CRYSTAL M. FULLER, PHD ■ DAVID VLAHOV, PHD
AMELIA M. ARRIA, PHD ■ DANIELLE C. OMPAD, MHS
RICHARD GARFEIN, PHD ■ STEFFANIE A. STRATHDEE, PHD

Factors Associated with Adolescent Initiation of Injection Drug Use

Dr. Fuller is an Assistant Professor, Department of Epidemiology, Mailman School of Public Health, Columbia University, New York. She is also an Investigator with the Center for Urban Epidemiologic Studies, New York Academy of Medicine. At the time of this study, she was Project Director, Collaborative Injection Drug Users Study (CIDUS-2), Baltimore site. Dr. Vlahov is Director, Center for Urban Epidemiologic Studies, New York Academy of Medicine, New York. At the time of this study, Dr. Fuller also was a doctoral candidate, and Dr. Vlahov was a Professor, Infectious Disease Program, Department of Epidemiology, Johns Hopkins University Bloomberg School of Public Health (JHUBSPH), Baltimore; Dr. Vlahov was also principal investigator of CIDUS-2. Dr. Arria is Deputy Director, Center for Substance Abuse Research, University of Maryland, College Park. At the time of this study, Dr. Arria was also an Assistant Scientist with the Department of Mental Hygiene, JHUBSPH. Ms. Ompad and Dr. Strathdee are with the Infectious Disease Program, Department of Epidemiology, JHUBSPH. Ms. Ompad is a doctoral candidate, and Dr. Strathdee is an Associate Professor and serves as the current principal investigator of CIDUS-2. Dr. Garfein is a Project Officer, National Center for HIV, STD, and TB Prevention, Division of HIV/AIDS Prevention, CDC, Atlanta.

SYNOPSIS

Objective. The purpose of this study was to evaluate the extent to which demographic, sexual, and non-injection drug use practices predict adolescent initiation of injection drug use.

Methods. Street recruited injection drug users 15–30 years of age in Baltimore, Maryland, who initiated injection within five years of study enrollment, completed a questionnaire that included a year-by-year history regarding the five years prior to initiation of injection. Factors associated with initiation during adolescence (≤21 years of age) versus young adulthood (>21) were determined using logistic regression.

Results. Of 226 participants, most were female (61%) and African American (64%). Median age of participants was 25; median age at initiation of injection was 23. Factors significantly associated with adolescent initiation in multivariate analysis included race other than African American, and practices prior to initiating injection including condom use, lack of cocaine use, exclusive crack smoking just prior to initiation, and smoking marijuana. Adolescent initiates also had shorter durations of illicit drug use prior to initiating injection.

Conclusion. Short-term non-injection drug use, particularly exclusive crack smoking, was associated with adolescent initiation of injection drug use. Early prevention efforts targeting this high-risk group of younger drug users are warranted in order to delay or prevent onset of injection drug use.

Address correspondence to:
Dr. Fuller, Mailman School of Public Health, PH18-120, Columbia Univ., 622 W. 168th St., New York NY 10032; tel. 212-305-6223; fax 212-305-9413; e-mail <cf317@columbia.edu>.

Injection drug use continues to be a major risk factor for acquisition of human immunodeficiency virus (HIV), hepatitis B virus (HBV), and hepatitis C virus (HCV).[1-9] Cohort studies conducted among injection drug users (IDUs) have indicated that younger (≤21 and ≤35 years of age) age and short-term injection drug use are risk factors for HIV infection.[1,2,10,11] Cross-sectional studies have consistently shown younger ages (≤21 and ≤35 years of age) to be independently associated with HIV seroprevalence as well as high-risk injection practices.[12-15]

Among the few cross-sectional studies conducted among young or newly initiated IDUs, both high-risk sexual practices (such as trading sex for money or drugs, having multiple sex partners, men having sex with men) and injection practices (injecting cocaine or speedball or sharing injection equipment within a high-risk network, for example) have been found to be independently associated with HIV seroprevalence.[19,20] These studies have emphasized the need for more comprehensive research among young or newly initiated IDUs so that timely intervention and prevention programs may be implemented.[3,16-18,21,22]

Because transmission of HIV, and particularly HCV, occurs soon after initiation of injection (often within the first two years), only a brief window of opportunity exists to intervene and prevent infection.[6,8,9] Although IDUs typically initiate injection drug use during late adolescence, a sizable subgroup begins injecting during early and late adulthood.[15,16,18,23] With one exception,[18] among the few studies that have described the differences between younger and older initiates with respect to HIV risk behavior it is younger initiates who have reported higher levels of sexual and injection risk behaviors.[15-17] Previous researchers have noted that it is plausible that a strong association exists between initiation of injection drug use and early non-injection drug use or sexual behaviors prior to initiation.[16] Thus, specific risk behaviors found to be more common among adolescent initiates might be targeted for specific interventions that might decrease the acquisition of HIV, HBV, and HCV infection.

