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Alcohol Use and Food Insecurity Among People Living with HIV in Mbarara, Uganda and St. Petersburg, Russia

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Abstract Food insecurity (FI) is a documented problem associated with adverse health outcomes among HIV-infected populations. Little is known about the relationship between alcohol use and FI. We assessed whether heavy alcohol use was associated with FI among HIV-infected, antiretroviral therapy (ART)-naïve cohorts in Uganda and Russia. Inverse probability of treatment weighted logistic regression models were used to evaluate the association using cross-sectional baseline data. FI was experienced by half of the Russia cohort (52 %) and by a large majority of the Uganda cohort (84 %). We did not detect an association between heavy alcohol use and FI in either cohort (Russia: AOR = 0.80, 95 % CI 0.46, 1.40; Uganda: AOR = 1.00, 95 % CI 0.57, 1.74) or based on the overall combined estimate (AOR = 0.89, 95 % CI 0.60, 1.33). Future studies should explore the determinants of FI in HIV-infected populations to inform strategies for its mitigation.

Resumen La inseguridad alimenticia (IA) se asocia a peor estado de salud en la población infectada por el VIH. La relación entre el consumo de alcohol y la IA ha recibido poca atención. En este estudio evaluamos si el consumo excesivo de alcohol estaba asociado con la IA en pacientes infectados por el VIH que no recibían terapia antirretroviral de Uganda y Rusia. Utilizamos modelos ponderados de regresión logística de probabilidad inversa de tratamiento para evaluar la asociación entre consumo de alcohol IA usando datos transversales de las dos cohortes de pacientes. La IA estaba presente en la mitad de los pacientes en Rusia (52 %) y en una amplia mayoría de los pacientes en Uganda (84 %). No detectamos una asociación entre el consumo excesivo de alcohol y la IA en ninguno de los dos países (Rusia: AOR = 0.80, 95 % CI 0.46, 1.40; Uganda: AOR = 1.00, 95 % CI 0.57, 1.74) ni tampoco en la estimación combinada de las dos cohortes (AOR = 0.89,

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95 % CI 0.60, 1.33). Es necesario conocer los determinantes de la IA en poblaciones infectadas con el VIH para diseñar estrategias para combatirla.

Keywords Food insecurity · HIV · Alcohol

Palabras Clave Inseguridad alimenticia · VIH · Alcohol

Introduction

Overview

Globally, 795 million people are undernourished, including 780 million people in developing countries [1]. Food insecurity (FI), the "limited or uncertain availability of nutritionally adequate and safe foods or limited or uncertain ability to acquire acceptable foods in socially acceptable ways" and HIV infection often co-occur [2, 3]. Improving food security among HIV-infected people is a global health priority, as this population is highly vulnerable to the effects of inadequate nourishment [4–7].

Food Insecurity Among Individuals with HIV Infection

Numerous studies have found an association between FI and ART non-adherence in such diverse populations as people with illicit drug use or alcohol use in the United States [8, 9], patients receiving ART at health facilities in the Democratic Republic of Congo, Namibia, and Senegal [10–12], and patients initiating ART in Peru [13]. In a study in Mbarara, Uganda in which participants were followed for a median of 2.1 years, 26 % of those severely food insecure gave up ART for food during follow-up and 80 % gave up "adequate food for themselves or their family" to access outpatient care [14].

FI has also been associated with adverse health outcomes in HIV-infected populations. These adverse outcomes include reduced health-related quality of life as measured by the medical outcomes study-HIV (MOS-HIV) (i.e., mental health and/or physical health status scores) [14, 15]; low CD4 count [16, 17]; increased depressive symptom severity [18]; new opportunistic infections [14]; an increase in the number of hospitalizations [14]; incomplete viral suppression [19–23]; and mortality [24]. How FI affects these important HIV outcomes is not clear, as is evident in a study from San Francisco in which associations between FI and low CD4 count and unsuppressed viral load were not fully explained by ART non-adherence, supporting the proposition that FI affects clinical outcomes via multiple pathways [17].

