



Contextual Determinants of Drug Use Risk Behavior: a Theoretic Framework

Sandro Galea, Jennifer Ahern, and David Vlahov

ABSTRACT *Over the past two decades, public health research has emphasized the role of individual risk behaviors, primarily injection and sexual risk behaviors, in the spread of HIV infection. Much less emphasis has been given to understanding the determinants of these risk behaviors. Although individual characteristics are partly responsible for risky injection and sexual behaviors, they do not explain all the inter-personal variability in risk behavior. Contextual factors associated with HIV risk behavior may include structural factors (e.g., availability of services), social norms and attitudes (e.g., social trust), disadvantage (e.g., neighborhood socioeconomic status), and features of the physical environment (e.g., housing quality). This article presents a conceptual framework that incorporates some of the key contextual domains that may affect drug use behavior. It also presents data from a study of street-recruited drug users as an example of the relations between social contextual factors and frequency of injecting drug use, and discusses some methodological challenges in the study of contextual determinants of drug use behavior.*

KEYWORDS *HIV, Risk behavior, Injection drug use, Context of HIV risk, Neighborhoods, Review*

INTRODUCTION

Drug use has been a consistent feature of the urban environment for the past century, despite sustained and costly efforts at prevention. The economic, health, and social costs associated with drug use are enormous.¹⁻⁵ In the past two decades, injection drug use has been one of the two most common routes for the spread of HIV infection worldwide.⁶ Although extensive research has been devoted to identifying individual factors associated with drug use, our ability to explain drug use risk behavior remains limited.⁷ It is increasingly clear that research focusing on individual patterns of drug use is insufficient to fully explain interindividual drug use behaviors or how these behaviors facilitate the spread of disease.

The field of public health developed from practical concerns with social and environmental issues that have an impact on the health of human populations.^{8,9} Early public health practitioners identified environmental and social forces associated with well-being and implemented efforts to ameliorate them. However, for most of the 20th century, research emphasis, driven by improved methodological techniques and a growing interest in chronic disease etiology, shifted to individual-

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level risk factors, and less attention was given to environmental and social conditions associated with health and well-being.¹⁰⁻¹² More recently, research efforts have aimed at accounting for multiple levels of analysis, including individual as well as group-level factors.¹³ New epidemiologic techniques have also enabled researchers to weigh the relative importance of risk factors at the individual and group levels.^{14,15} While most research on contextual factors has been in the form of ecological analyses,¹⁶⁻¹⁸ recent work has introduced a better understanding of how larger contextual forces interact with and shape individual-level behaviors.^{19,20} These studies have usually linked information on small-area characteristics available from archival data to survey-based measures of individual-level covariates from epidemiologic studies.^{21,22} For example, neighborhood, socioeconomic status,²³ and aggregate measures of income and poverty²⁴ have been associated with well-being. In addition, features of the social environment have been associated with risk behavior, including smoking and alcohol use,²⁵⁻²⁷ cardiovascular risk factors,^{28,29} physical activity, and violence.³⁰⁻³³

In the realm of substance use, a number of individual-level factors have been identified that may affect drug users' risk behaviors, including social networks and social support,³⁴⁻³⁶ psychological factors,^{37,38} and individual experiences.³⁹ Newer work has begun to discuss the impact of social and economic contextual factors on substance use behavior.^{40,41} Among the early research that has shown an association between contextual factors and drug use are analyses of the relations between alcohol outlets and alcohol,⁴² income distribution and smoking,⁴³ and ethnographic research that has suggested a role for contextual social and economic factors in determining illicit drug use.⁴⁴ Although these studies provided early empirical evidence for the role that contextual factors play in shaping illicit drug use, there have been few systematic efforts to consider the different contextual factors that may be important determinants of drug use risk behavior and to study the relative contribution of these factors empirically. This article discusses one possible theoretic framework that may guide such work and provides an empirical example of how components of this framework may be tested.