We recruited adolescent and young adult IDUs between the ages of 15 and 30 in Baltimore, Maryland, and collected year-by-year histories of sexual and drug use practices up to five years prior to initiation of injection to study entry. The purpose of this study was to evaluate the extent to which demographic, sexual, and non-injection drug use practices differentiate adolescent versus young adult initiation of injection drug use.

METHODS

Study population. Between July 1997 and May 1999, 276 adolescent and young adult IDUs were recruited into a prospective study of HIV infection (Risk Evaluation and Assessment of Community Health—REACH II) through extensive community-based street outreach in Baltimore. Experienced outreach workers who engaged young drug users on the street served as the primary method of recruitment for this study. The outreach team posted flyers in various settings such as youth shelters, treatment centers, emergency rooms, public health clinics, the Baltimore City Needle Exchange Program, and neighborhoods with vacant buildings. Participants were also recruited through word of mouth. Since adolescent and young adult IDUs tend to be difficult to locate, a recreational vehicle (mobile clinic) was used to enhance accessibility to this hidden population. The REACH II van parked in various areas with high drug activity in the city and was used to recruit, enroll, and interview study participants. A stationary clinic site in East Baltimore also operated daily in conjunction with the mobile clinic. Participants were compensated $15 for their time spent during the baseline study visit.

To be eligible for the study, participants had to be 15 to 30 years of age (verified by photo identification), to have injected drugs no more than 5 years before study entry, and to report injecting at least once in the 6 months prior to study entry. Injection status was verified by presence of "stigmata," or track marks. If without visible stigmata, participants were enrolled only if their reported injection history was less than one year and frequency of injection was less than one time per week. During this study, non-IDUs (crack smokers, and intranasal heroin or cocaine users) were enrolled simultaneously to reduce the incentive to fabricate an injection history simply to obtain study entry for the associated remuneration. Participants who reported a history of injection at the baseline visit and subsequently reported having no lifetime history of injection at a follow-up visit were excluded from the analysis. Of 276 screened IDUs, 226 (82%) were considered eligible and were included in the final analysis.

The Institutional Review Board of the Johns Hopkins School of Public Health (Committee on Human Research) approved this study. An active community advisory board (CAB) was established that consisted of community leaders from community-based organizations and social services agencies. The REACH II CAB facilitated development of referral protocols and recruitment strategies.

Adolescent crack smokers transition relatively quickly from a short period of exclusive crack smoking to a brief period of other non-injection drug use (heroin or cocaine, for example), and subsequently to injection drug use.

Data collection. After participants were screened for eligibility (by the outreach worker during the recruitment phase and by the interviewer during the enrollment phase), informed consent was obtained and a structured interview was administered privately by a trained interviewer. The baseline interview covered topics that included demographics, drug use, injection, and sexual practices. In addition to characteristics measured as "ever" having occurred and those occurring during the six months preceding study entry, we obtained year-by-year histories of specific sexual (condom use and trading sex, for example) and drug use practices (such as frequency of marijuana, alcohol, heroin, cocaine, and crack use). The histories spanned the five years prior to initiation of injection use up to the study entry date, using an interviewer strategy described elsewhere.[24,25] In brief, these histories began with prevalence measures of behaviors occurring in the most remote period (five years prior to initiation) and moved forward in time to the most recent period (one year prior study entry).

Due to the event of unequal time periods among participants from initiation of injection drug use to study entry, duration of injection use was controlled in the final analysis.

Data analysis. Variables explored as potential correlates of adolescent initiation (≤21 years of age) of injection drug use compared with initiation among young adults (>21 years of age) included demographic characteristics such as sex, race or ethnicity, duration of injection drug use, source of income, and juvenile arrest. Most of the study sample was comprised of either African American (64%) or white (31.4%) participants, which also reflects the racial make-up of the general population of Baltimore. The fewer than 5% reporting Hispanic or other ethnicity were combined with the white category to create an African American versus non-African American variable so that similar comparisons across previous studies can be made. We examined current sexual practices, including sex with an IDU and multiple sex partners (three or more sex partners within the six months prior to study entry).

