Relationships of deterrence and law enforcement to drug-related harms among drug injectors in US metropolitan areas

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Objective: To understand associations of punitive policies to the population prevalence of injection drug users and to HIV seroprevalence among injectors.

Design and methods: A lagged-cross-sectional analysis of metropolitan statistical area data. Estimates of drug injectors per capita and of HIV seroprevalence among injectors in 89 large US metropolitan areas were regressed on three measures of legal repressiveness (hard drug arrests per capita; police employees per capita; and corrections expenditures per capita) controlling for other metropolitan area characteristics.

Results: No legal repressiveness measures were associated with injectors per capita; all three measures of legal repressiveness were positively associated with HIV prevalence among injectors.

Conclusions: These findings suggest that legal repressiveness may have little deterrent effect on drug injection and may have a high cost in terms of HIV and perhaps other diseases among injectors and their partners – and that alternative methods of maintaining social order should be investigated. © 2006 Lippincott Williams & Wilkins

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Introduction

Becker [1], Wilson [2], and many other analysts argue that punishment and stigmatization deter criminal behavior by making it costly for the perpetrator. Politicians and the mass media have highlighted crimes and drugs as the cause of many social problems, and have thereby stigmatized criminals and, in particular, drug users [3,4]. Perhaps as a consequence of these arguments and stigmainducing activities, there has been a great increase in the USA in state and local law enforcement personnel (from 770 000 in 1992 to 951 000 in 2002), expenditures for incarceration (from US\$ 100 per capita in 1991 to US\$ 184 per capita in 2001), and arrests and imprisonments in the USA in recent decades (jail and prison inmates increased from 1.2 million in 1990 to 2.1 million in 2001) [5]. Much of this repressive effort has focused on the 'War on Drugs'; arrests for drug possession in the United States increased from 540 800 in 1982 to 1 235 700 in 2002 [6].

Punishment and stigmatization may have unanticipated effects on public health in general and on drug-related harm in particular. As injection is a more efficient means of taking drugs than intranasal use, a number of researchers have suggested that punishment and stigmatization might increase the pressures on non-injecting heroin users and perhaps cocaine users to take up injection drug

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use (and for injectors to continue injecting) through decreasing the supply of drugs or driving up their costs [7,8]. Others have found that aggressive police tactics and/or stigmatization may lead injection drug users (IDUs) to engage in hurried injection behaviors, to share syringes more often, and/or to inject in high-risk environments [9–16] and, in addition, to impede the creation or functioning of syringe exchange [17–20], drug treatment or other programs to improve users' health [21].

This study investigated whether three measures of legal repressiveness in large US metropolitan areas were associated with the population prevalence of injection drug use and with HIV prevalence among IDUs.

Methods

'Sample' and its statistical implications

The sample was the 96 largest metropolitan statistical areas (MSA) in the USA in 1993. MSAs, as defined by the US Census Bureau, are contiguous counties that contain a central city of 50 000 people or more and that form a socio-economic unity as defined by commuting patterns and social and economic integration within the constituent counties [22,23]. The paper thus studies a 'population' rather than a sample, so there is no sampling error (although there is measurement error). The relevance of statistical inference is debatable. Some researchers studying similar populations use 'P-values' or 'confidence intervals' as heuristic devices to avoid over-interpreting model parameters [24-29] (We refer here to 'pseudoconfidence intervals'.) Other analysts might view the population as a random sample of 'possible universes'; in this interpretation 'pseudo-confidence intervals' has a probabilistic interpretation.

Missing values on the three measures of legal repressiveness reduced the number of MSA (N) to 89.

Variables

Dependent variables

As the derivations of both *dependent variables* (injectors per capita and HIV prevalence among injectors) have been described previously, they are described only briefly here.

Drug injectors per capita in the MSA population in 1998. This was estimated in a three-step process [30]. The number of persons who had injected drugs in the USA in 1998 was first estimated by adjusting and averaging others' prior estimates [31,32]. This number was then allocated to each MSA using four multipliers (using data on drug injectors among drug abuse treatment populations, HIV counseling and testing clients, and AIDS cases, and estimates of numbers of injectors and HIV prevalence among them in 1993) [30]. These four estimated numbers of injectors in

each MSA were then averaged; and the mean divided by the MSA population.

