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Cocaine, Opiates, and Ethanol in Homicides in New York City: 1990 and 1991

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ABSTRACT: Studies using medical examiner cases are useful in monitoring drug use in special populations. This study assesses the presence of cocaine and its metabolite, benzoylecgonine (BE), opiates and ethanol in all homicide victims who were injured and who survived two hours or less after injury in 1990 and 1991 in New York City. There were 2824 homicides in the study period and cocaine and/or BE were found in 884 (31.3%) of cases. In over half of the cases positive for cocaine/BE, ethanol or opiates were found. African-Americans and Latinos were much more likely than whites or Asians to be positive for cocaine/BE. There were no differences between men and women in regard to being positive for cocaine/BE. Cocaine/BE was most frequently identified among victims 25 to 44 years of age. Males were more likely to be positive for ethanol. There were no differences among age groups or ethnic groups in regard to ethanol except for a very low ethanol incidence among Asians. Victims positive for cocaine/BE were more likely to be killed with firearms in open places. The percentage of victims positive for cocaine/BE remains approximately that found by other studies in the late 1980s, however, the percentage of opiate-positive homicides seems to be increasing. Opiates usually were found with cocaine/BE. Two-thirds of the cocaine and/or BE positive cases had cocaine present, thus they were under the influence of the drug at the time they were injured. The authors discuss how the use of cocaine, ethanol and opiates may be related to one's becoming a homicide victim.

KEYWORDS: toxicology, cocaine, opiates, ethanol, homicide, New York City

Studies in large metropolitan areas such as Miami, New York and Los Angeles in the 1980s have found that roughly 40% of cocaine positive decedents are victims of homicide [*1–3*]. Studies of smaller areas in Arizona and Utah have found that the incidence is only 20% [*4,5*]. The percentage of homicides positive for cocaine has increased from 1 to 3% in the early 1980s [*6,7*] to around 20% in the mid 1980s [*6–9*], to roughly 30% in the late 1980s [*10,11*]. Ethanol has remained constant over time in terms of being present in one-third to one-half of homicide victims [*12–14*]. In the early 1980s opiates were found in 18% of homicides [*7*]. Later in that decade opiates fell to 4% in victims of non-gang homicides [*10*].

This is the first large study of homicides in the 1990s to assess the role of cocaine, opiates and ethanol. Unlike most studies in the past, it differentiates the neurobehaviorally active compound, cocaine, from its metabolite benzoylecgonine (BE). It controls for the time interval between injury and death so as to take in consideration the elimination of drugs and ethanol from the body in the interval between injury and death. Last, it describes the types of drugs and ethanol present in regard to the demographic characteristics of victims and characteristics of the homicide.

Methods

The Chief Medical Examiner of New York City is responsible for the certification of all deaths due to violence in the five boroughs of the city. All deaths occurring in the calendar years 1990 and 1991 and certified as homicides (International Classification of Diseases E960–E975) by the Office of Chief Medical Examiner were eligible for the study. Demographic data, time and location of injury and death, cause of death, and toxicologic findings were abstracted from the files of the Office of Chief Medical Examiner. Race/ethnicity of the homicide victims was classified on the basis of information supplied by the family or other persons identifying the body, not merely by the last name or the victim's skin color. Location of injury was broadly classified as in a residence, in non-residential buildings or outside, which included streets, parks, cars, and other places outside buildings.

Some victims may survive their injury long enough to have eliminated drugs and ethanol from their bodies prior to death. In these instances negative postmortem toxicological findings would underestimate the presence of drugs or ethanol in victims at the time of the injury. Therefore, survival interval, defined as the period from injury to death, was calculated and rounded to the nearest hour for each case. The survival time of two hours was used as a cut-off because prior use of significant amounts of ethanol or drugs would be detected in this interval [*15–17*]. Victims surviving longer than two hours after injury were excluded from this study.

