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Impulsivity and linkage to HIV Care among People living with HIV in St. Petersburg, Russia

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Abstract

This study evaluated the association between impulsivity and linkage to HIV care among Russians living with HIV recruited from an inpatient narcology hospital. Linking Infectious and Narcology Care (LINC) study participants who completed the Barratt Impulsiveness Scale (BIS) were included in these analyses. The primary independent variable was impulsivity score which was categorized as high impulsivity (BIS score > 71) vs. low impulsivity (BIS score < = 71). The primary outcome, linkage to care post recruitment, was defined as one or more HIV medical care visits at 12-month follow-up. Multiple logistic regression models were used to evaluate

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Authors' contribution NE, DMC, EK and JHS contributed to the conceptualization and design of this study. DMC and EQ performed statistical analyses and all co-authors contributed to interpretation of results. AKD, NE, SB and JHS drafted the manuscript, and all co-authors critically reviewed the manuscript. JHS obtained funding for the study and EB, SB and EK contributed to administrative, technical, and material support for the study. AR, SB, EK and JHS provided supervisory support to the study. All authors read and approved the final manuscript.

Code Availability Not Applicable.

Declarations

Conflicts of interest / competing interests DMC serves on Data Safety and Monitoring Boards for Janssen. The remaining authors have no conflicts of interest to declare.

Ethics approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Consent to participate Informed consent was obtained from all individual participants included in the study.

Consent for publication Not Applicable.

the association between high impulsivity and linkage to HIV care controlling for potential confounders. Participants (N = 227) were adults with a mean age of 34 years (SD = 5), and the majority were male (74%). We did not detect a significant association between impulsivity and linkage to HIV care after adjusting for respondents' age, gender, CD4 cell count, and depression score. We also found that substance use and hazardous drinking did not appear to confound the relationship. Although our study was unable to detect an association between impulsivity and linkage to HIV care, it may provide direction for future research exploring the associations between impulsivity and HIV care.

Keywords

Impulsivity; HIV; PWID; Russia

Introduction

Linkage to HIV care, which refers to the process of initiating medical care among people diagnosed with human immunodeficiency virus (HIV), is a critical step in the HIV care continuum that is followed by antiretroviral treatment, retention in care, and finally suppression of the virus [1–3]. Research has identified impulsivity as one of the factors most commonly associated with poor decision-making [4]. Impulsivity is a multifactorial construct with cognitive, behavioral, and neuropsychological underpinnings. Impulsivity has been associated with risky health-related behaviors and non-adherence to treatment. High impulsivity has been found to be significantly associated with risky behaviors such as heavy alcohol use, illicit drug use, and highrisk sexual behaviors [5–7]. Impulsivity has also been found to be associated with injection drug use and lack of HIV treatment adherence [8, 9]. Research has shown that among people living with HIV, those who inject drugs are also more likely to avoid or delay HIV care [10–13]. Therefore, individuals with high impulsivity are more likely to engage in behaviors such as drug use while ignoring the negative consequences of that behavior, such as missing medical appointments [8]. Findings suggest that unhealthy behaviors, including substance use, further exacerbate impulsive tendencies. This creates a difficult-to-break cycle, where substance use leads to impulsivity, and high impulsivity fuels substance use [9, 14–16]. Understanding the intricate relationship between impulsivity, substance use, and linkage to HIV care is critical, especially in the context of Russia, which has the highest prevalence of HIV in Europe [17, 18].

The HIV epidemic in Russia

As of June 2021, about 1.1 million Russians out of 140 million were living with HIV [19, 20]. HIV testing and treatment cascade data from UNAIDS for 2020 show that 790,000 people living with HIV in Russia knew their status (approx. 72%). Of these, 620,000 (78.4%) people were on antiretroviral therapy (ART), and 590,000 (74.7%) people had achieved viral suppression [21]. While Russia has made considerable progress in identifying HIV cases, its HIV epidemic remains concentrated among at-risk populations, including people who inject drugs (PWID) [18]. Historically, injection drug use has been a major driver of the HIV epidemic in Russia [22]. Approximately 43% of new HIV infection cases

in Russia are among PWID; it is estimated that about 20–30% of PWID are HIV positive [18].