Alcohol Use and Food Insecurity

In a conceptual framework proposed by Weiser et al. [25, 26] (Fig. 1), FI increases the risk of HIV acquisition and transmission and worsens HIV/AIDS morbidity and mortality via nutritional, mental health, and behavioral pathways. In this framework, along the mental health pathway, FI is hypothesized to be positively associated with drug and alcohol use which are thought to be (1) directly associated with worse clinical outcomes and (2) indirectly associated with worse clinical outcomes via positive associations with ART non-adherence, missed clinic visits, and treatment interruptions. The resulting morbidity leads to increased FI (e.g. by reducing one's ability to work), thus forming a self-reinforcing downward cycle [25, 26]. In addition to the associations between FI and health outcomes, the association between FI and alcohol use may also be bidirectional [26], as FI is associated with poor mental health [27], anxiety symptoms [28], and depressive symptoms [18, 28–30].

Although several studies have explored the association between illicit drug use and FI in HIV-infected populations [31], the association between alcohol use and FI in HIV-infected populations has received less critical scrutiny. Normén et al. found a positive unadjusted association between ever having been in a drug or alcohol treatment program and FI among patients enrolled in a public ART program in British Columbia, Canada [32]. Among homeless and marginally housed HIV-infected persons in San Francisco, Weiser et al. found an unadjusted association between recent drug use and severe FI, but no such association with recent problem alcohol use [21]. A positive unadjusted association between recent heavy episodic drinking and FI was found among veterans receiving ART in the Veterans Aging Cohort Study, but no association was detected between past year hazardous alcohol consumption

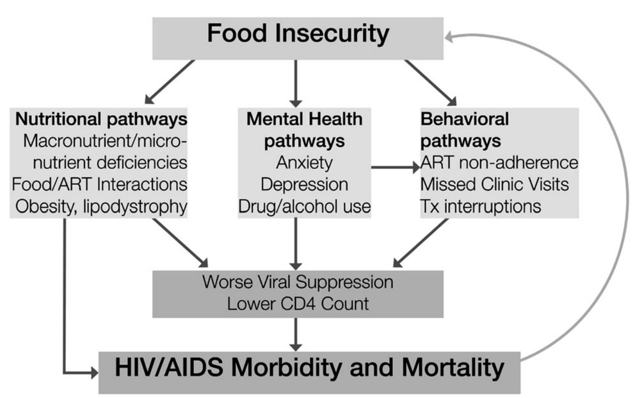

Fig. 1 Food insecurity and HIV/AIDS morbidity and mortality [25]

and FI [19]. Among HIV–HCV co-infected individuals in six Canadian provinces, Cox et al. did not find an independent association between current heavy alcohol use and FI [33].

In studies outside the realm of HIV infection, the association between alcohol use and FI has been examined numerous ways with inconsistent results. In Ethiopia, any alcohol use by the head of the household was independently associated with an increase in the level of FI [34]. Among women with newborns in South Africa, FI was independently associated with hazardous drinking [35]. In South Africa, Eaton et al. found unadjusted associations between two measures of alcohol use and FI among women but not among men [36]. No significant independent association was found between heavy episodic drinking and FI among US military veterans in the Veterans Health Administration [37]. It is notable that most of the data about FI and health outcomes, both HIV and non-HIV-related, come from work in North America and Africa. Understanding alcohol's relationship to FI in countries with particularly high per capita alcohol consumption (e.g., Sub-Saharan Africa and Eastern Europe) is of interest as the possibility of individuals buying alcohol rather than food is a real concern.

This study aims to contribute to the understanding of the relationship between alcohol use and FI in HIV-infected persons. Specifically, the primary objective is to evaluate the association between heavy alcohol use and FI among HIV-infected persons who have not initiated ART in Mbarara, Uganda and St. Petersburg, Russia. The pre-ART status allows an examination of the association between alcohol use and FI without the association being mediated by worse ART adherence. A secondary objective is to explore whether gender is an effect modifier of the relationship between alcohol use and FI. This secondary objective is intended to be descriptive and hypothesis-generating. There is evidence that women are at greater risk for FI than men [32, 38] and the association between alcohol use and FI may differ by gender [36].