A CONCEPTUAL MODEL OF THE CONTEXTUAL DETERMINANTS OF RISK BEHAVIORS

Figure 1 presents a conceptual framework that incorporates some of the key contextual variables that may be determinants of drug use behavior and related HIV risks. The proposed framework draws on some of the available evidence demonstrating associations between contextual factors and risk behavior, and on other established frameworks that discuss the effect of factors at multiple levels on health and behavior.^{10,45} This framework is based on the premise that social policy and regulation affect contextual, mediating, and individual-level factors. For example, specific policies may affect the allocation of social and health resources, thus indirectly influencing behavior (e.g., policies to increase available drug treatment services may decrease the number of drug users; conversely, policies to incarcerate drug users may influence the number of drug overdose episodes).^{46,47} Similarly, policy decisions may directly affect drug use, such as the increase of taxes that has been shown to decrease alcohol and cigarette consumption.⁴⁸ The second element in this model includes the key contextual variables that may affect risk behavior. Highlighted here are social norms, neighborhood disadvantage, and social capital (three features of the social environment), the physical environment, and availability of health

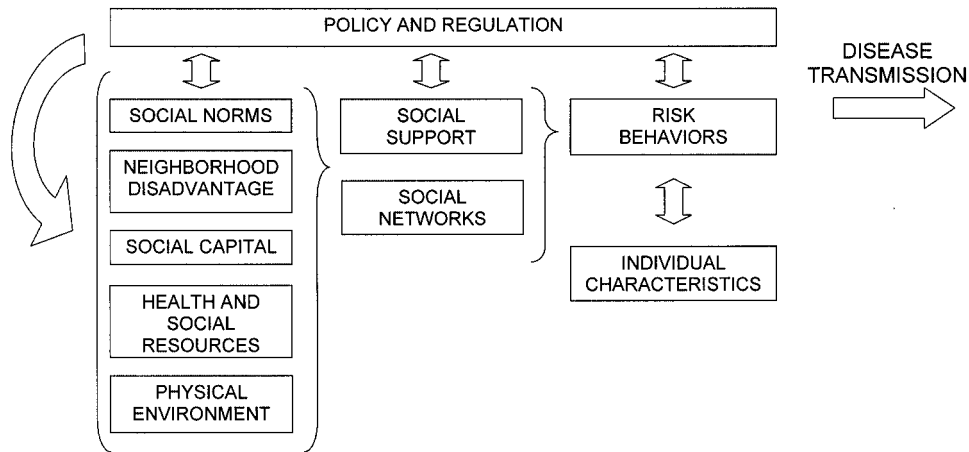


FIGURE 1. Determinants of risk behaviors: a conceptual model

and social resources. The specific contribution of these variables to interindividual variability in risk behavior may be tested empirically, and a few studies have demonstrated their role in shaping drug use risk behavior. For example, social norms have been identified as contextual variables that shape individual behavior.^{49,50} Since many of these contextual variables are interrelated and interactive, a full understanding of their roles in shaping risk behaviors must consider the contribution of other variables in the framework. For example, attitudes,⁵¹ violence,⁵² and resources in the community⁵³ have been linked to health.⁵⁴ These observations reflect what likely are complex (and frequently multidirectional and interactive) relations between factors at multiple levels, drug use, and health.

Multiple factors, such as social support and social networks, may mediate the relation between the social and physical environment and individual drug use risk behaviors.^{55,56} For example, social support systems are important mechanisms for the prevention of substance use behavior in many racial/ethnic groups.⁵⁵ Conversely, participation in drug-using social networks has been shown to be a determinant of drug use behavior.⁵⁶ Other social factors may affect drug use (e.g., discrimination) and mediate the relation between contextual determinants and risk behavior; however, there have been few studies of these factors in the context of drug use.