Challenges in linkage to HIV care among PWID

Despite the high burden of HIV faced by PWID in Russia, their linkage to HIV care remains low [23] and is plagued by several challenges, including a complex healthcare system, stigma and discrimination in healthcare settings, criminalization, and poor trust in the public care system [18, 24–26]. At an individual level, struggles with addiction, fear of stigmatization, and a lack of trust in the quality of care result in a significant portion of people diagnosed with HIV avoiding or delaying entering care in the public health system [18, 27, 28]. Poor linkage to HIV care among PWID is also attributable to the organization of the Russian healthcare system. The Russian health system offers universal health coverage. However, it separates drug treatment and HIV care, requiring patients to coordinate multiple services and care appointments [23, 29, 30]. Although Russia has a dense network of regional and city AIDS centers that play a key role in treating people diagnosed with HIV, few are engaged in programming focused on vulnerable populations, including PWID [18]. These factors, coupled with a fear of stigma and discrimination from healthcare workers among PWID, create conditions that make linking PWID to HIV care difficult [31]. It is imperative to understand factors that influence individuals' decision-making related to linkage to HIV care in this population to foster the development of effective linkage interventions.

Gaps in literature

While research has examined the role of impulsivity in risk-taking behaviors, little work has been done to examine how risky behaviors, such as alcohol and substance use, affect the association between impulsivity and linkage to HIV care. Understanding these pathways can thus help improve healthcare decision-making and health outcomes for HIV patients with a history of substance use.

Conceptual Framework and Aims

The LINC study was grounded in Social Cognitive Theory (SCT) and Psychological Empowerment Theory (PET) framework [32–34]. According to SCT, health behaviors (linkage to HIV care) are achieved when individuals have the self-efficacy to engage in behavior, have the skills to manage triggers (substance use), and believe that the behavior will be beneficial and socially supported [32]. This is based on foundations of personal empowerment, and for that, we draw from PET, which posits that individual empowerment is engendered when individuals have opportunities to influence the system that affects them, to have control over their role in transactions, and contribute to changing the system's interaction with them to meet their health needs [34].

The current research is grounded in these conceptual frameworks. It seeks to examine the association between impulsivity and the likelihood of initiating care among people with a current or a history of injecting drugs within 12 months of treatment for substance use. Specifically, we tested the following hypotheses: higher impulsivity is negatively associated

with linkage to HIV care. Secondarily, we explored the role of substance use and hazardous alcohol use in the relationship between impulsivity and linkage to HIV care.

Methods

Objective and Study Design

The current study is a secondary analysis of data from the Linking Infectious and Narcology Care (LINC) study implemented at the City Addiction Hospital in St. Petersburg, Russia, between July 2012 and May 2014. The objective of the LINC study was to improve the *treat* and *retain* dimensions of the "seek, test, treat, and retain" paradigm in Russia. In a randomized controlled trial, the study team implemented and assessed a behavioral and structural intervention designed to support and motivate people living with HIV who inject drugs to engage (i.e., initiate and retain) in HIV medical care and ultimately improve their HIV outcomes. The Institutional Review Boards of Boston University Medical Campus and First St. Petersburg Pavlov State Medical University approved the LINC study. A more extensive study protocol is published [33], and the study is registered with ClinicalTrials.gov (NCT00483483). In our previous study on the effectiveness of LINC, we found that the intervention significantly increased HIV-positive PWID's linkage to HIV care and was also associated with an increased likelihood of having a second CD4 count if CD4 > 350 within 12 months of enrollment [35].

This study seeks to examine the association between high impulsivity (i.e., a total Barratt Impulsiveness Scale score of 71 or higher) and linkage to HIV care (i.e., one or more HIV medical care visits for patients who are newly diagnosed or currently out of care) among PWID living with HIV.

Setting

Participants were recruited from inpatient wards at the St. Petersburg City Addiction Hospital between July 2012 and May 2014. The hospital is government-funded with a capacity of 500 beds and provides free addiction care to residents of St. Petersburg. The hospital treats approximately 7,000 patients annually, approximately 1500 of whom live with HIV.