Pre-initiation sexual practices included age at first sexual experience, having been raped or sexually assaulted, trading sex for drugs or money, and lack of condom use during the year prior to initiation of injection. A lifetime measure of having had sex with an injection drug user and having had current multiple sex partners (in past six months) were also explored. Pre-initiation drug use practices included use of alcohol, marijuana, inhalants, hallucinogens, heroin, crack, and cocaine. With the exception of hallucinogens and inhalants, each drug was measured using the year-by-year history described above. Although alcohol use was measured through the year-by-year history, a lifetime alcohol variable was not measured.

Each drug use practice was subdivided into three variables of differing time periods: (*a*) a broad time period defined as having "ever used prior to initiation of injection"; (*b*) a more refined time period defined as "used any time in the two years prior to initiation of injection"; and (*c*) a refined and specific time period defined as "used during year one or year two prior to initiation of injection." To be conservative, we did not consider those who reported first use of a specific drug type during the same year of initiation as having used that particular drug type *prior* to initiation. For example, participants reporting both first use of crack cocaine and first injection at age 18 were not considered as having used crack prior to initiation since it was uncertain whether the crack use actually preceded the first injection during that year. Thus, non-injection drug use practices preceding initiation may be slightly underestimated in this analysis. This approach was also employed when considering sexual practices.

To compare factors associated with initiation of injection among adolescents versus young adults, we performed simple descriptive statistical tests for all variables of interest. Where continuous data were skewed, medians and ranges rather than variable means were used. Continuous data were dichotomized, when appropriate, using natural cut-points unless the data suggested more

meaningful cut-points. For example, although the median age of initiation was 23, age 21 was used as the cut-point to distinguish adolescence from young adulthood, as defined by the American Medical Association and the American Academy of Pediatrics. We conducted bivariate analyses of contingency tables of exposure variables by adolescent initiation using chi-square tests and Mantel-Haenszel odds ratios to test the strength of the association. We conducted t-tests for differences between sample means. Variables that were significant at the 5% level in bivariate analyses were entered into multivariate models to determine the independent effect of each variable of interest on the initiation of drug use during adolescence. Formal tests of interactions were performed.

RESULTS

Of the 226 IDUs enrolled in the REACH II Study, the median age at study entry was 25 (range 15–30 years of age) and at initiation of injection was 23 (range 10–30 years of age), with 91 (40%) IDUs initiating drug use during adolescence. More than half the study sample was African American (64%), female (61%), and had been injecting for two years or less at study entry (61%) (Table 1). Adolescent initiates were less likely than young adult initiates to be female (odds ratio = 0.58), African American (odds ratio = 0.19), and to have reported injecting for two years or less (odds ratio = 0.19). Adolescent initiates were more likely than young adults to report spending time in juvenile arrests (odds ratio = 2.44) and more likely to report "street survival" (defined as trading sex, selling drugs, theft, or panhandling) as their primary source of income in the past six months (odds ratio = 2.13).

In terms of sexual practices (Table 2), adolescent initiates were significantly more likely than young adults to report having their first sexual experience prior to age 14 (odds ratio = 2.18) and to having multiple sex partners in the six months prior to study entry (odds ratio = 1.88). Although a lower proportion of adolescent initiates (31.3%) than young adults (43.8%) reported ever having

Table 1. Demographic characteristics associated with adolescent initiation of injection drug use among recently initiated IDUs in Baltimore, using logistic regression, 1997–1999 (N = 226)

Characteristic	*Number*	*Percent*	*Initiated at age ≤21 years (n = 91) Percent*	*Odds ratio*	*95% CI*
Duration of injection prior to enrollment?					
≤2 years	138	61	31.2	0.19	0.10, 0.34
3–5 years	88	39	54.6	1.00	
Race/Ethnicity					
African American	145	64	26.2	0.19	0.10, 0.34
White or Other[a]	81	36	65.4	1.00	
Sex					
Female	137	61	35.0	0.58	0.34, 0.99
Male	89	39	48.3	1.00	
Juvenile arrest					
Yes	45	20	57.8	2.44	1.27, 4.75
No	181	80	35.9	1.00	
Source of income[b]					
Street survival[c]	104	46	50.0	2.13	1.24, 3.66
Public assistance/job/none	122	54	32.0	1.00	

[a]Includes White (31.4%), Hispanic (1.8%), Native American (1.8%), and Other race/ethnicity (0.9%)
[b]In the six months prior to study enrollment
[c]Includes trading sex for money or drugs, selling drugs, theft, or pan handling

