Published in final edited form as:

J Epidemiol Community Health. 2009 April ; 63(4): 310–316. doi:10.1136/jech.2008.078048.

Substance use and behaviour disorders in Puerto Rican youth: a migrant family study

K R Merikangas¹, K P Conway², J Swendsen³, V Febo⁴, L Dierker⁵, W Brunetto⁶, M Stolar⁶, and G Canino⁴

¹ Intramural Research Programme, National Institute of Mental Health, Bethesda, Maryland, USA

² Division of Epidemiology, Services, and Prevention Research, National Institute of Drug Abuse, Bethesda, Maryland, USA

³ National Center for Scientific Research (CNRS UMR 5231), Bordeaux, France

⁴ University of San Juan, San Juan, Puerto Rico

⁵ Department of Psychology, Wesleyan University, Middletown, Connecticut, USA

⁶ Department of Epidemiology and Public Health, Yale University School of Medicine, New Haven, Connecticut, USA

Abstract

Background—Hispanics in the USA have higher rates of substance use disorders than similar ethnic groups residing in Latin American nations, and recent evidence suggests an increase in substance use among US Hispanic youth. This investigation examines the familial and societal correlates of this increase by comparing Puerto Rican families residing in the mainland USA and Puerto Rico.

Methods—Using migrant and controlled family study methods, 279 probands in San Juan and 236 probands in New Haven were recruited from treatment clinics and the general community to compose four diagnostic groups: drug abuse/dependence; alcohol abuse/dependence; psychiatric controls; unaffected controls. 806 biological offspring aged 12–17 were then directly interviewed.

Results—Total rates for alcohol use were greater among San Juan Youth than their migrant counterparts. By contrast, US migrant adolescents were more likely to use cannabis. A strong association was observed between parental and child substance use at both sites, particularly for boys, and offspring of probands with drug use disorders were at greatest risk for substance use and related disorders. Familial aggregation patterns did not vary substantially by site.

Conclusions—Despite societal influences on the magnitude and patterns of substance use in migrant youth, the consistent influence of parental disorders across sites reveals that the cross-generational transmission of substance use disorders in prior studies extends to Hispanic families and is an important factor to consider in the development of prevention strategies.

Correspondence to: Dr J Swendsen, CNRS 5231, 146 rue Léo Saignant, Bordeaux 33076 France; Joel.Swendsen@u-bordeaux2.fr.

Competing interests: None declared.

Ethics approval: Ethics committee approval from Yale University School of Medicine, USA.

Disclaimer: The views and opinions expressed in this report are those of the authors and should not be construed necessarily to represent the views of any of the sponsoring agencies, or the US government. This work was carried out at the Yale University School of Medicine and the University of Puerto Rico Behavioral Sciences Research Institute, and was completed before Dr Conway worked at the National Institutes of Health.

Comparisons of general population samples of adolescents from the island of Puerto Rico and the mainland USA have shown higher rates of substance use disorders among US youth.¹ Such findings are consistent with observations from other Puerto Rican, Mexican and South American samples, indicating lower rates of substance-related problems in the country of origin than corresponding ethnic groups born in the USA.^{2–8} These differences generally have been most visible in comparisons between countries, as analyses of US residents themselves demonstrate equivalent or lower rates of substance use disorders for Hispanics than for non-Hispanic white people.^{9–10} However, recent studies have indicated an alarming over-representation of Hispanic adolescents among those who use alcohol and drugs in the USA,¹¹ a trend that may be of particular concern for Puerto Ricans, who have higher rates of substance use disorders than other US Hispanic groups.¹² In addition, substance use in adolescence is strongly associated with the risk of behavioural disorders and delinquency,¹³ problems that further exclude youth from educational opportunities and that perpetuate social adversity.

Societal influences may interact with a multitude of individual or familial risk factors in the expression of substance use disorders. In particular, parental history of psychopathology is known to exert powerful influences on the unfolding of drug use in offspring.^{15–19} While familial transmission may reflect biological or genetic factors underlying the development of substance use and comorbid behaviour disorders,^{20–21} it may also result from disturbed social environments and modelling of dysfunctional parental behaviours.²² In particular, familial environments and social resources are often disrupted during migration, and this phenomenon has been hypothesised to be one mechanism through which migrant youth may have an increased propensity to these disorders.^{11–23} However, this possibility cannot be adequately studied without simultaneous knowledge of the familial vulnerabilities to psychopathology and migration status of samples investigated.

The present study integrates migrant and controlled family study designs to examine substance use, abuse and dependence among adolescent offspring of island and mainland Puerto Rican probands meeting criteria for substance dependence or other psychiatric disorders. The chief aims are (1) to assess the extent to which patterns of substance use and behaviour disorders differ as a function of migration status; (2) to investigate whether differences among island and mainland Puerto Rican youth may be attributable to differences in the aggregation of psychopathology in migrant and non-migrant families and (3) to examine the extent to which the prevalence of substance use and behaviour disorders differ by offspring gender and parental psychopathology.