EXAMPLE: ASSESSING THE IMPACT OF NEIGHBORHOOD DISADVANTAGE ON INJECTION DRUG USE

To assess the role of neighborhood disadvantage in shaping injection drug use behavior, we used data from a study of drug users (DUs) who were recruited in 2001 from the communities of East Harlem, Central Harlem, and South Bronx. Ethnographic mapping and targeted sampling were used to recruit the DUs, who were compensated \$15 for their voluntary participation. All participants completed an interviewer-administered structural questionnaire that inquired about patterns of drug use, personal characteristics, and individual social factors. Zip codes were the primary contextual unit of analysis. Data from the 2000 US census were used to calculate the proportion of households in each zip code with an income of less than

\$30,000 per year as a measure of neighborhood disadvantage. Multilevel modeling was used to determine the independent relation of neighborhood disadvantage and frequency of injection drug use per day while controlling for individual-level factors.

Overall, 610 DUs were eligible for this analysis; 63% were male, 51% were black, 40% were Latino, 19% were 25 to 34 years old, 41% were 35 to 44 years old, and 34% were over 45 years old. All participants reported their primary place of residence to be in one of 12 zip codes in the neighborhoods of interest. In a multivariable multilevel model, neighborhood disadvantage was a significant predictor of frequency of injection drug use ($\beta = 0.12$, $P = .007$) when controlling for individual age, race, gender, and annual income. Figure 2 shows the best-fit adjusted multilevel linear regression line describing the relation between neighborhood disadvantage and frequency of injection.

This brief analysis illustrates that DUs living in more disadvantaged zip codes were injecting drugs more frequently even after adjusting for the individual DUs' demographic characteristics and income. Although limited, this example provides evidence for a credible relation between neighborhood social determinants and individual risk behavior independent of individual factors. However, in order to guide potential interventions, it is important to understand the mechanisms underlying

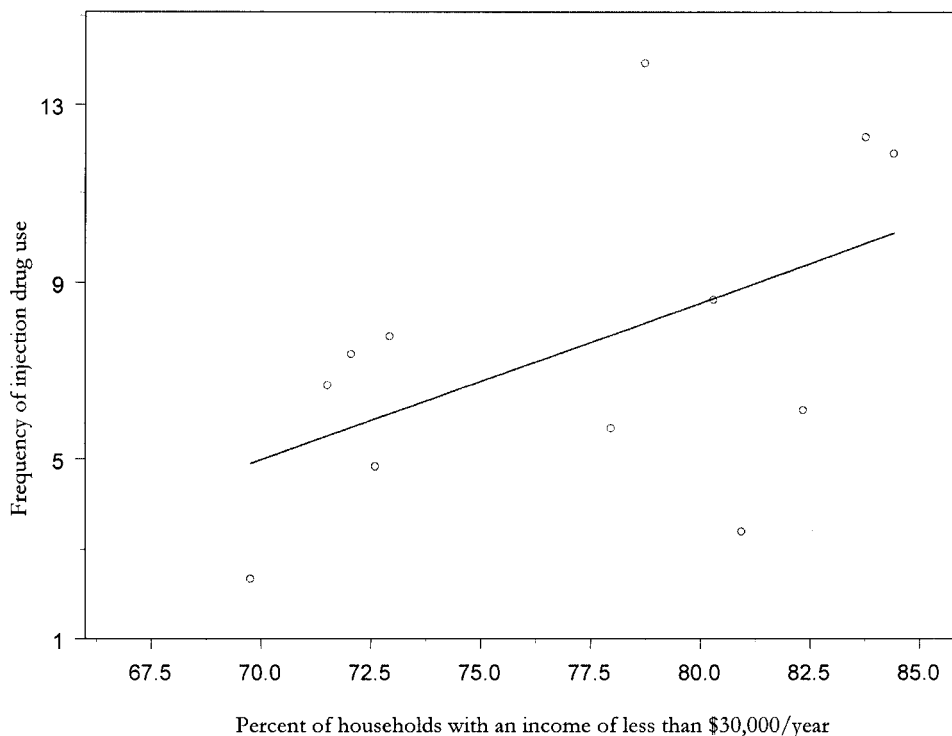


FIGURE 2. Frequency of injection drug use and neighborhood disadvantage (Level I $n = 610$; Level II $n = 12$). Analysis of 610 habitual drug users in New York City, residing in 12 different zip codes. Shown is best-fit line describing the relation between neighborhood disadvantage and individual frequency of injection drug use in a multilevel model, adjusting for individual age, race, sex, and annual income.

