneys (1 case), renal failure (1 case), congenital bands restricting the kidney (1 case) and fibroma (1 case). Enlargement of the spleen was noted in 3% of cases. Other miscellaneous pathology was noted in 8% of cases, including deep vein thrombosis, multiple organ failure and prostate enlargement.

Table 14: Other miscellaneous pathology noted at autopsy

	Males (n=122) %	**Females (n=23) %**	**All (n=145) %**
Renal	**7**	**9**	**6**
Spleen	**3**	**0**	**3**
Gastrointestinal	**2**	**0**	**1**
Injection-related pathology	**1**	**5**	**1**
Other	**10**	**0**	**8**
Any miscellaneous pathology	**22**	**9**	**20**

4.0 Discussion

4.1 *Major findings*

A number of major findings emerged from this study. Firstly, a large number of cocaine-related deaths occurred in NSW over the period 1993-2002, with peaks in 1998 and 2001. Secondly, these fatalities occurred almost exclusively in the Sydney metropolitan region, and in the City/Eastern suburbs in particular. Thirdly, demographic characteristics indicated cases were mostly male, with a mean age in the early thirties, and half of decedents were employed. Fourthly, toxicological analyses revealed that almost all deaths involved the concomitant use of other drugs. Finally, the study revealed high levels of coronary pathology among cocaine-related deaths, and of coronary artery atherosclerosis in particular.

4.2 Number of cocaine-related deaths

A total of 146 cocaine-related deaths occurred over the study period, with deaths increasing substantially from 1998 onwards. Deaths peaked in 1998, with a second peak in 2001. The peak years of cocaine-related deaths correspond to the two years that the use and availability of cocaine in NSW was at its highest[11,12]. As noted above, there was a substantial increase in the use of cocaine in Sydney in 1998, particularly among existing injecting heroin users[11]. There was a slight decline in cocaine use in 1999 and 2000, although levels of use were still estimated to be above those pre-1998[11,15]. The increase in deaths in 2001 corresponds with the Australian "heroin drought", during which time there were increases in the use of drugs such as cocaine and benzodiazepines to compensate for the reduced availability of heroin[12]. Overall, cocaine-related deaths over the study period reflected the availability and use of cocaine in NSW.

The most commonly reported direct cause of death was drug toxicity. In most cases, death was attributed to two or more drugs, a pattern consistent with that seen in the United States[1,2,5]. Consistent with the strong relationship between heroin and cocaine use previously reported in Australia[11], a pattern also noted in other countries[1], opioids were the drug class most commonly reported in toxic combination with cocaine. Deaths were not restricted to direct toxicity, with a further 11% of cases due to

complications of cocaine use, such as myocardial infarction or cerebrovascular accident.

4.3 *Geographic distribution of cases*

Deaths occurred almost exclusively within Sydney. Only 3 fatalities occurred outside the metropolitan area (although a fourth case collapsed in regional NSW, but was airlifted to Sydney prior to death). This stands in contrast to NSW heroin-related deaths, where 20% of deaths occur outside metropolitan Sydney[54]. It would appear that cocaine use in NSW is far more geographically restricted than heroin. This is consistent with data indicating cocaine use in Australia to be rare outside the Sydney metropolitan region[11,15]. Cocaine-related deaths were not restricted to Sydney drug users, however, with approximately a fifth of Sydney cases having resided outside Sydney at the time of death.

Sixty percent of deaths occurred within the City/Eastern suburbs region of Sydney. Many cases who died in this region had travelled there from other areas. Over a third of cases occurred within two postcode boundaries centred on Kings Cross. In sharp contrast to heroin-related fatalities, few cocaine-related fatalities occurred in Cabramatta[55]. Cabramatta is well known as the major heroin market in Australia, and competes with Kings Cross as a major drug market place[56]. Cocaine, however, does not appear to have the same widespread geographical distribution throughout Sydney.

4.4 *Demographic characteristics*

The majority of cases were single, born in Australia, and over 80% were male. Males also constitute the bulk of cocaine-related deaths elsewhere[1,2,4,5]. To an extent this reflects the preponderance of males among cocaine users[57]. However, males are still over-represented among these deaths, as national survey data indicate that males constitute approximately 60% of cocaine users[57]. It is also true that males constitute the majority of injecting drug users, and that the most common route of cocaine administration was by injection. However, again, males only represent two thirds of the injecting drug user population[51]. Unlike heroin-related deaths, where males are substantially more likely to have alcohol detected, there were no substantial gender differences in polydrug using patterns to explain the over-representation of male cases. Males were, however, five times more likely to have coronary disease.

The average age of decedents was in the mid-thirties, similar to overseas studies[1,2,4,5]. These cases were clearly not young, inexperienced drug users, with only 2% being in their teenage years. The number of older cases is worthy of note. Fourteen percent of cases were older than 45 years, and two cases were aged in their sixties. In a recent study of NSW heroin-related fatalities, only 4% of cases were older than 45 years[51].