Residents of the city registered as having a drug or alcohol use disorder can avail the facilities at this hospital. Patients need a referral from the district narcologist at the place of their residence to be hospitalized and receive treatment. Alternatively, patients can also pay for their treatment at the hospital, although the LINC study did not have any such patients. At the hospital, patients receive free additional care, including detoxification, early stabilization, and inpatient rehabilitation. Hospitalized patients typically stay for about 1–4 weeks [36].

The LINC study randomized to the intervention or standard of care, 349 Russian HIV-positive PWID hospitalized at a narcology hospital, of the 359 (97.2%) who met study eligibility requirements. Participants were not on ART at the time of recruitment. This study is a longitudinal secondary analysis of LINC participants who completed the Barratt Impulsiveness Scale at 6 and 12-month study visits (N = 227).

Eligibility

Eligibility criteria for the larger study included the following: (1) age 18–70 years; (2) HIV-positive; (3) hospitalized at the narcology hospital; (4) history of injection drug use; (5) agree to CD4 cell count testing; (6) have two contacts to assist with follow-up; (7) live within 100 km of St. Petersburg; (8) have a telephone; (9) willing to receive HIV care at Botkin Infectious Disease Hospital. Shortly after study initiation, HIV care at City AIDS Center was also acceptable. Participants were excluded if they were not fluent in Russian, were currently on antiretroviral therapy (ART), or had a cognitive impairment resulting in an inability to provide informed consent. After eligibility was verified and informed consent obtained, research assessors (RAs) administered the baseline assessment and randomized participants into the LINC intervention or to the narcology hospital's standard of care (control group) (Figure-1).

Participant assessments

The HIV-positive status of participants was assessed through medical records. Of the 349 participants in the LINC study, the mean years since HIV diagnosis was 7.3 years, and a total of 43 patients had used antiretroviral therapy (ART) before enrollment in the study [35].

Baseline study interviews were conducted at the narcology hospital by trained research staff and at 6- and 12-months post-enrollment at First St. Petersburg Pavlov State Medical University. All assessments were conducted by trained research assessors and administered in Russian.

Primary outcome

The primary outcome of interest was linkage to HIV care since study enrollment (defined as one or more HIV medical care visits since enrollment), captured at a 12-month follow-up. This information was obtained via chart review at the HIV clinic. Data collected from the chart included dates of appointments with an HIV physician at an outpatient clinic. Given the source of these data, centralized St. Petersburg HIV medical records, minimal loss to follow-up occurred for the primary outcome.

Primary independent variable

The Barratt Impulsiveness Scale (BIS) version 11 was used to measure impulsivity. The BIS-11 scale is one of the most widely used self-report measures of impulsivity in research and clinical settings [37–39]. The scale includes 30 items scored on a 4-point scale ranging from 1 to 4, with an overall score ranging between 30 and 120. We observed that the distribution of impulsivity scores was skewed in our sample, and preliminary analyses suggested the relationship with linkage to HIV care was non-linear. Hence, impulsivity scores were dichotomized at the median for this analysis, and high impulsivity was defined as a total BIS score of 71 or higher.

Substance Use and Hazardous Alcohol Use

Drug use data were collected using the modified Risk Behavior Survey (RBS) [40, 41], which is a structured interview that captures drug use and needle sharing practices over the past 30 days. Substance use was defined as the use of any of the following: heroin, other opioids, amphetamines, cocaine, or sharing works in the past 30 days.

The Alcohol Use Disorders Identification Test (AUDIT) was used to assess hazardous alcohol use among participants. AUDIT is a 10-item measure extensively used as a screening instrument for hazardous and harmful alcohol consumption [42, 43]. The measure includes items that capture alcohol consumption, drinking behavior, and alcohol-related problems. Responses to the items are scored from 0 to 4, with a maximum possible score of 40. Hazardous alcohol use was defined as a score greater than or equal to 8 on the AUDIT scale [44].