CI = confidence interval

Table 2. Current and pre-initiation sexual practices associated with adolescent initiation of injection drug use among recently initiated IDUs in Baltimore, using logistic regression, 1997–1999 (N = 226)

Characteristic	*Number*	*Percent*	*Initiated at ≤21 years of age (n = 91) Percent*	*Odds ratio*	*95% CI*
Age at first sex					
<14 years	96	42	51.1	2.18	1.27, 3.76
≥14 years	130	58	32.3	1.00	
Sex with an injection drug user					
Ever	64	28	31.3	0.58	0.32, 1.08
Never	162	72	43.8	1.00	
Multiple sex partners[a]					
≥3 sex partners	82	36	50.0	1.88	1.08, 3.28
<3 sex partners	144	64	34.7	1.00	
Rape or sexual assault prior to initiation					
Yes	29	13	32.4	0.67	0.32, 1.41
No	197	87	41.8	1.00	
Traded sex one year prior to initiation					
Yes	48	21	37.5	0.86	0.45, 1.66
No	178	79	41.0	1.00	
Condom use one year prior to initiation					
Yes	149	66	45.6	1.97	1.10, 3.54
No	77	34	29.9	1.00	

[a]In the six months prior to study enrollment

CI = confidence interval

sex with an injection drug user, these differences were not statistically significant. For pre-initiation sexual practices, adolescent initiates were more likely than young adults to report condom use within one year prior to initiation (odds ratio = 1.97). There was no significant difference between adolescent and young adult initiates in proportions of those who reported trading sex one year prior to initiation or those who had experienced forced sex.

Regarding average length of time from first use of non-injection drugs to initiation of injection, adolescent initiates had significantly shorter durations (5.2 years) than young adult initiates (10.6 years) for smoking marijuana, inhalant use (4.7 years among adolescents, 9.8 years among young adults), snorting heroin (2.7 years among adolescents, 6.4 years among young adults), snorting cocaine (2.3 years among adolescents, 7.2 years among young adults), and smoking crack (1.9 among adolescents, 5.2 years among young adults).

When drug use prior to initiation was examined (Table 3), adolescent initiates were more likely than young adult initiates to report using inhalants (odds ratio = 2.29) and hallucinogens (odds ratio = 2.56). Although the majority of IDUs in this study had used heroin, cocaine, or crack cocaine at some point prior to initiation, adolescent initiates were less likely than young adults to have used heroin (odds ratio = 0.51), cocaine (odds ratio = 0.42), or crack (odds ratio = 0.41). The two groups did not differ significantly in ever having used marijuana prior to initiation.

New associations emerged during examination of non-injection drug use specifically during the one or two years prior to initiation of injection. During this period, adolescent initiates were more likely than young adults to have smoked marijuana (odds ratio = 3.20). Although there were no significant differences between adolescent and young adult initiates when "Only snorting heroin" and "Only snorting cocaine" were examined, adolescent initiates were more likely to have exclusively smoked crack (odds ratio = 2.65), and were less likely to have exclusively snorted heroin and cocaine (odds ratio =

Table 3. Pre-initiation drug use practices associated with adolescent initiation of injection drug use among recent IDUs in Baltimore, 1997–1999 (N = 226)

Characteristic	*Number*	*Percent*	*Initiated at ≤21 years of age (n = 91)* *Percent*	*Odds ratio*	*95% CI*
Any time prior to initiation					
Used marijuana					
Ever	202	89	42.1	2.18	0.83, 5.72
Never	24	11	25.0	1.00	
Used inhalants					
Ever	48	21	56.3	2.29	1.20, 4.38
Never	178	79	36.0	1.00	
Used hallucinogenics					
Ever	48	21	58.3	2.56	1.34, 4.90
Never	178	79	35.4	1.00	
Snorted heroin					
Ever	179	79	36.9	0.51	0.27, 0.89
Never	47	21	53.2	1.00	
Snorted cocaine					
Ever	135	60	52.8	0.42	0.24, 0.72
Never	91	40	31.9	1.00	
Smoked crack					
Ever	124	55	52.0	0.41	0.24, 0.70
Never	102	45	30.7	1.00	
During year 1 or 2 prior to initiation					
Snorted heroin only					
Yes	57	25	35.1	0.75	0.40, 1.39
No	169	75	42.0	1.00	
Snorted cocaine only					
Yes	6	3	33.3	0.74	0.13, 4.10
No	220	97	40.5	1.00	
Smoked crack only					
Yes	16	7	62.5	2.65	0.93, 7.58
No	210	93	38.6	1.00	
Snorted heroin and cocaine only					
Yes	27	12	22.2	0.38	0.15, 0.99
No	199	88	42.7	1.00	
Drank alcohol daily					
Yes	25	11	48.0	1.43	0.62, 3.28
No	201	89	39.3	1.00	
Smoked marijuana					
Yes	142	63	50.0	3.20	1.76, 5.83
No	84	37	23.8	1.00	

