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Trajectories of injecting behavior in the Amsterdam Cohort Study among drug users

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ABSTRACT

Background: Injecting frequency among people who inject drugs (IDU) can change along distinct trajectories, which can reflect on incidence of HIV and HCV infections. We aimed at assessing these patterns of longitudinal changes, their predictors and their association with the incidence of HIV and HCV.
Methods: We analyzed data from the Amsterdam Cohort Study among Drug Users, selecting participants recruited from 1985 to 2005, injecting drugs before cohort entry and with records in at least three different six months intervals ($N = 740$). We used latent class mixed models to identify distinct trajectories of injecting, multinomial regression to identify socio-demographic variables associated with those patterns and Kaplan-Meier analysis for the estimation of the corresponding cumulative HIV and HCV incidence.
Results: Five distinct patterns for injecting frequency and for injecting since last visit were identified. The majority of participants (three groups, 69% of participants) had stable risk injecting behavior; the remaining displayed a decrease in injecting over time. Those with longer duration of injecting at cohort entry and those who entered the cohort in earlier years tended to have continuing high risk behavior. The HIV risk was highest among those with continuing high risk behavior and its changes over time mirrored the patterns of change in injecting in a group with decrease in injecting.
Conclusions: Individual longitudinal patterns of changes in injecting behavior are related to socio-demographic and drug use variables and are reflected in the incidence of HIV infections. Understanding these associations might provide valuable information for targeted interventions.

1. Introduction

Injecting drug users (IDU) may change their risk behavior in the course of their injecting career, either under the influence of harm reduction programs or for other reasons (Hser et al., 2009). Such changes will affect the risk of infectious diseases such as HIV and HCV, depending, for example, on frequency of infecting and sharing of syringes and needles (Aceijas and Rhodes, 2007; March et al., 2007). Young and recent onset injectors often display high levels of risk behavior and, therefore, put themselves at increased risk of contracting a blood borne infection, while older and more experienced injectors may present lower levels of risk behavior (Fennema et al., 1997).

Longitudinal changes in behavior can be conceptualized as trajectories describing typical patterns of change during the injecting career. Ideally, one would like to predict the development of risk behavior over time from individual characteristics. Consequently, characterizing individuals in terms of typical behavioral trajectories and predicting the future development might provide valuable information for targeting interventions. The analysis to identify the corresponding patterns can be conducted using semi-parametric latent class growth modeling or finite mixture models (Nagin and Odgers, 2010). This methodology was applied in multiple research areas and distinct trajectories were described in relation to

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alcohol use (Jackson and Sher, 2008; Schulenberg et al., 1996), smoking (Brook et al., 2008, 2007; Hu et al., 2008; Ingvar Rosendahl et al., 2008; Lessov-Schlaggar et al., 2008), drug use in general and joint use of multiple drugs (Jackson et al., 2008; Martino et al., 2008; Orlando et al., 2005; Wanner et al., 2006), and aggression, delinquency or social withdrawal (Broidy et al., 2003; Cjte et al., 2002; Huang et al., 2011; Lacourse et al., 2002, 2003; Oh et al., 2008; Prendergast et al., 2010; Tremblay et al., 2005).

Three studies addressed patterns of longitudinal changes in injecting over time using US samples of drug users (Genberg et al., 2011; Hser et al., 2007; Xie et al., 2006). Xie et al. (2006) found four different patterns of remission (varying between treatment resistance and different levels of improvement) in a sample from the New Hampshire Dual Disorders study. Hser et al. (2007) used a two component modelling (use versus non-use and frequency of use among the users) and identified three trajectories of injecting frequency among narcotic addicts originally admitted to the California Civil Addict Program. In a more recent publication, Genberg et al. (2011) analyzed data from the ALIVE study in Baltimore and described five patterns of drug use cessation. All these studies demonstrated similar patterns among drug users in the USA, despite different samples and variation in analytical methods. However, patterns of change in injecting can depend on cultural settings, and it is not clear if the findings can be generalized to other populations. Further evidence from other countries is necessary to confirm existing observations. A study from Switzerland reported trajectories of drug use behavior over time, but using only two predefined categories: a difference between the first and last visit, and assuming constant behavior during all visits (Weber et al., 2009). Previous research also did not study associations between patterns of changes in injecting and the risk of attracting related infections, which is the important public health outcome of injecting.