Covariates

Covariates included age (continuous), gender (male/female), CD4 cell-count (continuous) at baseline and depressive symptoms. Depressive symptoms were assessed with the Center of Epidemiological Studies – Depression (CES-D) scale, which is a 20-item self-report measure of depressive symptoms, including depressive mood, feelings of guilt and worthlessness, psychomotor retardation, loss of appetite, and sleep disturbances within the week before the interview [45, 46]. Responses to the items in the measure are scored between 0 and 3, thereby providing a minimum score of 0 and a maximum score of 60 [47]. For this study population, we considered a CES-D score of greater than or equal to 24 to suggest the presence of depressive symptoms [48].

Statistical analysis

LINC participants who completed the BIS questionnaire at six months were included in the analyses. We calculated means, standard deviations, medians, and interquartile ranges (25th and 75th percentiles) for all variables included in the primary analyses. We then stratified all variables by the main independent variable and impulsivity (high vs. low at six months). Spearman correlations were calculated for all independent variables and covariates, and no pair of variables included in subsequent regression models had a correlation > 0.40.

The main analysis used multivariable logistic regression models to assess the association between high impulsivity score and linkage to care, adjusting for potential confounders including respondent's age, gender, CD4 cell count at baseline, and depressive symptoms (model-1).

To explore whether substance use and/or hazardous drinking were confounders of this relationship, we fit two additional logistic regression models separately adjusting for substance use (model 2a) and hazardous drinking (model 2b) in addition to the potential confounders used in model-1.

We report adjusted Odds Ratios (AOR) and 95% Confidence Intervals (CIs) for the multivariable logistic regression model. We also conducted posthoc analyses using

generalized linear models with empirical standard errors to estimate risk differences. We performed all analyses using SAS 9.4 (Cary, NC).

Results

Participants (N = 227) were adults with a mean age of 34 years (SD = 5), and most were male (74%). The impulsivity scores ranged from 43 to 101 in the current sample out of a possible range of 30–120. In the absence of an absolute cut-off and based on patterns observed in the sample, we selected the median as the threshold for impulsivity. About half of the respondents (47.6%) had a high impulsivity score (> 71). More than half the respondents reported using substances in the past 30 days (51.1%) and were classified as hazardous drinkers based on the AUDIT scale (57.7%). At 12 months, 50.7% were linked to care, and among those who were linked, 43.5% had high impulsivity (Table 1).

Bi-variate associations show that among those who had a high impulsivity score, 46.3% were linked to HIV care at 12-month. In comparison, 54.6% of participants with a low impulsivity score were linked to HIV care at 12-month. Substance use at 12-month follow-up was higher among participants with high impulsivity scores. Among those who had high impulsivity, 60.2% reported substance use at 12-month as compared to 42.9% of those who had low impulsivity. Those who had high impulsivity appeared more likely to report hazardous drinking at 12-month follow-up (61.1%) as compared to those who had a low impulsivity score (54.6%) (Table-2).

Our primary hypothesis that higher impulsivity would be associated with lower linkage to HIV care was not supported. While we observed lower odds of linkage to HIV care for those with higher impulsivity, the association was not statistically significant (AOR = 0.73, 95% CI = 0.39–1.37) (Table 3) in models controlling for age, gender, CD4 cell count, and depressive symptoms. We note the adjusted risk difference (ARD) was 0.07 (95% CI = −0.08–0.22).

After additional adjustment for substance use and hazardous drinking, the results for impulsivity were similar ((AOR = 0.77, 95% CI = 0.41–1.45) and (AOR = 0.74, 95% CI = 0.40–1.38), respectively) suggesting these factors were not confounders of the relationship between impulsivity and linkage to HIV care. We also did not detect an association between either 12-month substance use or hazardous drinking and linkage to HIV care ((AOR = 0.62, 95% CI = 0.35–1.11) and (AOR = 1.31, 95% CI = 0.73–2.33) respectively) (Table-4). We note the adjusted risk differences for impulsivity in models controlling for substance use and hazardous drinking were ARD = 0.06 (95% CI= −0.09–0.21) and ARD = 0.07 (95% CI = −0.08–0.22), respectively.