CI = confidence interval

Table 4. Multivariate analysis of the relation between adolescent initiation of injection drug use and high-risk pre-initiation and post-initiation correlates among recently initiated IDUs in Baltimore, 1997–1999 (N = 226)

	Initiation at age ≤21 years		
Variable	*Unadjusted odds ratio*	*Adjusted[a] odds ratio*	*Adjusted 95% CI*
African American	0.19	0.15	0.07, 0.33
Duration of injection use ≤2 years	0.19	0.40	0.19, 0.81
First sex at age <14 years	2.18	2.38	1.20, 4.71
No condom use within one year prior to initiation	1.97	2.51	1.21, 5.39
Smoked crack within one year prior to initiation	0.22	0.23	0.08, 0.65
Smoked crack only during year 1 or year 2 prior to initiation	2.65	5.14	1.22, 21.61
Smoked marijuana during year 1 or year 2 prior to initiation	3.20	3.11	1.51, 6.41
Snorted cocaine prior to initiation	0.42	0.44	0.21, 0.95

[a]Adjusted for all variables listed in the logistic regression model. All unadjusted early behaviors significantly associated with adolescent initiation prior to adjustment were entered into the regression model.

CI = confidence interval

0.38). Daily alcohol drinking did not differ between the two groups during this period.

Multiple logistic regression was used to determine factors that were independently associated with adolescent initiation of injection drug use (Table 4). Compared with young adult initiates, IDUs who initiated injection drug use during adolescence were less likely to be African American (odds ratio = 0.15) or to have had an injection history of (≤2 years (odds ratio = 0.40). However, adolescent initiates were more likely to have had their first sexual experience at less than 14 years of age (odds ratio = 2.38) and to have reported condom use one year prior to initiation (odds ratio = 2.51). While adjusting for any crack cocaine use within one year prior to initiation (alone or in combination with other illicit drugs), adolescent initiates were more likely than young adults to have exclusively smoked crack (odds ratio = 5.14) during the two years prior to initiation. They were less likely, however, to have ever snorted cocaine prior to initiation (odds ratio = 0.44). The final model also showed adolescent initiates to be three times more likely than older initiates to have smoked marijuana during the two years preceding initiation.

DISCUSSION

Our major finding in this study was that age of initiation into injection drug use appears to be associated with different risk behaviors preceding initiation. Adolescent initiates had a briefer but more intense risk interval before starting to inject drugs. This observation might reflect several factors, but the implication is that the adolescent initiators who are also at the highest risk for HIV and HCV infections can be observed as having high-risk, pre-initiation behaviors that can be distinguished and identified for public health intervention.

Previous published reports have identified several factors associated with younger initiation of substance abuse (during early and late adolescence) that may explain a faster acceleration into injection compared with individuals reporting an older initiation of substance abuse (young adulthood).[26-29] Specifically, our findings are consistent with an earlier study[26] of adolescent substance abuse, which noted an association between developmental test results of participants and age of onset and intensity of drug used. For example, compared with older adolescent drug users (15–18 years of age), younger (12–14 years of age) adolescents who exhibited increased levels of substance abuse were more likely to exhibit psychological distress, which the authors posited might explain a faster progression into heavier drug use.[26] Although we did not have measures of psychological distress in this study, these earlier studies provide some evidence that the initiation and practice for risk behavior may vary by age of initiation into injection drug use; if so, age of initiation into injection would be important to consider when developing public health interventions. The differences seen in

Adolescent initiates were more likely than young adults to be other than African American, suggest[ing] possible sociocultural differences at the individual and group levels with respect to perceptions of illicit drug use and the transition into heavier use.

the early onset of illicit drug use are important to consider given the potential for early initiation of injection in this group, and the negative health consequences associated with early initiation.