Methods

Study Design

We analyzed baseline data from two prospective cohort studies within the Uganda Russia Boston Alcohol Network for Alcohol Research Collaboration on HIV/AIDS (URBAN ARCH) consortium: Uganda ARCH conducted in Mbarara, Uganda and Russia ARCH conducted in St. Petersburg, Russia.

Participants

Overview

The study population in both cohorts is HIV-infected, ART-naïve adults with a range of current alcohol consumption, including abstinence.

Russia ARCH Cohort

From November 2012 to June 2015, we enrolled 364 participants from clinical HIV and addiction sites, non-clinical sites, and via snowball recruitment in St. Petersburg, Russia. We obtained informed consent and conducted in-person assessments at First Saint Petersburg Pavlov State Medical University. Eligibility criteria included the following: 18–70 years of age; HIV infection and ART-naïve status verified with documentation from a healthcare provider; having a home or mobile telephone; living within 100 km of St. Petersburg; and providing the contact information of $\geq$2 friends or family members to assist in follow-up. Exclusion criteria were lack of fluency in Russian or cognitive impairment. Thirteen participants were subsequently unenrolled because they were determined to be HIV negative or due to unsuccessful phlebotomy, a key aspect of the main study. The study sample includes 351 participants, three of whom were excluded from adjusted analyses due to missing covariates.

Uganda ARCH Cohort

From September 2011 to August 2014, we enrolled 484 participants from the immune suppression syndrome (ISS) Clinic of the Mbarara Regional Referral Hospital in Uganda. Informed consent and in-person interviews were conducted at the ISS Clinic. Eligibility criteria included the following: $\geq$18 years of age; fluency in Runyankole or English; ability to give informed consent; residence within 60 km or less than a 2-h drive from the clinic; no current or previous ART; not scheduled for initiation of ART within the next 3 months; diagnosis of WHO Stage I or II disease (asymptomatic or mild disease); and CD4 count >350 cells/mm^3 (>500 as of February 19, 2014, due to a Ugandan guideline change for ART eligibility). Exclusion criteria were pregnancy or incarceration. Participants with low (<1000 copies/ml) or non-detected HIV viral load at baseline were tested for the presence of HIV antibodies or ART. Thirty-two of these participants were found to be either uninfected by HIV or had indeterminate results and five participants were positive for ART. These 37 participants were subsequently unenrolled from the study. Due to missing data, 445 participants were included in unadjusted analyses and 444 in adjusted analyses.

Ethics Statement

The Russia ARCH study was approved by the institutional review boards of Boston University Medical Campus and First St. Petersburg Pavlov State Medical University. The Uganda ARCH study was approved by the institutional review boards of Boston University Medical Campus, University of California, San Francisco, Mbarara University of Science and Technology, and the Uganda National Council of Science and Technology.

Measurements

At both study sites, all baseline assessments were conducted in person by trained research assessors. In Mbarara, assessments were administered in Runyankole or English, based on each participant's language preference. In St. Petersburg, all assessments were administered in Russian.

Outcomes

The primary outcome was any FI in the past 4 weeks as measured by nine items of the household food insecurity access scale (HFIAS) as revised in 2007 [39, 40]. The nine items and three domains of the HFIAS were created to capture the experience of lack of food access "across countries and cultures" [39]. The HFIAS is used to categorize households as food secure, mildly food insecure, moderately food insecure, and severely food insecure [40]. In the main analysis, we dichotomized level of FI as any level of FI (mild, moderate, or severe) versus food secure. In a secondary analysis, we dichotomized level of FI as severely food insecure versus not severely food insecure.