Method

Participants

The sample of probands comprises self-identified Puerto Rican adults who either reside in the standard metropolitan area of San Juan (Puerto Rico) or have migrated to New Haven (Connecticut) after living on the island for at least 5 years during childhood. Probands were eligible if they had offspring between ages 12 and 17, and provided consent to interview themselves, their offspring, spouse/co-parent, and other household members. Probands were excluded if they showed evidence of psychosis or organic brain disorder. These criteria yielded 279 probands from San Juan and 236 probands from New Haven, who were interviewed with the *Composite International Diagnostic Interview* (CIDI, version 2.1),²⁴ and placed into one of four hierarchical diagnostic groups lifetime history of disorder according to the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-IV)²⁵: (1) drug abuse or dependence (regardless of alcohol, mood or anxiety disorders); (2) alcohol abuse or dependence (regardless of mood or anxiety disorders); (3) major depression, dysthymia, bipolar disorder, panic disorder with or without agoraphobia, agoraphobia, generalised anxiety disorder, social phobia,

post-traumatic stress disorder, three or more specific phobias, or antisocial personality disorder; (4) no disorder. A total of 806 biological offspring (424 from San Juan; 382 from New Haven) aged 12–17 were interviewed directly using the *Computerised Diagnostic Interview for Children* (DISC, version 4).²⁶ The demographic characteristics of the probands and offspring, by site and by proband diagnostic group, are presented in table 1.

Proband recruitment procedures

In the goal of reducing biases associated with treatment-seeking samples and improving the generalisation of results, the probands from both sites were recruited from clinic (public outpatient substance abuse and/or mental health facilities) and community sources. The New Haven site recruited 99 (42%) probands from nine clinics in areas with high concentrations of Latino residents as identified by the 1990 US census. The San Juan site recruited 115 (41%) probands from 11 clinics located within the San Juan metropolitan area, including the Veterans Affairs hospital. Identical recruitment procedures were used to identify probands from clinics at both sites, including calling potential participants from a clinic-provided list of clients, recruiting through clinic caseworkers and by posting advertisements within clinics. The remaining probands from New Haven (n= 137) and San Juan (n=164) were recruited from the general community. Specifically, households from neighbourhoods inhabited by the clinic-recruited probands were visited door-to-door by recruiters who ascertained eligibility of potential probands and their family members. These neighbourhoods were located predominantly in low-income areas.²⁷ Community recruitment strategies were adjusted throughout the enrolment process to enhance identification of eligible probands and to balance the proportion of clinic and community probands within each diagnostic group. At the New Haven site, 264 (97.4%) of 272 contacted households were occupied by residents who identified themselves as Puerto Rican, of which 139 (53%) met eligibility criteria and 137 (98.6%) participated. In San Juan, 1902 households were listed, of which 315 (16.6%) were eligible. A total of 111 households were then eliminated in order to balance clinic and community probands by gender or because the specified quota for each of the categories investigated had been fulfilled. Of the remaining 204 eligible households, 164 (80.3%) participated.

Interview procedures

After providing informed consent, all adults and children aged 12–17 residing in the household for at least 6 months were interviewed face-to-face in the respondent's home or at the research centre by Puerto Rican lay interviewers. All participants were given a choice of being interviewed in English or Spanish. Several quality control procedures were established to maximise the integrity of the data-gathering process: (1) selection of highly qualified interviewers who completed a detailed training programme, (2) audio-taping of interviews and randomly selecting 25% for review to verify adherence to the training instructions and to assess completeness of data, and (3) holding regular meetings to evaluate interviewers, provided feedback, review cases and address questions of interviewers.

Adult assessment

A computerised version of the CIDI 2.1²⁶ was administered to all individuals over age 17 living in the selected household, including the proband, spouse, adult offspring, other adults residing in the home for at least 6 months, and ex-partners who had biological children with the proband but who were not living in the household. The CIDI is a structured diagnostic instrument administered by trained lay interviewers that produces diagnoses according to DSM-IV²⁵ and ICD-10.²⁸ Seven clinical modules were administered at both sites: nicotine dependence, phobic states and other anxiety disorders, depression and dysthymia, mania and bipolar disorder, post-traumatic stress disorder, alcohol abuse/dependence and drug abuse/dependence. Both sites

added the antisocial personality disorder module from the Diagnostic Interview Schedule (DIS).²⁹ The CIDI has been documented to have high levels of diagnostic coverage, test-retest and procedural reliability, and validity.^{30–32} The reliability and validity of the DIS for use in the Puerto Rican adult population has also been previously established.³³