Although adolescent initiates were less likely than young adult initiates to have ever smoked crack, exclusive crack smoking one or two years prior to initiation demonstrated the strongest relationship with adolescent initiation of injection. Surprisingly, we observed that smoking crack in combination with use of other drugs one year prior to initiation was inversely associated with adolescent initiation of injection. These findings may suggest that adolescent crack smokers transition relatively quickly from a short period of exclusive crack smoking to a brief period of other non-injection drug use (heroin or cocaine, for example), and subsequently to injection drug use. It should be noted that the association between adolescent initiation and crack use was probably not explained by a period effect that reflects the crack epidemic, as we studied the same calendar time for the two groups. No other significant associations were observed during the year prior to initiation; however, adolescent initiates were more likely than young adults to report smoking marijuana within the two years prior to initiation, but young adults were more likely to report a history of cocaine use any time prior to initiation. Our findings, especially when coupled with an earlier study that noted early adolescence (≤20 years of age) to be associated with increased levels of substance abuse when compared with late adolescence (20–30 years of age),[27] emphasize the need for interventions aimed not only at delaying the onset of illicit drug use during adolescence, but also at reducing levels of use among young adult non-injection drug users, to help prevent transition into injection.

Given that the median age at study entry was 25 years, it is not surprising that adolescent initiates in this study sample had a longer duration of injection than adults, since most participants initiated injection over the age of 21 (median age at initiation was 23 years) and the median length of injection was two years. These findings provide evidence that the typical age of initiation into injection drug use may be moving more into young adulthood as opposed to late adolescence, which has been suggested in a recent report.[18]

We also found that adolescent initiates were more likely than young adults to be other than African American, in contrast to a recent study of IDUs in New York.[18] These findings support earlier studies which found white males to have higher rates of mental illness, polydrug abuse, and early initiation of non-injected drugs (that is, tobacco, alcohol and marijuana) compared with African American males.[30-32] These ethnic differences could suggest possible sociocultural differences at the individual and group levels with respect to perceptions of illicit drug use and the transition into heavier use (social networks and social cohesion, for example) that were unexplored in the current study. However, it is important to acknowledge the potential for selection bias. For example, younger African American initiates who had injected drugs longer may have been more difficult to recruit than older African American initiates; however, reasons for this occurring more often within certain ethnic groups warrant further ethnographic evaluation. Conversely, older white initiates who injected for shorter durations may also have been more difficult to recruit. This could be due to the fact that adolescent initiates in this study were more likely to report street survival as their primary source of income; it is plausible that older white initiates with more stable sources of income may not have been as accessible and, thus, their opportunity for enrollment may have been minimized compared to the younger white initiates. On the other hand, since the majority of IDUs in Baltimore are African American, mirroring the city's population, it is unclear why younger and long-term drug-using African Americans would be under-represented in our study. A previous study of recently initiated IDUs conducted in Baltimore found similar results with respect to age of initiation, race, and length of injection drug use.[33] In each of these Baltimore studies, different

Adolescent initiates had a briefer but more intense risk interval before starting to inject drugs.

methods of recruitment were used, which suggests that selection bias may not fully explain our results.

Our examination of early sexual behaviors found that adolescent initiates were more likely to report their first sexual experience at age 14 or younger compared with older initiates, which is consistent with previous studies.[21,34,35] We found no association between pre-initiation, high-risk sexual practices (such as trading sex for drugs or money) and adolescent initiation of injection. In fact, adolescent initiates were more likely to report condom use compared with young adult initiates. This could indicate that younger people are more receptive to safer-sex prevention messages than older initiates. It is possible, however, that adolescents may have been more likely to provide socially desirable responses for condom use, especially since they had more sexual partners than older initiates.

Limitations. Since sampling was based upon self-referral, certain subgroups may have been under-represented, as discussed above. These results may not be generalizable to other populations of recently initiated injectors. To reduce potential selection bias, we used a mobile clinic to broaden recruitment.

In cross-sectional studies, misclassification of exposure can occur due to biased recall or difficulty recalling events. In this study, older initiates may have had more difficulty than younger initiates remembering pre-initiation behaviors. To minimize recall bias, we attempted to assist recall of the chronological sequence of events by referring to other memorable biographical landmarks (for example, pregnancy, childbirth, time spent incarcerated, last high school grade attended). By combining periods across pre-initiation years during the analysis, the potential for misclassification was reduced. In spite of these measures, non-differential misclassification could have occurred if a participant could not accurately remember behavioral events during the year-by-year history (by "telescoping" or "distancing"),[25] which would tend to bias associations towards the null. It should also be noted that without a non-injection drug using comparison group, our findings must be interpreted with caution. Further studies including a comparison group of non-IDUs who reamin non-IDUs into adulthood are required to further validate these findings.