Main Independent Variable

The main independent variable in this study was heavy alcohol use. For Uganda ARCH, we used the alcohol use disorders identification test-consumption (AUDIT-C) to assess drinking in the previous 3 months [41, 42]. Participants with AUDIT-C scores in the hazardous range (AUDIT-C score $\geq$4 for men; $\geq$3 for women) or a blood phosphatidylethanol (PEth) level of $\geq$50 ng/ml were considered heavy drinkers. We included PEth, a metabolite of ethanol, as part of our assessment of heavy drinking because previous studies in Uganda have found common underreporting of alcohol use in an HIV care setting [43–45].

For Russia ARCH, we assessed alcohol use via the 30-day Timeline Followback method [46, 47]. With the aid of a calendar, the assessor and participant discussed alcohol consumption on each of the past 30 days and recorded the volumes of 4 alcoholic drink types (beer or low alcohol content cocktails, wine or high alcohol content cocktails, spirits, fortified wine) consumed on each day. The volumes were later converted to standard drinks with conversions for the alcohol content of each drink type [48]. Heavy alcohol use was defined in men as those who drank >4 drinks in a day or 14 drinks per week in the past 30 days and in women as those who drank >3 drinks in a day or 7 per week [49].

Covariates

Covariates were selected based on the literature and clinical knowledge about the two populations. Factors included as potential confounders for both Russia ARCH and Uganda ARCH included: age, gender, educational attainment beyond basic education in each setting (greater than nine grades in Russia and greater than primary education in Uganda), marital status (defined in Uganda as having a spouse, defined in Russia as married or living with a partner), and income (self-reported monthly income tertiles for the Russia ARCH cohort; an asset index score categorized into low, medium, or high household wealth in Uganda).

In addition to the above, for Russia ARCH, we included the covariates of drug dependence and alcohol dependence in the past 12 months (DSM-IV criteria) with the Mini International Neuropsychiatric Interview 6.0 (MINI) drug instrument and alcohol instrument [50]; and MOS Social Support Survey score [51], dichotomized at the median. Baseline CD4 count was available for a subset of Russian participants and was included in a sensitivity analysis.

For the Uganda ARCH cohort, additional covariates included: religious affiliation, categorized as Catholic, Protestant/Anglican, and Muslim/Saved/other; literacy, evaluated by the research assistant and dichotomized as being able to read a full sentence versus not being able to read a full sentence; CD4 count (continuous); and HIV Symptom Index (dichotomized at the sample's median) [52]. Drug dependence was not assessed in Uganda due to the rarity of drug use.

Statistical Analysis

We stratified preliminary analyses by cohort to characterize the two study samples and assess whether the association between heavy alcohol use and FI was similar in the two cohorts. To characterize the study samples, we first computed descriptive statistics for baseline characteristics overall and stratified by heavy alcohol use. Propensity scores were used to minimize confounding due to measured covariates [53]. We applied the propensity scores using inverse probability of treatment weighted (IPTW) logistic regression models to evaluate the association between heavy alcohol use and FI. Predicted probabilities of heavy alcohol use (i.e., the propensity score for each participant) were calculated from a multiple logistic regression model, which included the potential confounders of the association between heavy alcohol use and FI. Subjects were then weighted by the inverse probability of being in their observed alcohol group, with probabilities determined based on estimated propensity scores. We evaluated covariate balance by assessing standardized differences by heavy drinking status in the weighted sample. An absolute difference of <0.20 was considered acceptable [54].

The Russia and Uganda ARCH cohorts come from two diverse populations with unique demographics. In addition, covariates were expected to differ for the two cohorts as described above. Thus although we have individual level data from the two cohorts, because covariates differed by cohort, the data were not pooled into a single analysis as this may produce biased results. A random effects meta-analysis was used to account for within and between study variability [55].