Child assessment

Psychiatric disorders in children 12–17 years of age were assessed using the computerised fourth version of the DISC²⁶, which generates diagnoses based on DSM-IV and ICD-10. The DISC has been tested in English- and Spanish-speaking samples.^{34–37} Both sites administered the parent (DISC-P) and youth (DISC-Y) versions. The DISC-P was administered to the primary caretaker of participating children and assessed social phobia, specific phobia, panic disorder, agoraphobia, generalised anxiety disorder, major depressive disorder/dysthymia, attention deficit hyperactivity disorder and oppositional defiant disorder. For these sections, the Puerto Rico site administered only the whole life module, whereas the New Haven site administered the past-year module and, if past-year psychopathology was negative, the whole life module as well. In addition, the Puerto Rico site assessed lifetime anorexia/bulimia, conduct disorder and separation anxiety disorder, and the New Haven site assessed past-year alcohol use disorders, conduct disorder, nicotine dependence, other substance use disorders and post-traumatic stress disorder. The DISC-Y sections included all of these disorders with the exception of anorexia/bulimia. A confidential self-report questionnaire was also administered to adolescents. Modified from the Monitoring the Future study³⁸ this measure assessed current, past year, and lifetime drug and alcohol use.

Statistical methods

For continuous variables, analysis of variance was used to test for differences between group means and to examine statistical interactions. For categorical variables, χ -square tests and logistic regression with site-by-proband group interaction terms were used to test for significant differences between proportions. Logistic regression was used to estimate the association between migration status and disorders in relatives and biological offspring. Our ability to ascribe differences in a given outcome to migration effects rather than selection biases depends on the degree to which the San Juan and New Haven probands are equivalent on relevant factors associated with migration status and the outcome measures. We therefore used propensity score stratification^{39 40} to enhance the comparability of the two groups.

The models on which these results are based include dichotomous variables for the proband group membership (ie, drug 0/1, alcohol 0/1, psych 0/1). To apply these methods, logistic regression was performed on the data in which the dependent variable was a dichotomous indicator of San Juan versus New Haven residence (ie, 0 = San Juan, 1 = New Haven). Predictor variables were potential confounders of the association between migration status and the outcomes of proband age, sex, source (clinic vs community), marital status, income (over/under \$10 000 per year), education (high school completed, yes/no), employment status (employed vs not) and family size (less than four, four, more than four household members). The propensity score used for each proband was the linear predictor resulting from the logistic regression model. Based on their scores, the probands were then partitioned into five⁴¹ strata by quintiles. These strata are homogeneous within levels and heterogeneous between levels, and represent increasing levels of similarity to San Juan multivariate profiles on the above covariates. To determine whether the stratification had effectively balanced the potential confounders between the two sites within the five strata, univariate t-tests for continuous variables and χ -square tests for categorical variables were used.³⁹ No significant differences accrued. Biological offspring were assigned to the same quintile as their index proband. These group assignments were then included in a logistic regression model to estimate the effect of

migration status on outcome measures, controlling for relative covariates and proband selection bias.

Finally, a normally distributed random effect to account for possible dependence of outcomes within families was entered into the logistic model. The SAS NLMIXED⁴² procedure was used to compute the parameter estimates of the model. The random effect at the family (proband) level assumes that each family has its own unobserved constant level of liability which induces correlation among observations within families. Conditional ORs are estimated for migration risk and covariate effects, that is, ORs that are adjusted for the unobserved heterogeneity of familial risk, and thus the homogeneity within families.⁴³

Model: p_{ij} = probability that person i in family j has outcome

$$\text{logit}(p_{ij}) = \beta_0 + \sum_{h=1}^r \beta_h \times_{hij} + u_{0j} \quad \text{with} \quad u_{0j} \sim N(0, \sigma_u^2)$$

Results

Demographic characteristics

Table 1 presents the demographic characteristics of New Haven and San Juan probands and their child offspring. Although these demographic characteristics were generally similar across sites, there were significant site-by-proband group interactions for sex and age in specific proband groups. These demographic and social differences were therefore controlled in all subsequent analyses.

Substance use and behaviour disorders among child offspring by parent proband group

Table 2 presents the 12-month prevalence rates of behavioural disorders, substance use and substance abuse/dependence among offspring by site and by proband diagnostic group. Concerning main effects by site for substance use and disorders assessed through structured interviews, the overall rates for alcohol use were greater in San Juan than in New Haven. By contrast, New Haven adolescents were more likely to use marijuana. No significant differences were found across sites concerning diagnoses of alcohol and drug abuse or dependence, and no differences were observed for behaviour disorders.