Discussion

This study addresses a gap in the literature by assessing how alcohol use and substance use affect the association between impulsivity and linkage to HIV care among PWID in Russia. The primary aim of this study was to evaluate the association between impulsivity and linkage to HIV care. We examined this question through secondary data analysis of the LINC study, a clinical trial among Russians living with HIV recruited from an inpatient

narcology hospital [33, 35]. This study contributes to the literature by finding that high impulsivity is not associated with linkage to HIV care among PWID in Russia. We also find that substance use and hazardous drinking do not confound the association between impulsivity and linkage to HIV care.

Consistent with previous literature, we note that substance use and impulsivity appear to be associated in this sample. For example, Barnes and colleagues (1999) found that impulsivity was associated with daily alcohol consumption, with a small effect size [49]. A large effect size was observed in a study using the Barratt Impulsiveness Scale to assess the correlation between impulsivity and alcohol use disorders [50]. The same scale also yielded a small effect size for the association between impulsivity and past substance dependence disorder [51]. Another study reporting a large effect size found impulsivity was associated with alcohol- and drug-related problems as measured by the Michigan Alcoholism Screening Test [52].

While impulsivity has been found to increase substance use behavior, some argue a bidirectional relationship between impulsivity and substance use [53–56]. For example, de Wit (2009) found that substance use negatively impacts performance on behavioral impulsivity tasks [54]. Research also suggests that substance use may have deleterious effects on cognitive development and increases impulsive tendencies [53]. These findings are critical to our results, especially given that our study focused on people who had a history of injecting drugs, which has been shown to be associated with impulsivity.

While other factors may influence decision-making in the context of substance use and linkage to care [57, 58], it is important to note that the methodological approach to the measurement of impulsivity in the current study may in part explain the lack of significant findings. In this study, we examined impulsivity as a global construct based on previous literature, which suggested that the Barratt Impulsiveness Scale measured a unidimensional construct of impulsivity. However, recent work by Dunne et al. has identified a two-factor model including non-planning and behavioral impulsivity among HIV-positive patients. This study found that non-planning impulsivity was associated with poor ART adherence. The study found that behavioral impulsivity was not associated with ART non-adherence among HIV-positive patients [8]. Behavioral impulsivity involves acting without thinking as compared to non-planning impulsivity. The latter, which includes present-focused thinking, may result in decisions being inconsistent with an individual's long-term goals or values, such as linking to HIV care. A future step in this work is to examine whether non-planning impulsivity is associated with initiating HIV care for this population.

Limitations

The LINC study was not designed to evaluate the relationship between impulsivity and linkage to HIV care. Therefore, this exploratory study may have been underpowered. In post hoc power calculations, we assumed the proportion linked to HIV care among those with low impulsivity was 55% (as observed in our sample). Based on this, our study has 80% power to detect an odds ratio as small as 0.46. Therefore, it is likely that this study was underpowered to detect associations of the observed magnitude (i.e., an odds ratio of 0.73). It is also important to consider that there is no standard cut-off for impulsivity with

the Barratt Impulsivity Scale. Therefore, we relied on using a median value to dichotomize the group. We found that the BIS score in our sample was within the range of scores obtained in other contexts. For example, a study conducted on students, faculty, and staff at the University of Massachusetts Boston had a mean BIS score of 60.23 (SD = 10.76). A different study conducted on suicide attempters in Yokohama, Japan, found a mean BIS score of 68.84 (SD = 11.32) in their sample [59, 60].

Additionally, the intervention addressed HIV-positive people who had a history of injecting drugs and received addiction treatment within the narcology hospital. Therefore, findings from the study have modest generalizability. However, narcology hospitals are a common mode of addiction treatment in Russia and Eastern Europe [61]. In Russia, engaging both HIV-positive PWID within narcology treatment and those not engaged in such care is needed. The study's implications may apply only to the Russian context, as opioid agonist treatment is unavailable in the country [62].

Conclusions

We did not find a statistically significant association between impulsivity and linkage to HIV care among HIV-positive patients in a Russian Narcology Hospital. While our study measured impulsivity as a global construct, future studies may examine the associations between non-planning impulsivity and linkage to HIV care.