There was not a significant difference between the cohort-specific odds ratios ($p = 0.59$). Therefore we conducted a subsequent analysis to provide a single overall estimate of the association between heavy alcohol use and FI. Secondary analyses of the outcome of severe FI were analyzed using the same approach. To explore and describe whether gender is an effect modifier of the relationship between heavy alcohol use and FI, we stratified analyses by gender within each cohort, developing propensity score models separately for men and women. We also conducted post hoc analyses to explore whether income (Russia cohort)/household wealth (Uganda cohort) were effect modifiers of the relationship between heavy alcohol use and FI and whether drug dependence was a mediator of the association between heavy alcohol use and FI in the Russia cohort. An alpha level of 0.05 was used for all tests. Analyses were conducted using SAS version 9.3 (SAS Institute Inc., 2011).

Results

The Russia ARCH cohort study sample included 351 participants with a mean age of 34 years and 71 % male; 250 (71 %) reported current heavy alcohol use. Educational attainment greater than basic education was common (79 %). Nearly half (43 %) were married or were living with a partner and over a third (37 %) injected drugs in the past 30 days. A majority (62 %) met criteria for alcohol dependence in the past 12 months and a similar proportion (56 %) for drug dependence. FI in the past 4 weeks was common, with 52 % food insecure, including 23 % severely food insecure. In the propensity score weighted sample (Table 1), participants without heavy drinking were similar to participants with heavy drinking on all characteristics which were considered potential covariates in the Russia ARCH cohort.

The Uganda ARCH cohort study sample included 445 participants with a mean age of 34 years and 32 % male; 192 (43 %) had current heavy alcohol use and half (49 %) were married. Two-thirds (68 %) were literate and 30 % had education beyond basic education. No participants had injected drugs in the past 30 days. A small minority (18 %) met criteria for alcohol dependence in the past 12 months. Half (49 %) were Protestant or Anglican, 35 % were Catholic, and 16 % were Muslim, Saved, or other. FI in the past 4 weeks was very common, with 84 % food insecure, including 32 % severely food insecure. In the propensity score weighted sample (Table 1), participants without heavy drinking were similar to participants with heavy drinking on all characteristics which were considered potential covariates in the Uganda ARCH cohort.

Heavy Alcohol Use and Food Insecurity

In unadjusted analyses (Table 2), we did not find a significant association between heavy alcohol use and FI in the Russia ARCH cohort (OR = 0.90, 95 % CI 0.57–1.43) or in the Uganda ARCH cohort (OR = 0.85, 95 % CI 0.51–1.42).

In the weighted analyses, adjusted for potential confounders (Table 3), we did not detect an association between heavy alcohol use and FI in either cohort (Russia: AOR = 0.80, 95 % CI 0.46–1.40; Uganda: AOR = 1.00, 95 % CI 0.57–1.74) or based on the overall combined estimate from the two cohorts (AOR = 0.89, 95 % CI 0.60–1.33). A confirmatory analysis adjusting for baseline CD4 count in the subset of the Russian cohort with CD4 count results available (n = 246) yielded similar results to the primary results above (AOR = 0.59, 95 % CI 0.14–2.46).

In exploratory gender-stratified analysis (Table 4) we did not find an association between heavy alcohol use and FI among women (AOR = 0.44, 95 % CI 0.16–1.23) or men (AOR = 1.02, 95 % CI 0.53–1.99) in the Russia ARCH cohort. Similarly, in the Uganda ARCH cohort, the analysis did not find an association between heavy alcohol use and FI among women (AOR = 1.14, 95 % CI 0.55–2.39) or men (AOR = 0.65, 95 % CI 0.25–1.70).