Regarding the main effect of parent proband group, offspring of all affected parent proband groups had greater substance use of any type, as well as greater rates of alcohol use disorders and substance use disorders than those of controls (no significant difference was found specifically for drug use disorders). Offspring of parents with drug abuse had significantly more nicotine use and alcohol use than those of parents with alcohol use disorders, and more alcohol use, nicotine use and marijuana use than offspring of parents with psychiatric disorders. Similar to the lack of main effect by site, no overall differences were observed by proband group concerning the prevalence of behavioural disorders.

Table 2 also presents results for the association between parental disorder and site using confidential questionnaire data. Children of affected parents reported higher levels of use of all three substances considered here. The rates of substance use were generally greater based on the confidential questionnaire than direct interviews, but the pattern of results across sites and by proband groups was highly similar to the diagnostic interview.

The 1-year prevalence rates of behaviour disorders and substance use and disorders in offspring by sex and parent proband group are presented in table 3. Based on clinical interviews, males

had greater rates of nicotine use, alcohol and substance abuse/dependence and behavioural disorders than females. Males also had greater nicotine use and a trend towards greater rates of marijuana use as measured by self-report. Although the sex difference was generally consistent across sites, male offspring of parents with psychiatric disorders in Puerto Rico had higher rates than those in New Haven (sex $\times$ proband group $\times$ site interaction, $p < 0.05$).

Discussion

Contrary to previous investigations of Hispanic groups that reported lower rates of substance use in countries of origin than in the US,^{2–8} the overall rates of substance use were actually higher among island than mainland youth (50.1% vs 36.7%). While this difference was unexpected, it is attributable mainly to greater alcohol use among island Puerto Rican children, a finding that has been previously reported.¹ By contrast, the greater rates of cannabis use among offspring of US migrants is a pattern that may be attributable in part to altered parenting practices or greater tolerance for the use of this substance in the mainland environment than in Puerto Rico.^{23 44 45} A strong association was also observed between parental and child substance use in both mainland and island Puerto Ricans. These results are consistent with prior controlled family studies of high-risk offspring,^{17 18} as well as with family history data concerning other Hispanic migrant populations.²³ However, the present findings are novel in demonstrating that the familial aggregation of these conditions is stable across ethnic subgroups and migration status.

There were also important differences in the magnitude of risk for substance use in offspring based on type of disorder in parents. Offspring of probands with drug abuse/dependence were particularly more likely to use substances and to meet criteria for substance use disorders than healthy controls. Significant sex differences were also observed, with an elevated risk for males of similar magnitudes for both sites. While sex differences in substance use disorders are well documented^{9 11} the present findings confirm that risks posed by male gender are largely unaffected by migration status. Finally, the majority of significant results was observed relative to substance use, and was largely attenuated for diagnoses of abuse or dependence. This finding likely reflects the young age of the sample, of which a portion may develop substance use disorders in subsequent years. Substance use and experimentation in adolescence nonetheless remains an important target for prevention, especially in populations characterised by increased social adversity.

In addition to the joint use of migrant and family study methodology, the strengths of the findings are that they are based on direct diagnostic interviews with both probands and offspring in their preferred language. The selection of proband groups from both clinic and community settings increased the representative nature of the samples, and the statistical analyses controlled for demographic differences across sites. However, several limitations of this investigation should be considered in interpreting the results. First, the analyses address only the general characteristics of familial aggregation or global migration effects, and numerous potentially important mediating and moderating factors were not examined. While diverse instruments and multiple informant strategies were used to minimise under-reporting of substance use, this potential bias cannot be excluded. Finally, the findings are based on Puerto Rican samples that may differ from other ethnic groups concerning risk and protective factors for these disorders. The findings nonetheless provide a context for cross-site comparability in a homogeneous ethnic group.

Future research of migrant samples may benefit from integrating family history in understanding the risk and protective factors for the development of substance use disorders. In this regard, the promotion of treatment and prevention programmes targeting vulnerable Hispanic populations has been slow. Some approaches have failed to show salient effects,⁴⁶

while others have demonstrated the efficacy of culturally sensitive techniques but only in treatment-seeking or delinquent samples.⁴⁷ A clear need exists for the expansion of intervention and prevention programmes for high-risk Hispanic youth, and in particular prior to the onset of behavioural and substance-related problems.

What is already known on this subject

- Consistent with findings from other Hispanic groups, Puerto Rican adolescents in the USA have been shown to have higher rates of substance use disorders than adolescents living in Puerto Rico.
- The reasons for this difference have been widely debated, as societal influences may interact with a multitude of individual or familial risk factors in the expression of substance use disorders.

What this study adds

- This study used a novel combination of methods to examine migration influences separately from family-based vulnerabilities to substance use disorders.
- The transmission of substance use disorders across generations was strong but did not vary markedly by migration status, thereby indicating that these familial vulnerabilities are unlikely to explain the increase in substance use in migrant populations.
- By contrast, the significant differences observed by migration status clarify the likelihood that societal and cultural factors play a key role in this phenomenon.