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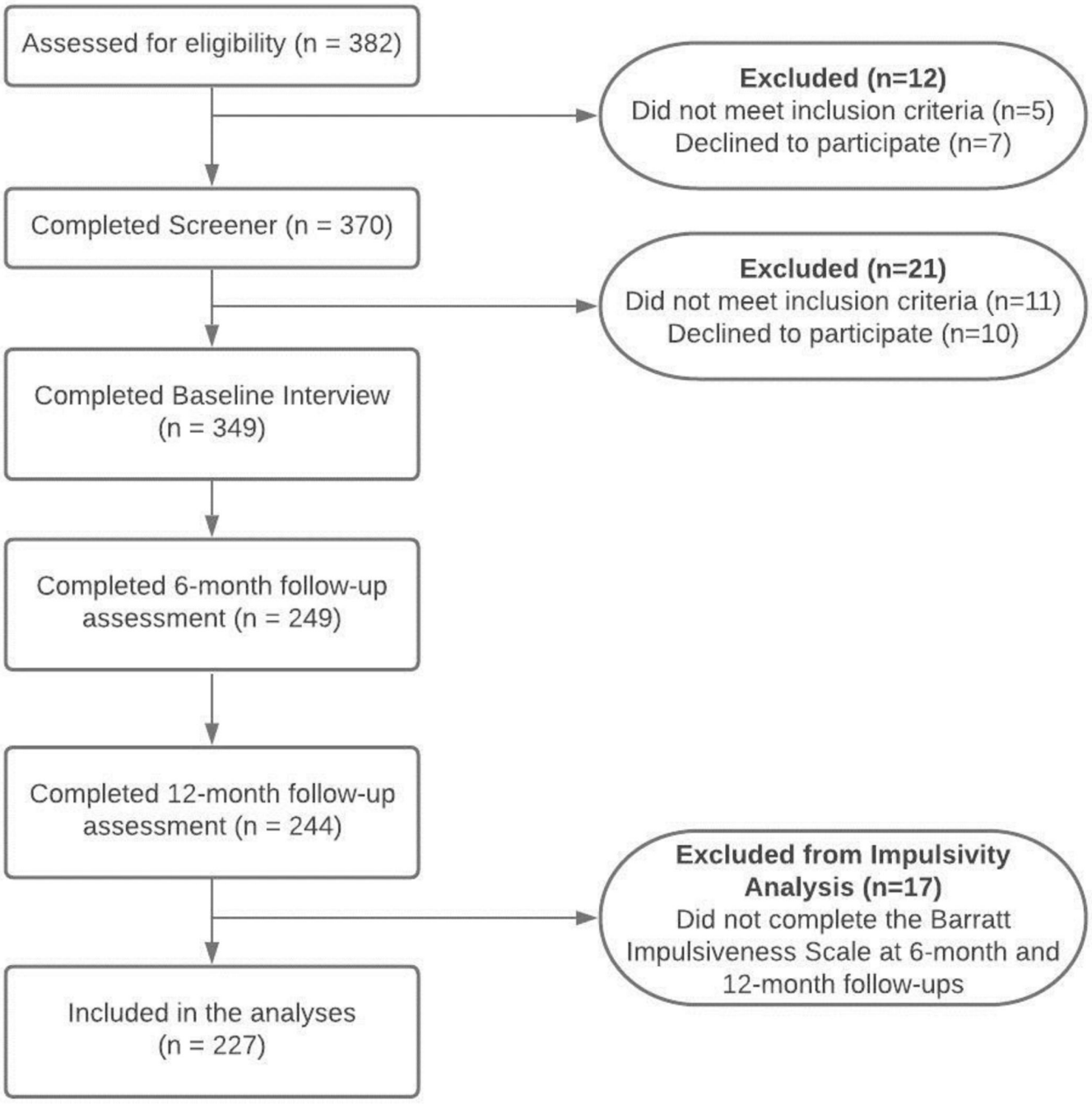

Figure 1:
Inclusion of participants for the Impulsivity analysis from the LINC study

Table 1

Descriptive statistics of demographic variables, impulsivity score, and other covariates across linkage to HIV care among N = 227 HIV positive patients in a Russian narcology hospital