There were no significant relationships between current heavy alcohol use and the secondary outcome of severe FI in unadjusted analyses (Table 2, Russia: OR = 0.98, 95 % CI 0.56–1.70; Uganda: OR = 1.35, 95 % CI 0.91–2.02) or adjusted analyses (Table 3, Russia: AOR = 0.85, 95 % CI 0.45–1.61; Uganda: AOR = 1.47, 95 % CI 0.93–2.31;

Table 1 Characteristics of HIV-infected ART-naïve cohorts from Uganda and Russia stratified by heavy alcohol use in the propensity score weighted samples

Characteristic	Russia ARCH cohort n = 348			Uganda ARCH cohort n = 444		
	Current abstinence or non-heavy alcohol use	Current heavy alcohol use	Standardized difference	Current abstinence or non-heavy alcohol use	Current heavy alcohol use	Standardized difference
Male	71.0 %	70.6 %	−0.01	32.1 %	31.1 %	−0.02
Age mean (SD)	34.1 (9.7)	33.7 (7.1)	−0.04	34.1 (13.6)	34.1 (15.0)	0.00
Greater than basic education	76.2 %	77.9 %	0.04	30.0 %	32.8 %	0.06
Married[a]	42.8 %	43.1 %	0.01	49.7 %	43.0 %	−0.13
Income tertile or asset category						
Lowest	37.2 %	37.4 %	0.00	38.5 %	37.1 %	−0.03
Middle	31.3 %	31.3 %	0.00	41.1 %	42.7 %	0.03
Highest	31.5 %	31.3 %	−0.01	20.4 %	20.2 %	0.00
Current injection drug use (30 days)	33.4 %	40.6 %	0.15	0 %	0 %	–
Alcohol dependence (12 months)	59.0 %	61.4 %	0.05	3.1 %	37.0 %	0.93
Drug dependence (12 months)	56.2 %	55.7 %	−0.01	–	–	–
Low social support	49.1 %	49.7 %	0.01	51.4 %	55.8 %	0.09
CD4 count[b] mean (SD)	558 (587)	520 (342)	−0.08	571 (271)	571 (296)	0.00
HIV symptom count high (4 weeks)	73.2 %	43.4 %	−0.63	62.6 %	65.1 %	0.05
Religion						
Catholic	–	–	–	36.5 %	35.7 %	−0.02
Protestant/Anglican	–	–	–	47.6 %	45.9 %	−0.03
Muslim/Saved/other	–	–	–	15.9 %	18.4 %	0.07
Literate	–	–	–	68.3 %	67.6 %	−0.01
Food insecurity (insecure vs. secure)	53.8 %	48.2 %	−0.11	83.5 %	83.4 %	0.00
Severe food insecurity (severe vs. moderate, mild, secure)	24.8 %	21.9 %	−0.07	28.2 %	36.6 %	0.18

[a] In Russia ARCH cohort, married or living with partner

[b] In Russia ARCH cohort, n = 246; in Uganda ARCH cohort, n = 444

overall combined estimate: AOR = 1.17, 95 % CI 0.69–1.99).

In gender-stratified analyses (Table 4), we did not find an association between heavy alcohol use and severe FI among women (AOR = 0.45, 95 % CI 0.16–1.30) or men (AOR = 1.30, 95 % CI 0.55–3.03) in the Russia ARCH cohort. In the Uganda ARCH cohort there was a significant positive association between heavy alcohol use and severe FI among women (AOR = 1.74, 95 % CI 1.02–2.97) but not among men (AOR = 0.95, 95 % CI 0.38–2.38).

In exploratory post hoc analyses, we did not detect interactions between heavy alcohol use and income for either the Russia cohort (p = 0.71) or the Uganda cohort (p = 0.27). Subsequent stratified analyses showed greater variability across income levels for the Uganda cohort compared with the Russia cohort [Russia: lowest income tertile (AOR = 0.67, 95 % CI 0.25–1.75), middle income tertile (AOR = 0.69, 95 % CI 0.22–2.11), highest income tertile (AOR = 1.11, 95 % CI 0.40–3.08); Uganda: lowest asset level (AOR = 0.96, 95 % CI 0.36–2.57), middle asset level (AOR = 1.56, 95 % CI 0.56–4.35), highest asset level (AOR = 0.62, 95 % CI 0.23–1.68)].