Acknowledgments

Funding: This work was supported in part by grants AA07080, DA09055, MH36197, and MH0049 (KRM) from the National Institutes of Health and the Intramural Research Program at the National Institute of Mental Health.

References

1. Warner LA, Canino G, Colón HM. Prevalence and correlates of substance use disorders among older adolescents in Puerto Rico and the United States: a cross-cultural comparison. *Drug Alcohol Depend* 2001;63:229–43. [PubMed: 11418227]
2. Aguilar, E.; Narvaez, A.; Samaniego, N. La farmaco-dependencia en el Ecuador. Ministerio de Salud Pública. UNFODAC; 1990.
3. Alegria M, Canino G, Stinson FS, et al. Nativity and DSM-IV Psychiatric Disorders Among Puerto Ricans, Cuban Americans, and Non-Latino Whites in the United States: results from the national epidemiologic survey on alcohol and related conditions. *J Clin Psychiatry* 2006;67:56–65. [PubMed: 16426089]
4. Canino G, Anthony JC, Freeman D, et al. Drug abuse and illicit drug use in Puerto Rico. *Am J Public Health* 1993;83:194–200. [PubMed: 8427322]
5. Grant BF, Stinson FS, Hasin DS, et al. Immigration and lifetime prevalences of DSM-IV psychiatric disorders among Mexican Americans and non-Hispanic whites in the United States: results from the National Epidemiologic Survey on Alcohol and Related Conditions. *Arch Gen Psychiatry* 2004;61:1226–33. [PubMed: 15583114]
6. Kandel DB, Davies M. High school students who use crack and other drugs. *Arch Gen Psychiatry* 1996;53:71–80. [PubMed: 8540779]
7. Sokol-Katz JS, Ulbrich PM. Family structure and adolescent risk-taking behavior: A comparison of Mexican, Cuban and Puerto Rican Americans. *Int J Addict* 1992;27:1197–1209. [PubMed: 1399160]

8. Vega WA, Alderete E, Kolody B, et al. Illicit drug use among Mexicans and Mexican American in California: the effects of gender and acculturation. *Addiction* 1998;93:1839–50. [PubMed: 9926572]
9. Kessler R, McGonagle K, Zhao S, et al. Lifetime and 12-month prevalence of DSM-III-R psychiatric disorders in the United States: Results from the National Comorbidity Survey. *Arch Gen Psychiatry* 1994;51:8–19. [PubMed: 8279933]
10. Gilman SE, Breslau J, Conron KJ, et al. Education and race-ethnicity differences in the lifetime risk of alcohol dependence. *J Epidemiol Community Health* 2008;62:224–30. [PubMed: 18272737]
11. Delva J, Wallace JM Jr, O'Malley PM, et al. The epidemiology of alcohol, marijuana, and cocaine use among Mexican American, Puerto Rican, Cuban American, and other Latin American eighth-grade students in the United States: 1991–2002. *Am J Public Health* 2005;95:696–702. [PubMed: 15798132]
12. Alegria M, Mulvaney-Day N, Torres M, et al. Prevalence of psychiatric disorders across Latino subgroups in the United States. *Am J Public Health* 2007;97:68–75. [PubMed: 17138910]
13. McClelland GM, Elkington KS, Teplin LA, et al. Multiple substance use disorders in juvenile detainees. *J Am Acad Child Adolesc Psychiatry* 2004;43:1215–24. [PubMed: 15381888]
14. Wilens TE, Biederman J, Abrantes AM, et al. Clinical characteristics of psychiatrically referred adolescent outpatients with substance use disorder. *J Am Acad Child Adolesc Psychiatry* 1997;36:941–947. [PubMed: 9204672]
15. Avenevoli, S.; Conway, KP.; Merikangas, KR. Familial risk factors for substance use disorders. In: Hudson, JL.; Rapee, RM., editors. *Current Thinking on Psychopathology and the Family*. Boston: Elsevier; 2005. p. 167-192.
16. McGue M, Elkins I, Iacono WG. Genetic and environmental influences on adolescent substance use and abuse. *Am J Med Genet* 2000;96:671–77. [PubMed: 11054776]
17. Merikangas KR, Avenevoli S. Implications of genetic epidemiology for the prevention of substance use disorders. *Addict Behav* 2000;25:807–20. [PubMed: 11125772]
18. Merikangas KR, Dierker LC, Szatmari P. Psychopathology among offspring of parents with substance abuse and/or anxiety disorders: a high-risk study. *J Child Psychol Psychiatry* 1998;39:711–20. [PubMed: 9690934]
19. Stallings MC, Cherny SS, Young SE, et al. The familial aggregation of depressive symptoms, antisocial behavior, and alcohol abuse. *Am J Med Genet* 1997;74:183–91. [PubMed: 9129721]
20. Hopfer CJ, Crowley TJ, Hewitt JK. Review of twin and adoption studies of adolescent substance use. *J Am Acad Child Adolesc Psychiatry* 2003;42:710–19. [PubMed: 12921479]
21. Stallings MC, Corley RP, Dennehey B, et al. A genome-wide search for quantitative trait Loci that influence antisocial drug dependence in adolescence. *Arch Gen Psychiatry* 2005;62:1042–51. [PubMed: 16143736]
22. Brook JS, Brook DW, de la Rosa M, et al. Pathways to marijuana use among adolescents: cultural/ecological, family, peer, and personality influences. *J Am Acad Child Adolesc Psychiatry* 1998;37:759–66. [PubMed: 9666632]
23. Vega WA, Sribney WM. Parental risk factors and social assimilation in alcohol dependence of Mexican Americans. *J Stud Alcohol* 2003;64:167–75. [PubMed: 12713189]
24. World Health Organization. Composite International Diagnostic Interview (CIDI, version 2.1). Geneva: World Health Organization; 1997.
25. American Psychiatric Association. Diagnostic and statistical manual of mental disorders. 4th. Washington DC: American Psychiatric Association; 1994.
26. Shaffer D, Fisher P, Lucas CP, et al. ENIMH Diagnostic Interview Schedule for Children Version IV (NIMH DISC-IV): description, differences from previous versions, and reliability of some common diagnoses. *J Am Acad Child Adolesc Psychiatry* 2000;39:28–38. [PubMed: 10638065]
27. US Bureau of the Census. US census of population and housing, 1990: summary population and housing characteristics. Washington: Government Printing Office; 1991.
28. World Health Organization. Tenth classification of mental and behavioral disorders: diagnostic criteria for research. Geneva: World Health Organization; 1992.
29. Helzer JE, Robins LN. The diagnostic interview schedule: its development, evolution, and use. *Soc Psychiatry Psychiatr Epidemiol* 1988;23:6–16. [PubMed: 3130671]