CONCLUSION

Despite these limitations, our data suggest that adolescent initiation of injection drug use is likely to be associated with non-injection drug use practices, particularly exclusive crack smoking just prior to initiation. Since adolescents who are newly initiated to injection drug use are at high risk for infection with HIV and hepatitis, these findings are important for targeting appropriate interventions, such as enhanced treatment options for adolescents and young adults. Additional studies investigating adolescent initiation that include changing social networks and predisposing mental health factors may provide useful information for planning programs to prevent early onset of illicit drug use and initiation of injection drug use, and subsequent blood-borne infections.

This study was part of the Collaborative Injection Drug User Study supported by the Division of HIV/AIDS Prevention at the Centers for Disease Control and Prevention, No. U64/CCU309690.

The authors thank the REACH II study team and staff at the Ferne Johnson Center. Ferne Johnson was a community advisory board member and one of the first activists in east Baltimore to dedicate her life to those struggling with HIV disease, particularly injection drug users, early in the epidemic. We are especially grateful for the assistance of David Celentano, ScD, and Carl Latkin, PhD, of Johns Hopkins University, School of Public Health, and to the young participants of the REACH II study, without whom this research would not have been possible.

References

1. Nelson KE, Vlahov D, Solomon L, Cohn S, Munoz A. Temporal trends of incident human immunodeficiency virus infection in a cohort of injection drug users in Baltimore, Maryland. Arch Intern Med 1995; 155:1305-11.
2. Nicolosi A, Leite MLC, Molinari S, Musicco M, Sarocco A, Lazzarin A. Incidence and prevalence trends of HIV infection in intravenous drug users attending treatment centers in Milan and Northern Italy, 1986–1990. J Acquir Immune Defic Syndr 1992;5:365-73.
3. Vlahov D, Anthony JC, Celentano DD, Solomon L, Chowdhury N. Trend of HIV-I risk reduction among initiates into intravenous drug use 1982-1987. Am J Drug Alcohol Abuse 1991;17(1):39-48.
4. van Ameijden EJC, van den Hoek JAR, Mientjes GHC, Coutinho RA. A longitudinal study on the incidence and patterns of HIV, HBV, and HCV infection among drug users in Amsterdam. Eur J Epidemiol 1993;9:255-62.
5. Levine OS, Vlahov D, Brookmeyer R, Cohn S, Nelson KE. Differences in the incidence of hepatitis B and human immunodeficiency virus infections among injecting drug users. J Infect Dis 1996;173:579-83.
6. Garfein RS, Vlahov D, Galai N, Doherty MC, Nelson KE. Viral infections in short-term injection drug users: the prevalence of the hepatitis C, hepatitis B, human immunodeficiency virus, and human T-lymphotropic viruses. Am J Public Health 1996;86:655-61.
7. Garfein RS, Doherty MC, Monterroso ER, Thomas DL, Nelson KE, Vlahov D. Prevalence and incidence of hepatitis C virus infection among young adult injection drug users. J Acquir Immune Defic Syndr Hum Retrovirol 1998;18:S11-S19.
8. Thomas DL, Vlahov D, Solomon L, et al. Correlates of hepatitis C virus infection among injection drug users. Medicine 1995;74:212-20.
9. Villano SA, Vlahov D, Nelson KE, et al. Incidence and risk factors for hepatitis C among injection drug users in Baltimore, Maryland. J Clin Microbiol 1997;35:3274-7.
10. van Ameijden EJC, van den Hoek JAR, van Haastrecht HJA, Coutinho RA. The harm reduction approach and risk factors for human immunodeficiency virus (HIV) seroconversion in injecting drug users, Amsterdam. Am J Epidemiol 1992;136:236-43.
11. Fennema JSA, van Ameijden EJC, van den Hoek A, Coutinho RA. Young and recent-onset injecting drug users are at higher risk for HIV. Addiction 1997;92:1457-65.
12. Booth R, Koester S, Brewster JT, Weibel WW, Fritz RB. Intravenous drug users and AIDS: risk behaviors. Am J Drug Alcohol Abuse 1991;17:337-53.
13. Marrero Rodriquez CA, Robles RR, Colon HM, Freeman DH, Matos TD, Reyes JC. HIV risk behaviors and HIV seropositivity among young injection drug users. P R Health Sci J 1993;12:7-12.