Variables	Response	Overall	Linkage to HIV Care	
			No 112 (49.3%)	Yes 115 (50.7%)
Age in Years	N Mean (Std Dev) Min, 25th, Median, 75th, Max	227 34 (5) 24, 31, 34, 37, 49	112 34 (5) 24, 31, 34, 38, 47	115 35 (5) 25, 31, 34, 37, 49
Gender	Male	169 (74.4%)	85 (75.9%)	84 (73.0%)
	Female	58 (25.6%)	27 (24.1%)	31 (27.0%)
Impulsiveness Score	Low (< = 71)	119 (52.4%)	54 (48.2%)	65 (56.5%)
	High (> 71)	108 (47.6%)	58 (51.8%)	50 (43.5%)
At Risk for Depression (CES-D Score > = 24)	No	103 (48.8%)	51 (49.0%)	52 (48.6%)
	Yes	108 (51.2%)	53 (51.0%)	55 (51.4%)
CD4 Cell Count	N Mean (Std Dev) Min, 25th, Median, 75th, Max	217 367 (254) 7, 182, 318, 492, 1419	106 380 (259) 7, 178, 363, 519, 1364	111 355 (249) 16, 182, 303, 487, 1419
Substance Use	No	111 (48.9%)	47 (42.0%)	64 (55.7%)
	Yes	116 (51.1%)	65 (58.0%)	51 (44.3%)
Hazardous Drinking (AUDIT)	No	96 (42.3%)	45 (40.2%)	51 (44.3%)
	Yes	131 (57.7%)	67 (59.8%)	64 (55.7%)

Table 2

Linkage to HIV care, substance use, hazardous drinking, and other covariates by impulsivity score among N = 227 HIV positive patients in a Russian narcology hospital

Variables	Impulsivity Score		
	Response	**<= 71 119 (52.4%)**	**>71 108 (47.6%)**
Age in Years	N Mean (Std Dev) Min, 25th, Median, 75th, Max	119 35 (5) 25, 32, 35, 38, 49	108 33 (5) 24, 30, 33, 37, 48
Gender	Male	100 (84.0%)	69 (63.9%)
	Female	19 (16.0%)	39 (36.1%)
At Risk for Depression (CES-D Score > = 24)	No	72 (66.1%)	31 (30.4%)
	Yes	37 (33.9%)	71 (69.6%)
CD4 Cell Count	N Mean (Std Dev) Min, 25th, Median, 75th, Max	116 371 (251) 16, 187, 327, 479, 1419	101 363 (259) 7, 155, 311, 523, 1364
Substance Use	No	68 (57.1%)	43 (39.8%)
	Yes	51 (42.9%)	65 (60.2%)
Hazardous Drinking (AUDIT)	No	54 (45.4%)	42 (38.9%)
	Yes	65 (54.6%)	66 (61.1%)
Linkage to HIV Care	No	54 (45.4%)	58 (53.7%)
	Yes	65 (54.6%)	50 (46.3%)

Table 3

Adjusted odds ratio for the association of Impulsiveness Score on linkage to HIV care (model 1)

		Adjusted Odds Ratio	95% Confidence Interval	p-value (Wald Chi-Sq)
Impulsivity Score	Low (< = 71)	Ref	-	0.33 (0.9373)
	High (> 71)	0.73	0.39–1.37	

Model adjusted for respondent's age, gender, CD4 cell count, and CES-D score

Table 4

Adjusted odds ratio for the association of impulsivity score on linkage to HIV care, adjusting for substance use (model-2a) and hazardous drinking (model-2b) in addition to other covariates

			Adjusted Odds Ratio	95% Confidence Interval	p-value (Wald Chi-Sq)
Model-2a	Impulsivity Score	Low (< = 71)	Ref	-	0.42 (0.6413)
		High (> 71)	0.77	0.41–1.45	
	Substance use	No	Ref	-	0.11
		Yes	0.62	0.35–1.11	(2.6130)
Model-2b	Impulsivity Score	Low (< = 71)	Ref	-	0.35 (0.2683)
		High (> 71)	0.74	0.40–1.38	
	Hazardous drinking	No	Ref	-	0.36
		Yes	1.31	0.73–2.33	(0.8246)

Both models adjusted for respondent's age, gender, CD4 cell count, and CES-D score