30. Cottler LB, Robins LN, Helzer JE. The reliability of the CIDI-SAM: a comprehensive substance abuse interview. *Br J Addict* 1989;84:801–14. [PubMed: 2758153]
31. Semler G, Wittchen HU, Joschke K, et al. Test-retest reliability of a standardized psychiatric interview (DIS/CIDI). *Eur Arch Psychiatry Neurol Sci* 1987;236:214–22. [PubMed: 3582430]
32. Wittchen HU. Reliability and validity studies of the WHO–Composite International Diagnostic Interview (CIDI): a critical review. *J Psychiatr Res* 1994;28:57–84. [PubMed: 8064641]
33. Canino G, Bird H, Shrout PE, et al. The Spanish Diagnostic Interview Schedule: reliability and Concordance with Clinical Diagnoses in Puerto Rico. *Arch Gen Psychiatry* 1987;44:720–26. [PubMed: 3498455]
34. Bravo M, Canino G, Rubio-Stipec M, et al. A cross-cultural adaptation of a diagnostic instrument: the DIS adaptation in Puerto Rico. *Cult Med Psychiatry* 1991;15:1–18. [PubMed: 2060311]
35. Bravo M, Ribera J, Rubio-Stipec M, et al. Test-retest reliability of the Spanish version of the Diagnostic Interview Schedule for Children (DISC-IV). *J Ab Child Psycho* 2001;29:433–44.
36. Jensen P, Roper M, Fisher P, et al. Test-retest reliability of the Diagnostic Interview Schedule for Children (DISC 2.1). Parent, child, and combined algorithms. *Arch Gen Psychiatry* 1995;52:61–71. [PubMed: 7811163]
37. Ribera JC, Canino G, Rubio-Stipec M, et al. The Diagnostic Interview Schedule for Children (DISC-2.1) in Spanish: reliability in a Hispanic population. *J Child Psychol Psychiatry* 1996;37:195–204. [PubMed: 8682899]
38. Pilgrim CC, Schulenberg JE, O'Malley PM, et al. Mediators and moderators of parental involvement on substance use: a national study of adolescents. *Prev Sci* 2006;7:75–89. [PubMed: 16572302]
39. D'Agostino RB. Propensity score methods for bias reduction in the comparison of a treatment to a non-randomized control group. *Stat Med* 1998;17:2265–81. [PubMed: 9802183]
40. Rosenbaum P, Rubin D. Reducing bias in observational studies using subclassification on the propensity score. *J Am Stat Assoc* 1984;79:516–24.
41. Cochran WG. The effectiveness of adjustment by subclassification in removing bias in observational studies. *Biometrics* 1968;24:295–313. [PubMed: 5683871]
42. Wolfinger, RD. SUGI, 24, paper 287. SAS Institute Inc; Cary NC: 1999. Fitting nonlinear mixed models with the new NLMIXED procedure.
43. Larsen K, Petersen JH, Budtz-Jørgensen E, et al. Interpreting parameters in the logistic regression model with random effects. *Biometrics* 2000;56:909–14. [PubMed: 10985236]
44. Vega WA, Sribney WM, Aguilar-Gaxiola S, et al. 12-month prevalence of DSM-III-R psychiatric disorders among Mexican Americans: nativity, social assimilation, and age determinants. *J Nerv Ment Dis* 2004;192:532–41. [PubMed: 15387155]
45. Szalay LB, Canino G, Vilov SK. Vulnerabilities and cultural change: Drug use among Puerto Rican Adolescents in the United States. *Int J Addict* 1993;28:327–354. [PubMed: 8463021]
46. Elder JP, Litrownik AJ, Slymen DJ, et al. Tobacco and alcohol use-prevention program for Hispanic migrant adolescents. *Am J Prev Med* 2002;23:269–75. [PubMed: 12406481]
47. Gil AG, Wagner EF, Tubman JG. Culturally sensitive substance abuse intervention for Hispanic and African American adolescents: empirical examples from the Alcohol Treatment Targeting Adolescents in Need (ATTAIN) Project. *Addiction* 2004;99:140–50. [PubMed: 15488112]