Half of cases were employed, a figure that stands in stark contrast to heroin-related fatalities, both in Australia and elsewhere[49,51]. In fact, professionals constituted a quarter of all cases. The socio-economic status of cases is consistent with research indicating two distinct populations of cocaine users in Australia: an employed, "functional" group of cocaine users, and a lower socio-economic, primarily unemployed, drug entrenched group of IDU[13]. It should be noted, however, that the majority of the higher socioeconomic cases had *also* injected cocaine prior to death. The distinction is thus not simply a contrast between the routes of administration, but between different social groups of users. Three quarters of cases were classified as drug dependent. There were notable differences in the socioeconomic status of dependent and recreational users, with dependent users more likely to be unemployed, and recreational users more likely to be in professional employment.

4.5 *Circumstances of deaths*

Injection was the most common route of cocaine administration among both genders. This is in contrast with population use of cocaine, where nasal administration predominates[57]. However it is important to note that, as had been reported elsewhere[16], cases were not restricted solely to injectors. Sixteen percent of cases died after using non-injecting routes of administration. This figure is far higher than the 1% reported among NSW heroin-related deaths[51]. The larger proportion of non-injecting cocaine deaths may reflect the larger proportion of cocaine users who use non-parenteral routes of administration compared to heroin users, who overwhelmingly inject the drug[57].

Few cases were in drug treatment. A notable minority (6%) had recently been released from prison. Almost all of these cases died within a week of release, and two died on the day of release. These data are consistent with recent studies that indicate the

period immediately following prison release to be a time of high mortality risk among drug users[58,59].

Suicide comprised 8% of cases. Suicide among drug users is an issue that is only now coming to be recognised as a major drug-related problem[60]. In a recent study of attempted suicide among injecting and non-injecting cocaine users we reported that 38% of injecting cocaine users had attempted suicide, as had 20% of non-injecting users[61]. Consistent with the recent Australian data on attempted suicide among cocaine users, suicides in the current study comprised both injecting and non-injecting cocaine users.

There was an over-representation of deaths on weekends. It is important to note that studies of heroin-related deaths consistently report no over-representation of deaths on weekends, reflecting the high proportions of unemployed, dependent users in this population[49]. In fact, Thursday, the day on which Government benefits are paid, has been shown to be the most common day for heroin deaths to occur in NSW[51]. Among cases in this study, however, most deaths occurred on Saturday, with Thursday the fifth ranked day.

Half of all cases, and three quarters of female cases, died in private homes. A notable proportion of deaths occurred in hotels, almost all of which occurred in the City/Eastern suburbs region. The high proportion of deaths that occurred in hotels in the City/Eastern suburbs reflects the attraction of Kings Cross, both as a drug market and a tourist attraction. Few deaths occurred in public places.

No intervention occurred prior to death in the vast majority of cases, partially reflecting the fact that 41% of cases died without others present. However, it also highlights the fact that reactions by drug users present at overdoses are poor[49,62]. In this study, in over half of cases where others were present, no intervention occurred prior to death.

4.6 *Toxicological findings*

There were wide variations in cocaine and benzoylecgonine concentrations among cases. A sizable proportion of cases had extremely high cocaine and/or

benzoylecgonine concentrations, ranging up to >8 mg/L and >20 mg/L respectively. However, a large proportion of cases had low blood concentrations. These data are consistent with previous research which suggests that cocaine-related fatalities may occur even in the presence of low cocaine concentrations[19,27,30,47]. One reason suggested for this phenomenon relates to the effects of cocaine on the heart[27,30,63]. Thus, the cumulative cardiotoxic effects of cocaine may produce pathology in which even a small amount of cocaine may result in death. Low levels of cocaine have also been shown to produce acute vasospasm[27,30,35]. In addition, the consumption of cocaine with other drugs, particularly opioids and alcohol, may substantially increase the risk of cocaine overdose, as is discussed below[18,19].

In almost all cases, drugs in addition to cocaine were detected, which is consistent with studies elsewhere[1,2,5,16]. Drug-related deaths due to the effects of a single drug appear rare. The drug most commonly detected in combination with cocaine was morphine, the major metabolite of heroin. The combination of cocaine and heroin has also been found to be the most common combination among fatalities in the United States[1,5,16]. The prevalence of this drug combination, in part, reflects the strong association between cocaine and heroin use in Australia and elsewhere[11]. However, the effects of combining these two drugs must be considered. As noted above, it has been argued that the combination of these drugs is more dangerous than when either is used alone[18,19]. It may also be speculated that respiratory depression may predispose to cardiac arrhythmia among cases where cardiac disease is present, as it was in a large proportion of cases in this study.

Alcohol was detected in over a third of cases, a level consistent with cocaine-related fatalities in the United States[1,5]. Unfortunately, cocaethylene is not tested for in the standard toxicology analyses conducted in NSW. As noted above, the concomitant ingestion of cocaine and alcohol produces cocaethylene, an active metabolite of cocaine that enhances, and extends, the effects of cocaine[17,21]. Alcohol may thus be more than an incidental finding among these cases. There was a negative correlation between blood alcohol and benzoylecgonine concentrations, indicating lower doses of cocaine in the presence of alcohol.