14. Telles PR, Bastos FI, Guydish J, et al. Risk behavior and HIV seroprevalence among injecting drug users in Rio de Janeiro, Brazil. AIDS 1997;11(Suppl 1):S35-S42.
15. Carneiro M, Fuller C, Doherty MC, Vlahov D. HIV prevalence and risk behaviors among new initiates into injection drug use over the age of 40 years old. Drug Alcohol Depend 1999;54:83-6.
16. Battjes RJ, Leukefeld CG, Pickens RW. Age at first injection and HIV risk among intravenous drug users. Am J Drug Abuse 1992;18:263-73.
17. Robles RR, Matos TD, Colon HM, Deren S, Reyes JC, Marrero CA. HIV risk behaviors among recent and more remote initiators of drug injection in Bayamón, PR, and New York City [abstract]. 61st Annual Scientific Meeting College of Problems of Drug Dependence; 1999 June; Acapulco, Mexico.
18. Des Jarlais DC, Friedman SR, Perlis T, et al. Risk behavior and HIV infection among new drug injectors in the era of AIDS in New York City. J Acquir Immune Defic Syndr Hum Retrovirol 1999;20:67-72.
19. Neaigus A, Friedman SR, Jose B, et al. High-risk personal networks and syringe sharing as risk factors for HIV infection among new drug injectors. J AIDS Hum Retro 1996;11:499-509.
20. Doherty MC, Garfein RS, Monterroso EM, Brown D, Vlahov D. Correlates of HIV infection among young adult short-term injection drug users. AIDS 2000 14(1):717-26.
21. Roy E, Haley N, Boivin JY, et al. Predictors of drug injection initiation in a street youth cohort [abstract]. 12th World AIDS Conference; 1998 June–July; Geneva, Switzerland.
22. Diaz T, Conover S, Edwards V, Monterroso EM, Susser E. Drug using behaviors of young and recent initiate injection drug users in New York City: a unique opportunity for prevention of HIV [abstract]. 12th World AIDS Conference; 1998 June; Geneva, Switzerland.
23. Stenbacka M: Initiation into intravenous drug abuse. Acta Psychiatr Scand 1990;81:459-62.
24. Anthony JC, Vlahov D, Celentano DD, Brown D, Vlahov D. Self-report interview data for study of HIV-1 infection among intravenous drug users: description of methods and preliminary evidence on validity. J of Drug Issues 1991;21:739-57.
25. Samuels JF, Vlahov D, Anthony JC, Chaisson RE. Measurement of HIV risk behaviors among intravenous drug users. Br J Addict 1992;87:417-28.
26. Brook JS, Cohen P, Jaeger L. Developmental variations in factors related to initial and increased levels of adolescent drug involvement. J Genet Psychol 1998;159:179-94.
27. Labouvie E, Bates ME, Pandina RJ. Age of first use: its reliability and predictive utility. Journal of Studies on Alcohol 1997;58:638-43.
28. Duncan SC, Duncan TE, Biglan A, Ary DV. Contributions of the social context to the development of adolescent substance use: a multivariate latent growth modeling approach. Drug Alcohol Depend 1998; 50(1):57-71.
29. Sayer AG, Allison TJ. Using developmental processes to predict substance use outcomes. Technical Report, University Park, PA: Methodology Center, College of Health and Human Development, Pennsylvania State University; 1998. Report No.: 98-25.
30. Lewinsohn PM, Hops H, Roberts RE, et al. Adolescent psychopathology, I: prevalence and incidence of depression and other DSM-III-R disorders in high school students. J Abnormal Psychol 1993;102:133-44.
31. Kosten TR, Rounsaville BJ, Kleber HD. Ethnic and gender differences among opiate addicts. Int J Addict 1985;20:1143-62.
32. Gillmore MR, Catalano RF, Morrison DM, Wells EA, Iritani B, Hawkins JD. Racial differences in acceptability and availability of drugs and early initiation of substance use. Am J Drug Alcohol Abuse 1990;16:185-206.
33. Doherty MC, Garfein R, Monterroso E, et al. Younger age of initiating injecting drug use is associated with risky behaviors and HIV infection in short-term injectors [oral presentation]. XI International Conference on AIDS; 1996 July; Vancouver, Canada.
34. Stanton B, Romer D, Ricardo I, Black M, Feigelman S, Galbraith J. Early initiation of sex and its lack of association with risk behaviors among adolescent African Americans. Pediatrics 1993;92(1):13-9.
35. Dinwiddie SH, Reich T, Cloninger CR. Prediction of intravenous drug use. Compr Psychiatry 1992;33:173-9. ■