In order to assess patterns of changes in injecting frequency among IDU in a European population, we used data from the Amsterdam Cohort Study among drug users (ACS). We studied potential heterogeneity in patterns of change, and assessed how the different patterns of change were linked to individual characteristics of the participants, and whether they were associated with the incidence of HIV and HCV.

2. Methods

2.1. Data source

The ACS has been described extensively elsewhere (Termorshuizen et al., 2005; van Ameijden and Coutinho, 2001; van den Hoek et al., 1988, 1990). In brief, it is an open, prospective cohort study initiated to investigate the prevalence, incidence and risk factors of infections with HIV-1 and other blood borne and/or sexually transmitted infections, as well as the effects of interventions. Participants are invited to visit the Amsterdam Health Service every 4–6 months. At study entry and every visit, they give blood for HIV testing and storage; they also complete a standardized questionnaire about their health, drug use and sexual risk behavior, and socio-demographic situation. Participation in the ACS is voluntary, and written informed consent is obtained prior to data collection. The study was approved by the institutional review board of the Academic Medical Center in Amsterdam.

We initially included data of 1175 IDU, who were recruited between April, 1985 and November, 2005 and had ever injected ('ever injectors') at cohort entry. However, for the analysis of pattern of change in injecting, we restricted the sample to 740 IDU with visits in at least three separate six-month time windows during the first 10 years since cohort entry. The dataset contained information on sex, age at cohort entry and age at first injection, needle sharing (ever) at cohort entry, the frequency of current injecting (in the last six months or since last visit) using eight categories: no injection, less than 1 day/month, 1 day/month, 2–3 days/month, once weekly, 2–6 days/week, once daily, and several times daily, and type of drugs preferentially used in last six months.

2.2. Statistical analysis

First, we described the sample in terms of socio-demographic variables, prevalence of HIV and HCV and drug use at study entry. Second, we assessed which time scale has the strongest association with injecting frequency: duration of injecting (which would indicate that the natural history of injecting is most important), year of entry in the cohort (indicating secular changes in the population of IDU) or time in the cohort (effects of participation in the cohort on behavior). In order to remove effects of drop out or differential censoring due to death, this analysis was restricted to a subsample of participants who had information about frequency of injecting in the time window of 4.5–5.5 years in the cohort ($N = 542$). Initially, the original frequency of injecting variable was used and the results were visually inspected. For a formal analysis, frequency of injecting was dichotomized in different ways and in each case random effects logistic regression was used for analysis. In these models, duration of injecting at cohort entry, year of entry in the cohort and time in the cohort were included as independent variables and dichotomized frequency of injecting at cohort entry and after five years as dependent variable, linked by participants' ID as random effects to link behavior at these two time points. This analysis was conducted with SAS macro GLIMMIX (Littell, 1996). In further analysis, time variable with the strongest effect (based on odds ratio) was used. Third, we used a growth mixture model to identify different patterns of changes in injecting behavior during the cohort time. Mixture models combine the features of longitudinal analysis and cluster analysis: groups with different average patterns of frequency of injecting over time are identified and their trajectories of changes in the frequency of injecting are described. The trajectories are described by polynomial functions and subjects are classified as belonging to a given group based on a summary measure describing deviation from the average trajectory for the group (Haviland et al., 2007; Jones et al., 2001; Nagin, 1999). The individual group membership is not fixed, but is estimated based on the highest probability of belonging to the given group. While the earlier versions of mixture models (latent class analysis models) did not allow for variation within groups, growth mixture models combine features of mixed and mixture models (Proust-Lima et al., 2014). In each run the number of distinct groups has to be specified, but the results for different numbers of groups can be compared by statistical criteria such as the Bayesian Information Criterion (BIC or adjusted BIC; Arrandale et al., 2006). In typical applications with large datasets, even for a high number of groups there are significant improvements in BIC. Therefore, the decision about the number of groups should also consider the interpretation of the distinct groups. For information about quality of separation of the different classes we present posterior class membership probabilities and report the relative entropy measure (Jung and Wickrama, 2008). Since the outcome variable (frequency of injecting) was ordinal and the data points at which it was assessed were not evenly distributed, we used for the analysis the lcmm library in R (Proust-Lima et al., 2014). Fourth, we studied whether socio-demographic characteristics, HIV and HCV status and history of drug use at cohort entry can be used to predict the estimated group membership with regard to the trajectories applying chi-squared test for univariate and multinomial regression for multivariable analysis. Finally, we applied Kaplan-Meier life table analysis to assess the cumulative incidence of HCV and HIV infection since cohort entry for groups with different behavior as defined in the mixture model analysis.