the observed relation. There are three primary plausible explanations for the data presented here. First, the psychosocial stresses associated with living in highly disadvantaged neighborhoods may be related directly to higher risk behavior as a coping mechanism.⁵⁷ Second, disadvantaged neighborhoods could have few supportive health and social resources, different configurations of social networks, or different psychological characteristics, all of which may affect drug use risk behavior. Third, it is possible that DUs who inject more frequently move into neighborhoods with more disadvantage as a way to get away from higher social control (in more advantaged neighborhoods) that may impinge on drug patterns. The measurement of variables that can represent these particular factors and the assessment of their relative contributions to drug use risk behavior could guide policy-based and public health interventions aimed at decreasing injection drug use and related adverse health consequences in these neighborhoods. Similar analyses should be conducted to address associations between neighborhood-level factors and sex risk behaviors to explore the full extent of the relations between contextual factors and HIV risk behaviors.

METHODOLOGICAL CONSIDERATIONS

Empiric evaluations of the impact of contextual factors on individual risk behavior require rigorous conceptual models to identify relevant contextual determinants and hypothesize a priori what the roles of these variables and potential mediating factors may be in explaining the observed associations. In the above example, the hypothesis was that neighborhood disadvantage would be associated with injection drug use frequency. Building on our observations, further testing would involve an examination of potential mechanisms to explain this relation (e.g., psychosocial stress due to living in disadvantaged neighborhoods, different social networks in disadvantaged neighborhoods).

Appropriate specification of relevant contextual levels may be difficult when conducting empiric evaluations but is critical for an assessment of the determinants of risk behavior. Among other problems, the misspecification of relevant levels of analysis may mask intraunit variability. For example, while analysis at the state level may be appropriate to determine the effect of state-level policies (e.g., enforcement of anticrime measures) on individual drug-use behavior, it is unlikely that state-level determinants will be as important as municipal-level determinants (e.g., emergency medical response) on drug overdose mortality. Similarly, specification of the relevant contextual-level variables at the level of interest is important. In the above example, zip codes were used as proxies for neighborhoods, but neighborhood units that are meaningful to residents may be more appropriate units of analysis in this context. Also, while the proportion of the population earning a low income may adequately represent gross neighborhood disadvantage, it may mask subtler disadvantage that can be expressed by assessing the proportion of persons receiving public assistance. An analysis that focuses on the former may fail to detect the role of public assistance in drug use or drug dealing behavior.

Adjustment for relevant individual-level correlates of risk behavior is also important for the proper identification and analysis of contextual determinants. For example, adjusting for individual income is critical in an analysis of the role of neighborhood disadvantage to avoid mistaking a compositional effect (i.e., an aggregate effect of individuals in a particular group) for a contextual effect (i.e., a true effect of the group). In the context of HIV, a multiplicity of risk behaviors,

including drug use and sex risk behaviors, determine the likelihood of disease transmission,⁵⁸ indicating how important it is to consider context and its role in shaping drug use and sex risk behaviors.

Contextual variables are difficult to measure and are rarely measured adequately. Researchers often use archival data to construct contextual variables. In the analytic example provided here, neighborhood income was used to represent neighborhood disadvantage. Neighborhood income, however, is a relatively limited proxy for overall neighborhood disadvantage that can manifest in multiple ways, including quality of housing, lighting, street maintenance, and availability of services and resources. Thus, archival data may be useful to construct contextual variables in some cases but may result in underspecification of the contextual variables of interest or in failure to detect important contextual effects.