HIV prevalence. This was defined as the proportion of IDUs who were HIV positive among IDUs in 95 MSAs in 1998, and was estimated by taking the mean of two estimates [33]. The first estimate was calculated by modifying Centers for Disease Control (CDC) voluntary HIV counseling and testing data to correct for their inherent underestimation of prevalence. Research-based data on HIV prevalence for 25 MSAs were used to calculate regression equations to perform these adjustments. The second estimate was based on methods developed by Lieb et al. [34]. Briefly, the estimated total number of HIV-positive IDUs (including those who are also men who have had sex with men) living in an MSA was designated as k (and estimated by adjusting data on AIDS cases). The estimated numbers of IDUs (a) [30] and the estimated HIV prevalence among IDUs (b) were variables related by the function, k = ab; thus, b = a/k.

Almost all of the independent variables precede the dependent variables in time so that the temporal sequence is correct. (This does not, of course, take account of the high degree of autocorrelation over time in many of these variables.)

Independent variables

The main *independent variables* were the three measures of legal repressiveness. They are: (1) arrests for possession or sale of heroin or cocaine (1994–1997), taken from US Federal Bureau of Investigation (FBI) data; (2) police employees per capita (1994–1997), taken from FBI data [35,36]; and (3) 'corrections' expenditures per capita (1997), taken from United States Census Bureau data on government finances [37].

Arrests for possession or sale of heroin or cocaine (1994–1997). Arrest of drug users may be an indicator of pressures on police; and the fear of arrest may encourage drug users to become or remain drug injectors and also may lead injectors to inject less safely [9,10,14–16].

Police employees *per capita*. This may reflect a public willingness to spend money and person-power on policing. It may also indicate more direct effects on HIV risk; for example, Davis *et al.* [20] found that police presence, as distinct from arrests, was associated with less use of syringe exchanges in Philadelphia.

Correction expenditures per capita. These are an indicator of public willingness to spend resources on local incarceration and probation systems as well as an indicator of the number of people arrested and the average time they spend in jail before and after trial, which would tend to increase fear of arrest and thus to risk of using drugs by injection in unsafe ways (as discussed above).

Consideration was given to using factor analysis as a data reduction strategy, but the three variables had intercorrelations that were too low for the resulting single factor to be meaningful (it captured slightly less than 50% of the variance; correlations were 0.08 between police employees per capita and corrections expenditures per capita; 0.19 between police employees per capita and heroin and cocaine arrests per capita; and 0.36 between heroin and cocaine arrests and corrections expenditures per capita.).

Control variables

Based on a review of relevant literature, a number of variables were included in the analyses as *control variables* because they might affect the dependent variables at the metropolitan area of analysis. These included the following items.

Region. US regions differ politically and culturally, and on mean values of both dependent variables and the three legal repressiveness measures. In order to make our categories for regions more homogeneous politically, culturally and economically, US Census categories for Region were adjusted by moving Maryland, Delaware and Washington, DC, to the Northeast Region; Texas to the West; and Oklahoma to the Midwest. Midwest was treated as the reference category because it had the lowest mean value on drug injectors per capita. (It had the second lowest mean value, 4.85%, on HIV prevalence, which was statistically indistinguishable [P(t) = 0.59] from the mean 4.56 HIV prevalence in the West.)

Presence of laws against over-the-counter sales of syringes. These laws were associated with higher levels of injectors per capita, and with greater HIV prevalence and incidence among IDUs, in 1993 [38].

Unemployment rate in 1990 [39]. A number of studies have found that economic conditions are associated with rates of substance use and/or HIV prevalence [38,40,41].

Proportion of the MSA population who are black. Many studies have found that black injectors are more likely than other injectors to be HIV infected and/or to have AIDS [42–48]; and earlier research from this project shows that

higher percentages of black populations than of whites in these metropolitan areas are injection drug users [49].

For analyzing HIV prevalence, injection drug users per 10 000 population in 1993 [32] was also used as a control variable. It was a predictor of HIV prevalence among injectors in 1993 [38].

Statistical analysis

Since the unit of analysis in this study is the metropolitan area, dependent variables are rates for a given metropolitan area. Correlation and linear regression are used to estimate associations among variables. Standardized coefficients (betas) are reported to facilitate comparisons of magnitudes of association. Regression diagnostics including collinearity diagnostics, tests of the assumptions of the model and tests for outliers and influential points were assessed. Sensitivity analyses assessed the effects of metropolitan areas with particularly high or low values of the dependent variables as well as possible measurement error in the dependent variables. Statistical analyses were done in SAS version 9 [50].

Results

Injectors per capita range from one-fifth of 1% to almost 2% of the population in these metropolitan areas (Table 1). HIV prevalence among injectors also has considerable range, from 2.4 to 27.4%.

In bivariate relationships, both per capita heroin and cocaine arrests and corrections expenditures per capita are associated with the number of injectors per capita (Table 2). After controlling for region and other variables, however, none of the three measures of legal repressiveness has a pseudo-P below 0.2.