Blood and urine samples were obtained at autopsy and stored at 4°C until assay. Blood was collected into 100 mL bottles containing 1g of sodium fluoride (preservative). Ethanol analysis was performed by head space gas chromatography. Initial screening was done on blood, and specimens were considered positive if the

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ethanol concentration was equal to or greater than 0.01 g%. Brain ethanol analysis was done by the same method in all cases where blood was positive. Initial screening for benzoylecgonine (BE), methadone and opiates was done on urine using a homogeneous enzyme immunoassay. A specimen was considered positive for all three analytes if the urine concentration was equal to or greater than 0.3 mg/L. In those cases in which urine was not available, initial screening for BE and opiates was performed on blood using radioimmunoassay. A specimen was considered positive if the blood concentration for either analyte was equal to or greater than 0.1 mg/L. Positive findings in urine or blood for BE and opiates were substantiated by radioimmunoassay in another specimen. All positive specimens were subsequently analyzed by gas chromatography, which also served as the initial screening test for cocaine and methadone in blood and for cocaine in urine. The limit of quantitation was 0.1 mg/L. All positive gas chromatographic findings were subsequently confirmed by gas chromatography/mass spectrometry.

Two-tailed chi-square tests ($\alpha = .05$) were used to compare victims positive for different types of drugs and ethanol in regard to their demographic characteristics, cause of death and place of injury. Children under 14 years of age and victims in the Asian/other category were excluded from chi-square analyses because of low cell frequencies in the drug and ethanol positive categories.

For chi-square analyses victims were classified into one of five groups based on toxicology: 1.) cocaine and/or BE detected (without ethanol or opiates), 2.) cocaine and/or BE detected with opiates, 3.) cocaine and/or BE detected with ethanol, 4.) ethanol detected alone (without cocaine/BE or opiates) and 5.) none of these drugs detected. For the purposes of this study methadone was included in the opiates category. Victims positive for all three drugs, cocaine/BE, opiates and ethanol were placed in group 2, the cocaine/BE and opiates group.

Results

There were 2824 homicides in which victims survived two hours or less after being injured. Cocaine or its metabolite was found in 884 cases (31.3%). Toxicology was positive for cocaine/BE without ethanol or opiates in 379 (13.4%) of cases, with ethanol in 300 cases (10.6%), with opiates in 205 cases (7.3%). All three substances, cocaine/BE, ethanol and opiates were found in 82 cases (2.9%) and these were included in the cocaine/BE and opiates category. Ethanol was found without cocaine or opiates in 596 cases (21.1%). Opiates alone were found in 2% of victims and these cases were excluded from subsequent analyses. None of these substances were found in 1344 (47.6%) cases.

The presence of these substances in the various gender, race and age groups is presented in Table 1. Males (22.5%) were more likely than females (10.1%) to be positive for ethanol but there were no gender differences in the detection of cocaine/BE alone or with other substances. ($x^2 = 29.08$, df = 4, $P < .001$) African-Americans and Latinos were much more likely than whites, Asians and other races to be positive for cocaine/BE alone or with ethanol. Latino victims (9.4%) and whites (10.6%) were more likely than African-Americans (5.5%) to be positive for cocaine/BE with opiates. ($x^2 = 35.02$, df = 8, $P < .001$) Victims 25 to 34 years of age were more likely than those of other ages to be positive for cocaine/BE alone (18.0%), and for cocaine/BE with ethanol (15.2%). Victims 35 to 44 years of age (13.1%) were more likely than victims in other age groups to be positive for cocaine/BE with opiates. ($x^2 = 257.48$, df = 20, $P < .001$) For those 15 years and older, there were no major differences in the presence of ethanol alone across age groups.