Multilevel analyses are frequently limited by inadequate power. The number of persons studied, the number of contextual units, and anticipated intragroup correlations determine statistical power in multilevel analysis,⁵⁹ yet few studies are designed to have sufficient power for these analyses. As the proposed model of risk behavior presented in Figure 1 suggests, it is likely that the relations between contextual determinants, risk behavior, and disease transmission are complex and nonlinear. More sophisticated statistical models are necessary to account for the likely relations among many contextual determinants and risk behaviors.

CONCLUSION

Contextual social factors have been identified as important determinants of risk behavior and hence of HIV transmission. Although this is increasingly recognized in the literature, few studies have been designed to specifically test multilevel hypotheses. Methodological limitations, including the appropriate specification of relevant group-level constructs and statistical efficiency, limit analyses of the role of contextual factors. In the area of HIV transmission, key questions about the role of contextual determinants remain. Among these are the identification of the primary contextual factors that shape individual drug use and sexual risk behavior, assessment of the relative contribution of different contextual factors to HIV risk behavior after adjustment for individual characteristics, and the identification of modifiable contextual factors that may be the target of public health interventions to reduce drug use, sexual risk taking, and HIV. Addressing these questions will raise new challenges and opportunities for understanding and preventing HIV transmission.

REFERENCES

1. Cornish JW, O'Brien CP. Crack cocaine abuse: an epidemic with many public health consequences. *Annu Rev Public Health*. 1996;17:259-273.
2. Cregler LL. Adverse health consequences of cocaine abuse. *J Natl Med Assoc*. 1989; 81(1):27-39.
3. Stein MD. Medical consequences of substance abuse. *Psychiatr Clin North Am*. 1999; 22(2):351-370.
4. Xie X, Rehm J, Single E, Robson L, Paul J. The economic costs of alcohol abuse in Ontario. *Pharmacol Res*. 1998;37(3):241-249.
5. French MT, Mausekopf JA, Teague JL, Roland EJ. Estimating the dollar value of health outcomes from drug-abuse interventions. *Med Care*. 1996;34(9):890-910.
6. Morrison L. The global epidemiology of HIV/AIDS. *Br Med Bull*. 2001;58:7-18.

