Original Report

Mental Health and Cognitive Performance Among Older People Living with HIV in Georgia

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Introduction: Highly effective antiretroviral therapy has increased the life expectancy of people living with HIV (PLWH), resulting in an increase in noncommunicable diseases, including cognitive and mental health disorders. Published literature on cognitive performance in older PLWH is scarce in low- and middle-income countries, including Georgia. Our study aimed to assess mental health and cognitive performance and identify associated factors among PLWH aged ≥40 years.

Methods: Primary mental health and behavior assessments included the Drug Use Disorder Identification Test, the Alcohol Use Disorder Identification Test, the Beck Depression Inventory (BDI), and the General Anxiety Disorder 7 (GAD-7). Cognitive assessments included the Montreal Cognitive Assessment (MoCA); Trail Making Tests A and B; verbal fluency; Stroop 1, 2, and 3; and Grooved Pegboard. Univariate and multivariable regression analyses were performed to identify factors associated with cognitive performance.

Results: Our sample included 125 PLWH (78 men, 47 women). Drug use–related problems or drug dependence was observed in 36% and hazardous or harmful alcohol consumption among 23%. Mild to extreme depressive symptoms were observed among 51% and mild to severe anxiety among 47%. A MoCA score <26 was observed among 89%. Multivariable regression analyses showed higher mean scores on the Stroop Test 3 associated with higher scores on the GAD-7 (β=.40; 95% CI, 0.12-0.68) and BDI (β=.70; 95% CI, 0.17–1.2). No other associations were observed.

Conclusion: This study shows high percentages of psychiatric and cognitive morbidities among older PLWH in Georgia. Longitudinal studies should be conducted to evaluate cognitive performance and associated factors among older PLWH in Georgia. *Ethn Dis.* 2025;35(2):73–82; doi:10.18865/EthnDis-2024-17

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Introduction

Twenty-first–century antiretroviral therapy (ART) effectively suppresses HIV viral load, reduces HIV-associated mortality, and increases lifespan.[1] Global projections are that, by 2030, the median age of people living with HIV (PLWH) will rise to 56.6 years, the proportion of PLWH aged ≥50 years will reach 73%, and about 84% of PLWH will have at least one noncommunicable disease (NCD).[2]

The increased lifespan is associated with a higher prevalence of neurodegenerative diseases and mental health problems among PLWH,[3,4] significantly impacting treatment adherence, quality of life, and overall HIV health outcomes.[4,5] Vascular risk factors, including hypertension, hypercholesterolemia, and obesity, in addition to substance use, depression, and anxiety may have additive effects on HIV and contribute to the relatively early onset of cognitive disorders among PLWH.[6-8] Literature on the cognitive performance among older PLWH is scarce in low- and middle-income countries, particularly in the Eastern Europe and Central Asia (EECA) region, experiencing the sharpest rise in the number of new HIV infections in the world.[9]

The overall burden of NCDs is high in Georgia.[10] The age-standardized prevalence of hypertension and the probability of dying from cancer, diabetes, or cardiovascular or chronic respiratory disease altogether among adults are 44.5% and 25%, respectively.[11] Substance use also places a substantial burden. Per capita annual consumption of pure alcohol is 14.4 L.[12] The prevalence of illicit drug use is higher than the average in the EECA region.[13]

A study on cognitive performance among individuals >40 years in Georgia demonstrated that the prevalence of mild cognitive impairment (MCI) (defined as Montreal Cognitive Assessment [MoCA] score <22) was 13.3% and the mean MoCA score was 25.2±3.1. Male sex, self-reported history of hypertension and

diabetes, living in rural areas, and older age (>65 years) were positively associated with MCI, and lower education was protective.[14] Among cognitively healthy individuals who developed MCI over 7 years, 86% showed depressive symptoms on the Beck Depression Inventory (BDI) at follow-up (no baseline data on BDI scores are available).[15]

The incidence and prevalence of NCDs, including cognitive disorders and associated risk factors, among PLWH in Georgia are unexplored. However, the burden is likely to be higher among PLWH due to the epidemiological features of HIV. Specifically, injection drug use was the leading transmission route for HIV infection, and at the time of this publication, it accounted for 31.3% of new infections in Georgia. Additionally, about 13% of HIV transmissions occur through men having sex with men.[16] Both communities, in addition to other key populations among which the HIV epidemic is concentrated in Georgia,[17] experience high levels of stigma and mental health and behavioral disorders.[18,19] The prevalence of hepatitis C virus (HCV) coinfection is particularly high among some PLWH, especially among PLWH who inject drugs.[19] One study conducted among women living with HIV in Georgia reported that >50% of survey respondents had had mental health symptoms since HIV diagnosis.[20]

Given this context, we aimed to assess cognitive performance (using standardized neurocognitive assessments as described in the Methodology section below) and measure the prevalence of mental health symptoms (using standardized screening methods for depression, anxiety, and drug and alcohol use disorders, described in the Methodology section below) among PLWH aged ≥40 years. We hypothesized that more mental health symptoms and substance use would be associated with poorer cognitive performance in our sample.