The presence of drugs and ethanol in relation to the characteristics of the homicide is presented in Table 2. Homicides that took place in streets, parks and other places outside of buildings were more likely to be positive for cocaine/BE with and without ethanol and opiates than were homicides taking place inside buildings. ($x^2 = 60.90$, df = 8, $P < .001$) Firearms were more likely than other means to be the cause of death for victims positive for cocaine/BE alone while non-firearm homicides were more likely than firearm homicides to be positive for ethanol alone. ($x^2 = 60.99$, df = 4, $P < .001$)

Next, the presence of cocaine was differentiated from its metabolite BE. (Table 3) Two-thirds of the cocaine/BE cases were positive for cocaine itself indicating that the victim was under the influence of cocaine at the time of injury. The rest were positive only for BE, indicating they had taken cocaine in the recent past. Roughly half (9.2%) of those under the influence of cocaine were also under the influence of ethanol. Ethanol was more often present with cocaine than with the metabolite, BE (4.2%). Overall, there was a total of 964 (33.3%) victims under the influence of ethanol.

Female victims (23.8%) were more likely than males (18.7%) to be positive for cocaine, while male (22.7%) victims were more likely than female victims (10.3%) to be positive for ethanol alone. (Chi-square = 35.47, df = 3, $P < .001$) Those killed by means other than firearms (31.7%) were more likely than those killed by firearms (18.6%) to be positive for ethanol alone. (Chi-square = 97.13, df = 3, $P < .001$) The same trends for cocaine, BE and ethanol reported earlier in terms of age and place of injury were found, however there were no statistically significant differences in regard to race of the victim.

Discussion

We have found that, compared to other studies, the steady increase in the percentage of homicides positive for cocaine or its metabolite from the early 1980s has leveled off in the beginning of the 1990s to 31.3%, which is roughly the percentage found in Atlanta (33.0%) and Los Angeles (28.0%) in 1987 [*10,11,18*]. In this study we differentiated cocaine from its metabolite and found that two-thirds of victims positive for cocaine/BE were positive for cocaine indicating that they were under the influence of cocaine at the time of injury. In this study the percentage of victims positive for opiates (9.3%) was higher than that found in Los Angeles (4%) in 1987 [*10*], but half of what was found in Manhattan (18%) in 1981 [*7*]. Unlike the earlier Manhattan study, in this study opiates infrequently were found alone and rather were found with cocaine/BE. The percentage of homicide victims positive for ethanol (34.6%) is within the range found by other studies since 1975 [*7,12–14*].

There has been a rise in homicide rates in the United States from the mid 1980s to the present time [*19*]. It is possible that the rise in cocaine use over that time period is related to the increase in homicides. It is not feasible to prove there is a direct causal link between using cocaine and becoming a homicide victim, since there is no comparable control group to detect cocaine use by toxicology at any point in time in the general population. However if one uses household surveys where people report past use of cocaine, homicide victims do seem to have a greater proportion of cocaine use than does the general population. For example

TABLE 1—*Demographic characteristics of homicide victims by toxicology findings.*

	Cocaine/ BE alone	Cocaine/BE and ethanol	Cocaine/BE and opiates	Ethanol alone	No Cocaine/ BE, ethanol or opiates
	N(Row %)	N(Row %)	N(Row %)	N(Row %)	N(Row %)
Gender[a]					
Male	333(13.3)	268(10.7)	181(7.2)	564(22.5)	1160(46.3)
Female	46(14.5)	32(10.1)	24(7.5)	32(10.1)	184(57.9)
	379(13.4)	300(10.6)	205(7.3)	596(21.1)	1344(47.6)
Race[b]					
White	20(9.7)	10(4.8)	22(10.6)	52(25.1)	103(49.8)
African-American	194(14.2)	174(12.7)	76(5.5)	278(20.3)	648(47.3)
Latino	162(14.3)	115(10.2)	107(9.4)	256(22.6)	493(43.5)
Asian/other	3(2.6)	1(0.9)	0(0)	10(8.8)	100(87.7)
	379(13.4)	300(10.6)	205(7.3)	596(21.1)	1344(47.6)
Age (years)[c]					
Under 14	2(3.1)	0(0)	0(0)	3(4.6)	60(92.3)
15–24	112(10.9)	78(7.6)	35(3.4)	229(22.3)	572(55.8)
25–34	179(18.0)	151(15.2)	104(10.4)	208(20.9)	354(35.5)
35–44	65(15.2)	56(13.1)	56(13.1)	80(18.7)	170(39.8)
45–54	16(8.3)	12(6.2)	7(3.6)	50(25.9)	108(56.0)
55 and older	4(3.4)	3(2.6)	3(2.6)	26(22.4)	80(69.0)
	378(13.4)	300(10.6)	205(7.3)	596(21.1)	1344(47.6)

[a]Chi-square = 29.08, df = 4, $P < .001$.
[b]Chi-square = 35.02, df = 8, $P < .001$ (Asian/other excluded from the analysis).
[c]Chi-square = 202.20, df = 16, $P < .001$ (Under 14 years of age excluded from the analysis).