Table 1
Sociodemographic characteristics of probands and biological offspring by site and proband group

	New haven proband group					San Juan proband group						
	Drug n = 44	Alcohol n = 33	Psych n = 97	Control n = 62	Total n = 236	p Value [‡]	Drug n = 76	Alcohol n = 45	Psych n = 83	Control n = 75	Total n = 279	p Value [‡]
Probands												
Male (%)	45.5	24.2 ***	10.3 **	17.7	20.8 ***	<0.0001	61.8	77.8	7.2	28.0	39.1	<0.0001
Mean age (SD)	37.7* (5.9)	39.2*** (6.6)	39.6 (7.4)	37.9* (5.8)	38.7*** (6.6)	0.3067	40.5 (6.1)	43.3 (7.8)	40.3 (6.5)	40.6 (7.9)	40.9 (7.0)	0.0922
Single-headed home (%)	54.6	48.5	70.1	56.5	60.6***	0.0755	43.4	20.0	53.7	46.7	43.5	0.0020
Income<\$10 000 (%)	38.6	33.3	52.6	45.2	45.3**	0.1855	61.8	42.2	61.5	62.7	58.8	0.1111
Less than high school (%)	50.0	39.4 [‡]	47.4	41.9	45.3**	0.7244	27.6	44.4	28.9	29.3	31.2	0.2357
Employed (%)	31.8	63.6	38.1	53.2	44.5	0.0100	39.5	48.9	36.1	50.7	43.0	0.2195
Clinic recruited (%)	63.6	57.6	39.2	-	-	0.0138	59.2	62.2	37.4	-	-	0.0050
Biological offspring	(n = 74)	(n = 52)	(n = 157)	(n = 99)	(n = 382)		(n = 117)	(n = 64)	(n = 124)	(n = 119)	(n = 424)	
Mean number of offspring (SD)	1.68 (0.9)	1.58 (0.8)	1.62 (0.8)	1.60 (0.8)	1.62 (0.8)	0.9299	1.54 (0.7)	1.42 (0.6)	1.49 (0.7)	1.59 (0.8)	1.53 (0.7)	0.6979
Male (%)	35.1 *	51.9	49.7	56.6 *	49.0	0.0408	54.7	51.6	55.3	46.2	52.0	0.4819
Mean age (SD)	14.2 (2.1)	14.3 (2.1)	14.3 (2.1)	14.3 (2.0)	14.3 [‡] (2.0)	0.9461	14.6 (1.8)	14.4 (1.7)	14.7 (1.8)	14.4 (1.7)	14.5 (1.7)	0.5020

Site and site-by-proband group differences:

*** p<0.001

** p<0.01

* p<0.05

[‡] p<0.10.

[‡] Test for homogeneity within site.