4.7 *Major autopsy findings*

Some form of cardiovascular pathology was noted in over half of cases. Males were substantially more likely to have cardiovascular pathology, and constituted all cases of severe pathology. The predominance of males with heart disease in these cases reflects higher rates of death from cardiovascular disease among males across the broader population.

Consistent with overseas studies[27,29,33,34,37,40-43], atherosclerosis of the coronary arteries was commonly reported. Fifteen percent of cases had moderate to severe atheroma detected, all of whom were male. The extent of the gender difference is illustrated by the fact that approximately half of males had some degree of atheroma, compared to a tenth of females. The most common sites of coronary atheroma were the aorta and the left coronary arteries. Previous research has reported a strong relationship between cocaine use and left coronary artery atheroma[27,29,33,34,37,40-43].

Cardiac hypertrophy was reported in 12% of cases, all of whom were males. Like coronary artery atheroma, cardiac hypertrophy has been associated with cocaine use[18,27,44-46]. The mechanism behind this is believed to relate to the increased cardiac demands for oxygen that result from cocaine consumption.

Can the cardiac pathology reported in this study be related to cocaine use? A definitive answer to this question cannot be given based upon the current data. However, the major cardiac pathologies noted, arterial atherosclerosis and cardiac hypertrophy, are consistent with studies of cocaine users elsewhere, and with the known cardiotoxic effects of the drug. It may be argued, of course, that these cases had pre-existing cardiac pathology, unrelated to chronic cocaine use. From the perspective of reducing the number of cocaine-related fatalities however, the question is somewhat academic. Regardless of whether death results from cocaine-induced cardiac pathology, or whether that pathology was pre-existing, using a cardiotoxic drug in the presence of heart disease can seriously compromise the integrity of the cardiovascular system. This is particularly true given the fact that there is no strong dose response for serious cocaine-induced sequelae. Whatever the case, a high level of cardiac pathology was a strong pathological feature of these cases.

It is worthy of note that in 10% of cases (all male) atherosclerosis of the cerebrovascular system was noted, most commonly among the basal vessels and carotid arteries. Given the central role of basal vessels in supplying blood to the entire brain, findings of atherosclerosis among these cases may have serious implications for cocaine users. A range of other pathology was also noted. Overall, the autopsy reports suggest that the general health of cases at the time of death was poor.

4.8 *Conclusions*

The current study indicates that cocaine-related deaths are a significant clinical problem in NSW. A significant number of cocaine-related fatalities have occurred in NSW over the past decade, with the number of deaths closely related to the availability of the drug. To date, fatalities have been almost exclusively within the Sydney region. Cocaine was, and has remained, difficult to obtain outside the Sydney region[11,15]. It would thus appear that interventions to reduce levels of cocaine-related morbidity and mortality should initially focus on Sydney drug users.

The demographic characteristics of fatalities indicate a large number of employed individuals, a significant proportion of whom do not inject. Any interventions would thus have to move beyond IDU, and also address other cocaine users, which may prove difficult. As in previous interventions to reduce heroin-related morbidity, information on the role of polydrug use would be vital, particularly in relation to heroin and alcohol[64]. Improving responses to cocaine-related events could also be targeted. Unlike heroin interventions, however, education on the cardiotoxic effects of cocaine would be central. To date, cocaine-related morbidity and mortality have not been specifically addressed in any major campaign. The current study indicates that cocaine-related mortality and morbidity are an area deserving of further clinical and research attention.

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Appendix 1: Specific locations of NSW cocaine-related fatalities, 1993-2002

Region	Location*
City/Eastern Sydney (n=87)	Alexandria (1), Bondi (3), City (4), Clovelly (2), Coogee (3), Darlinghurst (14), Eastlakes (1), Edgecliff (1), Elizabeth Bay (2), Kensington (1), Kings Cross (26), Kingsford (1), Little Bay (1), Moore Park (1), Potts Point (3), Pyrmont (2), Randwick (4), Redfern (5), Rushcutters Bay (2), Surry Hills (5), Vaucluse (1), Waterloo (1), Woollahra (1), Woolloomooloo (2)
Inner Western Sydney (n=11)	Ashfield (1), Camperdown (3), Erskineville (1), Haberfield (1), Leichhardt (1), Lewisham (1), Petersham (1), St Peters (1), Stanmore (1),
Western Sydney (n=22)	Auburn (1), Bankstown (1), Cabramatta (4), Campbelltown (1), Casula (1), Fairfield (2), Georges Hall (1), Harris Park (1), Lansvale (1), Lilli Pilli (1), Liverpool (1), Marayong (1), Mortlake (1), Mt Druitt (1), Punchbowl (1), Revesby (1), Warwick Farm (1), Westmead (1)
Southern Sydney (n=8)	Arncliffe (1), Brighton (2), Cronulla (2), Gymea (1), Rockdale (2)
Northern Sydney (n=15)	Brookvale (1), Chatswood (1), East Ryde (1), Fairlight (1), Hunters Hill (1), Kirribilli (1), Manly (1), Mona Vale (1), Mosman (1), Narrabeen (1), Neutral Bay (1), Palm Beach (1), St Ives (1), St Leonards (2)
Other NSW (n=3)	Goulburn (1), Moama (1), Uki (1)

**Number of cases in brackets*