Methodology

Data Collection

A cross-sectional pilot study was conducted in 5 major cities in Georgia: Tbilisi (the capital city), Gori, Kutaisi, Zugdidi, and Batumi. Community-based organizations were engaged to recruit participants, using a convenience sampling method. One hundred twenty-five PLWH aged ≥40 years and Georgian speakers participated in face-to-face interviews during February-September 2023. We collected data on sociodemographic characteristics, medical history, mental health, and cognitive performance. Additionally, we conducted laboratory blood tests and measures of body weight, height, and blood pressure. Participants were requested to arrive fasted for 8 to 12 hours before the collection of blood samples and to bring any necessary hearing and/or visual aids, current medications to facilitate verification of medication use, and their most recent laboratory $CD4^+$ count and HIV viral load test results. Data were collected by a researcher who had undergone training in data collection standards and techniques, particularly emphasizing the proficient administration of cognitive assessments. Laboratory tests were conducted in the Mrcheveli laboratory, which is accredited according to standard ISO 15189:20212–Medical Laboratories Quality Assurance & Competence. It specifies requirements for quality and competence in medical laboratories to ensure accuracy, reliability and timeliness of test results, quality control processes, and international patient safety goals. The whole process, including taking blood samples, interviewing, and cognitive assessments, took about 2 hours to complete. Upon completion, a monetary incentive of 40 GEL (about US $17) was given to the participants for their time.

To ensure high-quality data, data collection procedures were consistent, and instructions were thoroughly followed. Upon arrival, we explained to participants what they would expect during the cognitive assessments and what we wanted to measure. After taking blood specimens, participants were offered snacks to ensure fasting did not alter their cognitive performance. Every interview started with physical measurements, followed by cognitive assessments. Cognitive assessments were followed by collection of information on sociodemographic factors, HIV-associated factors, and medical history. The data collection was completed with self-administered measurements of anxiety and depression. All data collection was done during the first half of the day, from 9 AM to 2 PM. With this consistent approach, we aimed to minimize environmental factors that might have altered the results of cognitive and mental health assessments.

Ethics

Written informed consent was obtained from all participants before data collection. The Institutional Review Board at the National Center for Disease Control and Public Health in Georgia approved the protocol (IRB #2022-076).

Measurements

Predictor Variables

Predictor variables included substance use and mental health variables. The Drug Use Disorder Identification Test (DUDIT) was used to assess drug use disorders[21]; the Alcohol Use Disorder Identification Test (AUDIT) for alcohol use disorders[22]; the BDI for depression symptoms[23]; and the General Anxiety Disorder-7 (GAD-7) to assess anxiety symptoms.[24] The DUDIT and AUDIT scores were converted to dichotomous variables. Regarding drug use, we used both the score on the DUDIT and the response to a question about the use of opioid substitution therapy (OST). A drug use disorder was defined as a DUDIT score ≥6 for men and ≥2 for

women,[21] or if participants replied that they were on OST. Regarding the AUDIT, we used the cutoff score of ≥8 (maximum 40) to indicate the presence of a moderate or severe alcohol use disorder vs 0-8 to indicate the absence of alcohol use disorder. Raw scores on the BDI and GAD-7 were analyzed as continuous predictor variables.

Outcome Measures

Outcome variables were scores on cognitive performance assessments administered in the Georgian language and included the following. (1) To assess global cognition, MoCA, scored 0-30, with 1 point added for educational attainment ≤12 years, was performed. A higher score on the MoCA indicated better cognitive performance.[25] (2) Trail Making Tests A and B (TMT A and TMT B) assessed executive function, visual memory, and processing speed and measured in seconds. A higher score indicated poorer cognitive performance.[26] (3) Verbal (letter and semantic) fluency was used to evaluate verbal functioning. For the letter fluency test, participants were required to produce as many words as possible starting with 3 different letters of the Georgian alphabet (B, M, S), with 1 minute allocated for each letter. For semantic fluency, participants were asked to produce as many words as possible in 3 categories (animals, fruits, vegetables), within 1 minute for each category. Both sets of verbal fluency assessments were measured by the number of words produced, with higher scores indicating better cognitive performance.[27] (4) Three Stroop Color and Word Tests—1, 2, and 3—were utilized to assess processing speed, cognitive flexibility, resistance to interference from outside stimuli, selective attention capacity, and skills. The individual subset of the assessment was measured as a word count of correctly named colors in 45 seconds. A higher score indicated better cognitive performance.[28] (5) The Grooved Pegboard Test, measured in seconds, was administered to evaluate coordination and motor functions, including gross movements of hands, fingers, and arms, as well as fingertip dexterity on fine motor tasks.[29] A higher score denoted poorer cognitive function. We used raw scores in the analyses for each of the 9 cognitive outcomes because T scores are not available for Georgian PLWH.