7. Carael M, Buve A, Awusabo-Asare K. The making of HIV epidemics: what are the driving forces? *AIDS*. 1997;11(suppl B):S23-S31.
8. Rosen G. *A History of Public Health*. Baltimore, MD: Johns Hopkins University Press; 1993.
9. Susser M, Susser E. Choosing a future for epidemiology: I. Eras and paradigms. *Am J Public Health*. 1996;86:668-673.
10. Krieger N. Epidemiology and the web of causation: has anyone seen the spider? *Soc Sci Med*. 1991;39(7):887-903.
11. Wilkinson RG. *Class and Health: Research and Longitudinal Data*. London, England: Tavistock Publications; 1986.
12. Marmot MG, Kogevinas M, Elston MA. Social/economic status and disease. *Annu Rev Public Health*. 1987;8:111-135.
13. Anderson N. Solving the puzzle of socioeconomic status and health: the need for integrated, multi-level, interdisciplinary research. In: Adler NE, Marmot M, McEwan BS, Stewart J, eds. *Socioeconomic Status and Health in Industrial Nations: Social, Psychological and Biological Pathways*. New York, NY: New York Academy of Sciences; 1999:302-312.
14. Susser M. The logic in ecological: I. The logic of analysis. *Am J Public Health*. 1994; 84:825-829.
15. Diez-Roux AV. Bringing context back into epidemiology: variables and fallacies in multi-level analysis. *Am J Public Health*. 1998;88:216-222.
16. Roberts EM. Neighborhood social environments and the distribution of low birth weight in Chicago. *Am J Public Health*. 1997;87:597-603.
17. Kennedy BP, Kawachi I, Prothrow-Stith D, Lochner K, Gupta V. Social capital, income inequality and firearm violent crimes. *Soc Sci Med*. 1998;47(1):7-17.
18. Geronimus AT, Bound J, Waidmann A. Poverty, time, and place: variation in excess mortality across selected US populations, 1980-1990. *J Epidemiol Community Health*. 1998;53:325-334.
19. Von Korff M, Koepsell T, Curry S, Diehr P. Multi-level analysis in epidemiologic research on health behaviors and outcomes. *Am J Epidemiol*. 1992;135:1077-1082.
20. Daly MC, Duncan GJ, Kaplan GA, Lynch JW. Macro-to-micro links in the relation between income inequality and mortality. *Millbank Q*. 1998;76(3):315-339.
21. Boyle PJ, Gatrell AC, Duke-Williams O. The effect on morbidity of variability in deprivation and population stability in England and Wales: an investigation at small-area level. *Soc Sci Med*. 1999;49:791-799.
22. Zierler S, Krieger N, Tang Y, et al. Economic deprivation and AIDS incidence in Massachusetts. *Am J Public Health*. 2000;90:1064-1073.
23. Yen IH, Kaplan GA. Neighborhood social environment and risk of death: multi-level evidence from the Alameda county study. *Am J Epidemiol*. 1999;149:898-907.
24. Waitzman NJ, Smith KR. Phantom of the area: poverty-area residence and mortality in the United States. *Am J Public Health*. 1998;88:973-976.
25. Crum RM, Muntaner C, Eaton WW, Anthony JC. Occupational stress and the risk of alcohol abuse and dependence. *Alcohol Clin Exp Res*. 1995;19(3):647-655.
26. Kleinschmidt I, Hills M, Elliott P. Smoking behavior can be predicted by neighborhood deprivation measures. *J Epidemiol Community Health*. 1995;49(suppl 2):S72-S77.
27. Duncan C, Jones K, Moon G. Smoking and deprivation: are there neighborhood effects? *Soc Sci Med*. 1999;48:497-505.
28. Diez-Roux AV, Nieto FJ, Muntaner C, et al. Neighborhood environments and coronary heart disease: a multi-level analysis. *Am J Epidemiol*. 1997;146:48-63.
29. Davey-Smith G, Hart C, Watt G, Hole D, Hawthorne V. Individual social class, area-based deprivation, cardiovascular disease risk factors, and mortality: the Renfrew and Pasiley study. *J Epidemiol Community Health*. 1997;52:399-405.
30. Yen IH, Kaplan GA. Poverty area residence and changes in physical activity level: evidence from the Alameda county study. *Am J Public Health*. 1998;88:1709-1712.