All three measures of legal repressiveness are associated with higher HIV prevalence in bivariate analysis and with other potential predictors statistically controlled. Police employees per capita has the strongest association (beta = 0.358) with HIV prevalence, such that a one standard deviation increase in police employees per capita

Table 1. Distributions of key va	ariables in 89	arge metropolitan areas i	in the United	d States of America.
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Variable	Mean (SD)	Median (interquartile range)	Minimum, maximum
Injection drug users, per 10 000 population, 1998	67 (34)	60 (42, 87)	19, 173
HIV prevalence among injection drug users, 1998	7.7% (5.5%)	5.5% (3.9%, 9.7%)	2.4%, 27.4%
Average arrests for cocaine or heroin per 10 000 population, 1994–1997	15 (12)	11 (7, 20)	1, 55
Average police employees per 10 000 population, 1994–1997 Corrections expenditures per person, 1997 (US\$)	27 (9) 52 (23)	27 (21, 32) 47 (35, 66)	8, 68 8, 130

Table 2. Associations of three measures of legal repressiveness with injection drug users per capita in 89 large metropolitan areas in the United States of America, 1998^a.

	Bivariate beta ^a	Pseudo-confidence intervals ^c	Unstandardized multiple regression coefficient ^b	Standardized beta in multiple regression ^b	Pseudo-confidence intervals ^c
Arrests for heroin or cocaine per 10 000 population (mean, 1994–1997)	0.339	0.405 to 1.58	0.356	0.123	-0.200 to 0.918
Police employees per 10 000 population (mean, 1994–1997)	0.002	-0.766 to 0.780	-0.417	-0.115	-1.10 to 0.26
Corrections expenditures in dollars per capita (1997)	0.327	0.183 to 0.773	0.018	0.012	-0.276 to 0.313

R-squared for the multiple regression equation is 0.50; P(F) < 0.0001. Adjusted *R*-squared = 0.42.

^aIn regression diagnostics, Baltimore was an outlier with Studentized residual = 3.52, indicating that it had considerably more drug injectors per capita than the equation predicted. When the equation was re-run with Baltimore left out, the lack of association between the legal repressiveness measures and injectors per capita remained, with no multiple regression beta having a magnitude > 0.07.

^bBeta is the standardized regression coefficient. In bivariate analyses, it equals Pearson's *r*. Control variables are percent unemployed, 1990; percent of population who are black, 1990; laws against over-the-counter syringe sales; and region of the USA (with dummy variables for Northeast, South and West, with Midwest as the reference category).

^cSince this is a study of a population rather than a sample, 'pseudo-confidence intervals' are presented as a heuristic device as discussed in the text.

would yield a 0.358 standard deviation increase in the predicted value of HIV prevalence (Table 3).

Sensitivity analyses

The data used for the dependent variables were subject to considerable potential error whose magnitude and variance are not well-characterized. To assess the sensitivity of results to such error, we re-ran the regressions based on two different logics. First, we re-ran them for each dependent variable after removing the two metropolitan areas with the highest and the two with the lowest values on that dependent variable. (Hence, N = 85 for each of these analyses.)

Second, each dependent variable had been created as the mean of separate partial estimates – four separate estimates of drug injectors per capita [30] and two separate estimates for HIV prevalence [33]. We thus re-ran the

analyses separately using each of the separate partial estimates in turn as the dependent variable.

Between analyses removing the extreme values and those using the separate partial estimates, the sensitivity analyses produced three separate regression equations for HIV prevalence, each of which estimated the regression coefficients for each of the three indicators of repressiveness, and five equations for injectors per capita. The nine estimated parameters for HIV prevalence were all positive in the three sensitivity regressions for that dependent variable, with seven of them significantly so. None of the 15 parameters in the five sensitivity regressions for injectors per capita was significantly different from zero.

We then compared the parameter estimates for the new equations with those in the original run, using *t*-tests and

Table 3. Predictors of HIV	prevalence among injection d	rug users in 89 large metropolita	n areas in the United States of America, 1998 ^a .
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	Bivariate beta ^a	Pseudo-confidence intervals ^b	Unstandardized multiple regression coefficient ^b	Standardized beta in multiple regression ^b	Pseudo-confidence intervals ^c
Arrests for heroin or cocaine per 10 000 population (Mean, 1994–1997)	0.292	0.042 to 0.237	0.107	0.223	0.026 to 0.188
Police employees per 10 000 population (Mean, 1994–1997)	0.413	0.130 to 0.360	0.212	0.358	0.113 to 0.310
Corrections expenditures in dollars per capita (1997)	0.245	0.009 to 0.108	0.048	0.200	0.005 to 0.090

R-squared for the multiple regression equation is .62; P(F) < 0.0001. Adjusted *R*-squared = 0.57.