TABLE 2—*Characteristics of homicides by toxicology findings for victims.*

	Cocaine/ BE alone N(Row %)	Cocaine/BE and ethanol N(Row %)	Cocaine/BE and opiates N(Row %)	Ethanol alone N(Row %)	No Cocaine/ BE, ethanol or opiates N(Row %)
Place of Injury[a]					
Private residence	108(15.6)	74(10.7)	45(6.5)	120(17.4)	344(49.8)
Other building	58(8.6)	46(6.8)	33(4.9)	172(25.5)	365(54.2)
Outside	210(14.5)	180(12.4)	124(8.6)	302(20.9)	630(43.6)
	376(13.4)	300(10.7)	202(7.2)	594(21.1)	1339(47.9)
Cause of Death[b]					
Firearms	326(14.6)	229(12.0)	160(7.2)	409(18.3)	1108(49.6)
Other	53(9.0)	71(10.3)	45(7.6)	187(31.6)	236(39.9)
	379(13.4)	300(10.6)	205(7.3)	596(21.1)	1344(47.9)

[a]Chi-square = 60.90, df = 8, $P < .001$.
[b]Chi-square = 60.98, df = 4, $P < .001$.

TABLE 3—*Toxicological findings for cocaine, benzoylecgonine (BE) and ethanol in homicide victims.*

Drug	Number	(%)
Cocaine/BE	292	(10.1)
Cocaine/BE and ethanol	266	(9.2)
BE only	223	(7.7)
BE and ethanol	122	(4.2)
Ethanol only	616	(21.3)
None of the above	1372	(47.5)
	2891	(100.0)

our finding that almost one-third of homicide victims were using cocaine in the *two days* preceding injury was more than 15 times the proportion of persons aged 12 years and older who reported cocaine use in the *month* prior to the National Household Survey in 1991 [*20*].

The pharmacological effects of cocaine include irritability, anger, suspiciousness, and violence [*21*]. These effects may make the victim seem provocative, especially if the perpetrator also is using cocaine. Opiates and/or ethanol are used concurrently with cocaine in an attempt to diminish these unpleasant effects of cocaine [*23*]. Ethanol intoxication may have further contributed to risky behavior by homicide victims through disinhibition, impulsivity and impaired judgment [*24,25*]. Interestingly in this study female homicide victims were more likely than males to be positive

for cocaine/BE at the time of injury. Other studies of non-lethal violence have shown that women who use cocaine are more likely to be attacked in domestic disputes than women who do not [26].

Characteristics of victims and homicides differ in regard to cocaine use versus ethanol use. In general cocaine use was associated with homicides among the young and homicides occurring in public and committed by firearms. Victims killed while under the influence of ethanol with or without cocaine were unremarkable in terms of age but were disproportionately killed indoors and with means other than firearms. Although we did not have access to the circumstances of the homicide, we believe it likely that at least some of the homicide victims using cocaine were involved in drug-dealing on the streets as buyers or sellers. The distribution of cocaine involves violence used for the control of sales territory or retaliation against other dealers [27]. On the other hand ethanol may be associated more with violence in social and domestic situations.

In conclusion, the rise in cocaine positive homicides has leveled off at one-third of homicides in 1990 and 1991. Opiate positive homicides have increased from the mid 1980 levels. Although opiates are found in homicide victims, cocaine is usually present as well. Continued monitoring of these substances in homicides is in order, as is further study of the pharmacological and economic aspects of drug use and drug dealing and violence.

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