31. O'Campo P, Gielen AC, Faden RR, Xue X, Kass N, Wang MC. Violence by male partners against women during the childbearing years: a contextual analysis. *Am J Public Health*. 1995;85:1092–1097.
32. Cubbin C, Williams Pickle L, Fingerhut L. Social context and geographic patterns of homicide among US black and white males. *Am J Public Health*. 2000;90:579–587.
33. Cunradi CB, Caetano R, Clark CL, Schafer J. Alcohol-related problems and intimate partner violence among white, black, and Hispanic couples in the U.S. *Alcohol Clin Exp Res*. 1999;23(9):1492–1501.
34. Latkin CA, Mandell W, Vlahov D. The relationship between risk networks' patterns of crack cocaine and alcohol consumption and HIV-related sexual behaviors among adult injection drug users: a prospective study. *Drug Alcohol Depend*. 1996;42:175–181.
35. Russell DW, Booth B, Reed D, Laughlin PR. Personality, social networks, and perceived social support among alcoholics: a structural equation analysis. *J Pers*. 1997;65(3):649–692.
36. Unger JB, Chen X. The role of social networks and media receptivity in predicting age of smoking initiation: a proportional hazards model of risk and protective factors. *Addict Behav*. 1999;24(3):371–381.
37. Myers T, Millson M, Rigby J, Rankin J, Mindell W. Biographical characteristics of injection drug users and behavioral predispositions related to HIV prevention and drug use. *Can J Public Health*. 1994;85(4):264–268.
38. Gordon LW, Glantz MD, eds. *Individual Differences in the Biobehavioral Etiology of Drug Use*. NIDA Research Monograph 159. Washington, DC: US Government Printing Office; 1996.
39. Tomas JM, Vlahov D, Anthony JC. Association between intravenous drug use and misbehavior. *Drug Alcohol Depend*. 1990;25:79–89.
40. Luthar SS, D'Avanzo K. Contextual factors in substance use: a study of suburban and inner-city adolescents. *Dev Psychopathol*. 1999;11(4):845–867.
41. Galea S, Vlahov D. Social determinants and the health of drug users: the role of socioeconomic status, homelessness and incarceration. *Public Health Rep*. 2002;117(suppl 1):S135–S145.
42. Scribner R, Cohen D, Kaplan S, Allen SH. Alcohol allocation and homicide in New Orleans: conceptual considerations for small area analysis of the effect of alcohol outlet density. *J Stud Alcohol*. 1999;60:310–316.
43. Diez-Roux AV, Link BG, Northridge ME. A multi-level analysis of income inequality and cardiovascular disease risk factors. *Soc Sci Med*. 2000;50:673–687.
44. Waterston A. *Street Addicts in the Political Economy*. Philadelphia, PA: Temple University Press; 1993.
45. Kaplan GA. What is the role of the social environment in understanding inequalities in health? *Ann NY Acad Sci*. 1999;896:116–119.
46. Sinay T. Access to quality health services: determinants of access. *J Health Care Finance*. 2002;28(4):58–68.
47. Seaman SR, Brett RP, Gore SM. Mortality from overdose among injecting drug users recently released from prison: database linkage study. *BMJ*. 1998;316:426–428.
48. Chaloupka FJ, Grossman M, Saffer H. The effects of price on alcohol consumption and alcohol-related problems. *Alcohol Res Health*. 2002;26(1):22–34.
49. Caetano R, Clark CL. Trends in situational norms and attitudes toward drinking among whites, blacks, and Hispanics: 1984–1995. *Drug Alcohol Depend*. 1999;54(1):45–56.
50. Mitchell R, Gleave S, Bartley M, Wiggins D, Joshi H. Do attitude and area influence health? A multi-level approach to health inequalities. *Health Place*. 2000;6:67–79.
51. Logan TK, Schenck JE, Leukefeld CG, Meyers J, Allen S. Rural attitudes, opinions, and drug use. *Subst Use Misuse*. 1999;34(4–5):545–565.
52. Morenoff, JD, Sampson RJ. Violent crime and the spatial dynamics of neighborhood transition: Chicago, 1970–1990. *Soc Forces*. 1997;76(1):31–64.
53. Sloggett A, Joshi H. Deprivation indicators as predictors of life events 1981–1992 based on the UK ONS longitudinal study. *J Epidemiol Community Health*. 1998;52:228–233.

54. Sooman A, Macintyre S, Anderson A. Scotland's health—a more difficult challenge for some? The price and allocation of healthy foods in socially contrasting localities in the West of Scotland. *Health Bull.* 1993;51(5):276–284.
55. De La Rosa MR, White MS. A review of the role of social support systems in the drug use behavior of Hispanics. *J Psychoactive Drugs.* 2001;33(3):233–240.
56. Schroeder JR, Latkin CA, Hoover DR, Curry AD, Knowlton AR, Celentano DD. Illicit drug use in one's social network and in one's neighborhood predicts individual heroin and cocaine use. *Ann Epidemiol.* 2001;11(6):389–394.
57. Sinha R. How does stress increase risk of drug abuse and relapse? *Psychopharmacology (Berl).* 2001;158(4):343–359.
58. Kral AH, Bluthenthal RN, Lorvick J, Gee L, Bacchetti P, Edlin BR. Sexual transmission of HIV-1 among injection drug users in San Francisco, USA: risk-factor analysis. *Lancet.* 2001;5;357(9266):1397–1401.
59. Hoover DR. Power for T-test comparisons of unbalanced cluster exposure studies. *J Urban Health.* 2002;79(2):278–294.