An additional post hoc analysis was performed to assess potential mediation by drug dependence in the Russia cohort. We found that the adjusted odds ratio for heavy alcohol was similar in models with (AOR = 0.80, 95 % CI 0.46–1.40) and without drug dependence as a covariate (AOR = 0.73, 95 % CI 0.42–1.28), suggesting drug dependence is not a mediator of the relationship between heavy alcohol use and FI.

Although propensity score analyses do not generate measures of association between potential confounders and the outcome of interest, we ran multiple logistic regression

Table 2 Unadjusted associations between heavy alcohol use and food insecurity among HIV-infected ART-naïve cohorts from Uganda and Russia

Outcome	Russia ARCH cohort				Uganda ARCH cohort			
	Current abstinence or non-heavy alcohol use n = 101	Current heavy alcohol use n = 250	Crude OR (95 % CI)	p value	Current abstinence or non-heavy alcohol use n = 253	Current heavy alcohol use n = 192	Crude OR (95 % CI)	p value
Food insecurity (insecure vs. secure)	54 (53.5 %)	127 (50.8 %)	0.90 (0.57, 1.43)	0.65	215 (85.0 %)	159 (82.8 %)	0.85 (0.51, 1.42)	0.54
Severe food insecurity (severe vs. moderate, mild, secure)	23 (22.8 %)	56 (22.4 %)	0.98 (0.56, 1.70)	0.94	73 (28.9 %)	68 (35.4 %)	1.35 (0.91, 2.02)	0.14

Table 3 Adjusted associations between heavy alcohol use and food insecurity among HIV-infected ART-naïve cohorts from Uganda and Russia

	N	Adjusted* OR (95 % CI)	p value
Primary outcome: food insecurity			
Russia ARCH	348	0.80 (0.46, 1.40)	0.43
Uganda ARCH	444	1.00 (0.57, 1.74)	0.99
Overall combined estimate	792	0.89 (0.60, 1.33)	0.59
Secondary outcome: severe food insecurity			
Russia ARCH	348	0.85 (0.45, 1.61)	0.62
Uganda ARCH	444	1.47 (0.93, 2.31)	0.10
Overall combined estimate	792	1.17 (0.69, 1.99)	0.17

* Based on inverse probability treatment weighted logistic regression models

Table 4 Adjusted associations between heavy alcohol use and food insecurity by gender

Cohort	Stratum	N	Current abstinence or non-heavy alcohol use	Current heavy alcohol use	Adjusted* OR (95 % CI)	p value
Primary outcome: food insecurity						
Russia ARCH	Women	102	18 (66.7 %)	38 (50.7 %)	0.44 (0.16, 1.23)	0.12
	Men	246	35 (48.0 %)	89 (51.4 %)	1.02 (0.53, 1.99)	0.95
Uganda ARCH	Women	300	166 (86.0 %)	94 (87.9 %)	1.14 (0.55, 2.39)	0.72
	Men	144	48 (81.4 %)	65 (76.5 %)	0.65 (0.25, 1.70)	0.38
Secondary outcome: severe food insecurity						
Russia ARCH	Women	102	11 (40.7 %)	16 (21.3 %)	0.45 (0.16, 1.30)	0.14
	Men	246	12 (16.4 %)	40 (23.1 %)	1.30 (0.55, 3.03)	0.55
Uganda ARCH	Women	300	57 (29.5 %)	50 (46.7 %)	1.74 (1.02, 2.97)	0.04
	Men	144	16 (27.1 %)	18 (21.2 %)	0.95 (0.38, 2.38)	0.92

* Based on inverse probability treatment weighted logistic regression models

models in preliminary analyses. Among the common covariates (age, gender, education, marital status, and income/wealth), female gender was associated with increased odds of FI in the Uganda cohort (AOR = 2.13, 95 % CI 1.19–3.78) but not in the Russia cohort (AOR = 1.15, 95 % CI 0.66–1.99). In both cohorts, low income or wealth versus high was associated with increased odds of FI (Uganda: AOR = 3.33, 95 % CI 1.55–7.14; Russia: AOR = 4.63, 95 % CI 2.50–8.57) and middle income or wealth versus high was associated with increased odds of FI (Uganda: AOR = 2.68, 95 % CI 1.36–5.26; Russia: AOR = 3.68, 95 % CI 2.02–6.70).