Table 2
Substance use and behaviour disorders among offspring 12–17 by parent proband group and site

	Drug abuse/dependence (1)			Alcohol abuse/dependence (2)			Psychiatric disorder (3)			Controls (4)		Overall rates		Main effects	
	San Juan n = 117	New Haven n = 65	Total n = 182	San Juan n = 64	New Haven n = 49	Total n = 113	San Juan n = 123	New Haven n = 145	Total n = 268	San Juan n = 119	New Haven n = 91	Total n = 210	Total n = 773	Proband group	Site
Child interview															
Any behaviour Dx*	13.7	10.8	12.6	12.5	10.2	11.5	9.7	9.7	10.1	8.4	8.8	8.6	10.5	NS	NS
Substance use															
Any use	54.7	47.7	52.1	53.1	30.6	43.4	50.4	31.7	40.2	38.7	20.8	30.9	41.0	1, 2, 3 vs 4	SJ***
Nicotine	24.8	30.8	26.9	9.4	22.4	15.0	25.2	20.0	22.4	13.4	18.7	15.2	20.6	1, 2, 3 vs 4 1 vs 2	NS
Alcohol	54.7	47.7	52.2	51.6	22.4	38.9	49.6	29.7	38.8	37.0	18.7	28.6	39.2	1, 2, 3 vs 4 1 vs 2 1 vs 3	SJ***
Marijuana	12.8	20.0	15.4	4.7	24.5	13.3	8.9	13.1	11.2	4.2	9.9	6.6	11.3	1, 2, 3 vs 4	NH***
Disorders															
Any substance	6.0	7.7	6.6	1.6	4.1	2.7	6.5	5.5	6.0	3.4	1.1	2.4	4.7	1, 2, 3 vs 4	NS
Alcohol	4.3	4.6	4.4	1.6	0	0.9	4.9	2.8	3.7	0.8	0	0.5	2.6	1, 2, 3 vs 4	NS
Drug	2.6	7.7	4.4	0	4.1	1.8	3.3	4.1	3.7	2.5	1.1	1.9	3.1	-	NS
Child self-report															
<i>Substance use</i>															
Any use	55.2	60.9	56.6	45.3	50.0	46.9	55.3	42.5	48.5	42.9	36.3	40.0	47.9	1, 2, 3 vs 4	NS
Nicotine	26.7	34.4	29.1	10.9	25.0	16.8	24.4	19.2	21.6	15.1	19.8	17.1	21.5	1, 2, 3 vs 4 1 vs 2 1 vs 3	NS
Alcohol	54.3	56.3	54.4	45.3	43.8	44.2	50.4	40.4	45.1	39.5	31.9	36.1	44.8	1, 2, 3 vs 4	NS
Marijuana	9.5	26.6	15.4	3.1	20.8	10.6	4.1	10.3	7.4	5.0	13.2	8.6	10.1	1, 2, 3 vs 4 1 vs 3	NH***

* Includes conduct disorder, attention deficit disorder, oppositional defiant disorder.

 p<0.001.

Table 3

	Parent proband group											
Child interview	Drug abuse/dependence		Alcohol abuse/dependence		Psychiatric disorder		Control		All		Total	Sex
	Male n = 87	Female n = 95	Male n = 58	Female n = 55	Male n = 138	Female n = 130	Male n = 105	Female n = 105	Male n = 388	Female n = 385		
Any behaviour Dx [†]	13.8	11.6	13.8	9.1	12.3	7.7	12.4	4.8	12.9	8.1	10.5	M*
Substance use												
Any substance	55.1	49.5	48.3	38.2	44.9	35.4	33.3	28.6	44.6	37.4	41.0	§
Nicotine use	31.0	23.2	13.8	16.4	27.5	16.9	17.1	12.8	23.4	17.7	20.6	M*
Alcohol use	55.2	49.5	44.8	32.7	44.2	33.1	31.4	25.7	43.2	35.0	39.2	§
Drug use	16.0	14.7	15.5	10.9	13.8	8.5	5.7	7.6	12.4	10.1	11.3	-
Disorders												
Any substance	8.0	5.3	3.4	1.8	8.7	3.1	2.9	1.9	6.2	3.1	4.7	M*
Alcohol	4.6	4.2	1.7	0.0	6.5	0.8	1.0	0.0	2.8	1.3	2.6	M*
Drug	4.6	4.2	1.7	1.8	5.1	2.3	1.5	1.9	3.6	2.6	3.1	-
Child self-report	(n = 87)	(n = 93)	(n = 57)	(n = 55)	(n = 139)	(n = 129)	(n = 107)	(n = 103)				
Substance use												
Any use	59.7	54.8	45.6	49.0	50.3	46.5	43.0	36.8	50.0	45.6	47.9	-
Nicotine	33.3	25.8	17.5	16.4	27.3	15.5	17.8	16.5	24.7	18.2	21.5	M*
Alcohol	57.4	52.7	43.9	45.5	45.3	45.0	40.2	32.0	46.4	42.9	44.8	-
Marijuana	17.2	14.0	10.5	10.9	10.8	3.9	8.4	8.7	32.2	8.6	10.1	M†

[§]Interaction between sex and proband group ($p<0.05$): significantly higher rates among male offspring of parents with psychiatric disorders in Puerto Rico vs New Haven.