^aIn regression diagnostics, three cities (Jersey City, Miami, and Newark) had Studentized residuals with absolute magnitude above 3. All were positive, indicating that HIV prevalence in these areas was much higher than the equation predicted. When the equation was re-run with these three metropolitan areas omitted, the parameters for police expenditures per capita and for correction expenditures per capita decreases slightly (to 0.201 and 0.044, respectively; the lower bounds of their pseudo-confidence intervals remained positive) but that for arrests for heroin or cocaine per capita decreased from 0.108 to 0.056 (pseudo-confidence interval -0.010 - +0.121).

^bBeta is the standardized regression coefficient. In bivariate analyses, it equals Pearson's *r*. Control variables are percent unemployed, 1990; percent of population who are black, 1990; laws against over-the-counter syringe sales; injection drug users per capita, 1993; and region of the United States (with dummy variables for Northeast, South and West, with Midwest as the reference category).

^cSince this is a study of a population rather than a sample, 'pseudo-confidence intervals' are presented as a heuristic device as discussed in the text.

treating the original value as fixed. Of the 24 comparisons, one was significant at P < 0.05, and another at P < 0.10, which is approximately what would be expected from a set of random numbers. Thus, the models do not appear to be very sensitive to likely errors in the dependent variables.

Discussion

Legal repressiveness is not independently associated with higher rates of injectors in metropolitan populations but is associated with higher HIV prevalence among injectors. These findings are subject to a number of limitations. First, causal mechanisms are hard to study at a single level of analysis as both higher-level and lower-level variables may affect observed relationships. Similarly, although almost all independent variables precede the dependent variables in time, all variables are subject to considerable temporal autocorrelation. Thus, causal inference would have been stronger if longitudinal data had been used. Such analyses are planned for the relatively near future, including further study of the possibly two-directional relationships between legal repressiveness and injectors per capita. 'Police employees per capita' is not the same as police on duty in drug-using areas or in drug squads, which may or may not have attenuated the effects of this variable. As police squads that exclusively target drug activities have been found to have particularly deleterious effects on HIV risk behaviors [10], future research should study the effects of particular categories of police personnel on drug injection and on HIV.

These data offer no support for deterrence theories that hold that legal repressiveness reduces levels of injection drug use since the multiple regression coefficients had pseudo-P values above 0.2. In this, they parallel the findings of Reinarman *et al.* [51] that legal repressiveness is not associated with patterns of cannabis or other drug use (among cannabis users) in a comparison of two cities with different drug policies.

The main finding of this paper is that higher rates of three measures of legal repressiveness are associated with higher HIV prevalence among injectors. This may be because fear of arrest and/or punishment leads drug injectors to avoid using syringe exchanges [13,19,20,52], or to inject hurriedly [9,10,16] or to inject in shooting galleries or other multiperson injection settings [53] to escape detection. Numerous studies have found that hurried injection and injection in shooting galleries and similar locations, as well as injecting while incarcerated [54,55], are associated with riskier injection practices [14,15,52,53]. The comparatively large magnitude of the association between police employees per capita and HIV prevalence suggests that the total size of police departments may be an important factor in heightening

these risks. In addition, the stigmatization side of legal repressiveness may create, among drug users, lowered self-concepts and other psychological or social conditions conducive of greater risk [56]; and may lead to public opinion that makes it more difficult to set up, fund, or find locations for syringe exchanges and drug treatment facilities [21,57,58].

It is critical to note that although large numbers of police employees and high expenditures on corrections may generally be associated with high rates of HIV among injectors, they do not always preclude implementation of effective HIV prevention programs. Although New York City is high on the measures of legal repressiveness, New York State legalized and funded large-scale syringe exchange programs carried out by non-profit organizations beginning in 1992. This was followed by an 80% reduction in HIV incidence among IDUs in the city [59]. From our experience, we would suggest that the development of co-operative working relationships between public health authorities and law enforcement authorities to promote HIV prevention programs for IDUs was crucial. Although policy and legal changes facilitated this co-operation, the existence of cooperation at the street level was key to this success.

The implications of this paper are clear. In terms of research, more study is needed to determine the sequelae of legal repressiveness (including determining whether the associations found in this paper are causal) and the mechanisms through which these sequelae arise. In terms of policy and practice, these findings suggest that legal repressiveness may have little deterrent effect on drug injection and may have a high cost in terms of HIV and perhaps other diseases among injectors, their partners, and the broader community, and that alternative methods of maintaining social order should be investigated.

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