Discussion

In this study of ART-naïve, HIV-infected individuals in Mbarara, Uganda and St. Petersburg, Russia, we were unable to detect an association between current heavy alcohol use and the primary outcome of FI or the secondary outcome severe FI.

Exploratory gender-stratified analyses found a significant association between heavy alcohol use and severe FI among women but not among men in the Uganda ARCH cohort. However, given the multiple comparisons conducted and the exploratory nature of these analyses, we interpret these results as preliminary, hypothesis-generating analyses that merit further investigation.

In post hoc analyses, income/household wealth did not appear to be an effect modifier of the association between heavy alcohol use and FI by income in either cohort. We also did not find evidence that drug dependence is a mediator of the relationship between heavy alcohol use and FI in the Russia cohort. We did not explore mediation by drug use in the Uganda cohort due to the rarity of drug use in that cohort. The Uganda cohort affords us the opportunity to explore alcohol use in the almost complete absence of other substance use.

This study is unique in its exploration of FI in Eastern Europe and its examination of FI and alcohol use in two very different contexts. The majority of participants in Uganda ARCH work in agriculture while residents in the St. Petersburg region live in a densely populated city. Although previous studies have explored FI in Mbarara, Uganda, this is the first study in that setting to investigate the association between alcohol use and FI. Despite the different cultural contexts, the prevalence of FI and alcohol use in these HIV-infected populations is very high and the estimated associations between FI and alcohol were similar.

Given food insecurity's association with adverse outcomes in HIV-infected persons, further research that may inform strategies for mitigating FI and the adverse consequences associated with FI in these populations is warranted. It is unlikely however, given the absence of a significant association between heavy alcohol use and FI in both cohorts, that addressing alcohol consumption per se will ameliorate FI or its possible undesirable associations.

Weiser et al. explores competing demands for resources in a resource-poor setting in the context of the tradeoff between food and healthcare services [14]. Anema et al. found that injection drug users in British Columbia who spend more than $50 per day on drugs had increased odds of FI in adjusted analyses compared with those spending less than $50 per day on drugs [56]. It may be that the relative expenditure for alcohol in Uganda and Russia was not as high, which may in part explain the absence of the association of alcohol use and FI. In a study in Mbarara, Uganda among HIV-infected participants with alcohol use in the past year, Asiimwe et al. calculated that the median total expenditure on alcohol was less than $20 over the past 3 months combined [57].

Limitations

The HFIAS was modified in the assessment administered to the Russia ARCH cohort. The modified questions ask only about a participant's experience with FI rather than the experience of all members of the participant's household, as this was perceived by Russian collaborators as a response that could be better assessed. This may result in misclassifying a participant in a food insecure household as food secure if, for example, another household member is forgoing food to aid the participant. In addition, the modified questions do not distinguish between eating less often, for example, due to a lack of resources versus other reasons. This may result in misclassifying a food secure participant as food insecure if they forgo food because of illness or other reasons rather than a lack of resources. These changes may affect the generalizability of our results with other household FI research. Assessing individual-level FI in the Russia ARCH cohort and household FI in the Uganda ARCH cohort may account for some of the differences seen in the two cohorts.

We cannot assess causality or directionality of associations due to the observational and cross-sectional design of this study. The outcome and main independent variables were acquired primarily via self-report. However, we believe that including the PEth biomarker in the Uganda ARCH sample addressed the area of most concern for underreporting, alcohol use in Uganda.

Conclusions

Despite FI and heavy alcohol use being very common in two HIV-infected ART-naïve cohorts in Mbarara, Uganda and St. Petersburg, Russia, these two characteristics, each associated in the literature with adverse HIV outcomes, were not significantly associated with each other.

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Compliance with Ethical Standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical 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.

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

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