Covariates

Covariates were selected among sociodemographic, HIV, behavioral, medical history, and clinical factors. Sociodemographic factors included age (a continuous variable); sex (male/female; all participants reported identifying as cisgender); regions of study sites (Tbilisi, Adjara, Imereti, Kartli, Samegrelo); level of educational attainment (completed secondary education vs higher education); income (enough income to cover their basic needs; yes/no); social status (they and/or their family members receive financial aid from the government; yes/no); marital status (never married vs currently married/cohabitating vs separated/divorced vs widowed); employment status (employment status during the last 12 months; yes/no). HIV factors included age of HIV diagnosis, years of being on ART, ever-interrupted ART, ART adherence in the last month, and history of HIV-associated dementia). Behavioral factors included past and current smoking status. Medical history (yes/no) of COVID-19, HCV, hepatitis B virus (HBV), tuberculosis (TB), syphilis, heart, kidney or liver diseases, cancer diagnosis, diabetes, stroke, and family history of dementia were assessed. Clinical factors included body mass index, arterial blood pressure, and laboratory (highly sensitive C-reactive protein [hs-CRP], lipids, glucose, erythrocyte sedimentation rate, hemoglobin A_{1C}) measurements.

Statistical Analysis

We performed simple, age-adjusted, and multivariable-adjusted linear regression analyses to identify associations between the primary predictors and each of the cognitive outcome scores. To identify relevant covariates for inclusion in multivariable models, considering the sample size and study design, we considered $P<.10$ as the level of statistical significance for at least 3 cognitive outcomes using univariate regression models. The same set of covariates, based on the aforementioned criteria, was included in all final multivariable regression analyses for all cognitive outcomes. Final multivariable regression models were evaluated at a significance level of $P<.05$. The same multivariable regression models were also used for sex-stratified analyses. Results were outputted as β coefficients and 95% CIs. Statistical analyses were conducted using R statistical software (v.4.3.2; R Core Team).

Results

Table 1 describes the characteristics of all participants. Although women showed higher mean scores on the semantic fluency, Stroop 1, and Grooved Pegboard tests compared with men, performance on the other cognitive assessments did not differ by sex. Men and women were not comparable concerning drug and alcohol use and smoking behavior. Factors more frequent in men included a high level of hs-CRP and a history of HCV and TB; however, women were more likely to be overweight compared with men.

Mental Health Characteristics

Overall, 30% had drug use–related problems and 6% had drug dependency. Both drug use–related problems and drug dependency were more prevalent in men than women (56% vs 6%, $P<.001$). Use of OST was reported

Table 1. Characteristics of PLWH study participants by sex

Characteristic	Overall, N=125	Male, N=78	Female, N=47	P value
Sociodemographic factors				
Place of residence, No. (%)				.003
Tbilisi	34/125 (27%)	15/78 (19%)	19/47 (40%)	
Gori (Kartli)	12/125 (9.6%)	10/78 (13%)	2/47 (4.3%)	
Batumi (Adjara)	25/125 (20%)	17/78 (22%)	8/47 (17%)	
Zugdidi (Samegrelo-Zemo Svaneti)	38/125 (30%)	21/78 (27%)	17/47 (36%)	
Kutaisi (Imereti)	16/125 (13%)	15/78 (19%)	1/47 (2.1%)	
Age, y	49.0 (44.0, 54.0)	50.0 (46.3, 54.0)	48.0 (43.0, 53.0)	.083
Education level, No. (%)				.078
Incomplete secondary school	20/125 (16%)	12/78 (15%)	8/47 (17%)	
Completed secondary school	32/125 (26%)	26/78 (33%)	6/47 (13%)	
Vocational education	37/125 (30%)	21/78 (27%)	16/47 (34%)	
Higher education	36/125 (29%)	19/78 (24%)	17/47 (36%)	
Employment status, No. (%)				.006
Yes	75/125 (60%)	39/78 (50%)	36/47 (77%)	
HIV-associated medical history				
Years of living with HIV	10.9 (6.1)	10.7 (6.3)	11.4 (6.0)	.518
Self-reported viral load <40, No. (%)	68/74 (92%)	37/42 (88%)	31/32 (97%)	.226
Self-reported CD4 count >500, No. (%)	53/81 (65%)	30/50 (60%)	23/31 (74%)	.287
Ever interrupted ART, No. (%)	35/125 (28%)	25/78 (32%)	10/47 (21%)	.274
Ever diagnosed AIDS and/or CD4 count <200, No. (%)	52/105 (50%)	34/65 (52%)	18/40 (45%)	.599
Medical history				
History of HCV, No. (%)	63/125 (50%)	53/78 (68%)	10/47 (21%)	<.001
History of HBV, No. (%)	16/125 (13%)	11/78 (14%)	5/47 (11%)	.783
History of TB, No. (%)	25/125 (20%)	21/78 (27%)	4/47 (8.5%)	.020
History of syphilis, No. (%)	10/125 (8.0%)	9/78 (12%)	1/47 (2.1%)	.088
History of heart disease, No. (%)	27/125 (22%)	17/78 (22%)	10/47 (21%)	1.000
History of diabetes, No. (%)	5/125 (4.0%)	4/78 (5.1%)	1/47 (2.1%)	.720
History of stroke, No. (%)	5/125 (4.0%)	3/78 (3.8%)	2/47 (4.3%)	1.000
History of cancer, No. (%)	7/125 (5.6%)	4/78 (5.1%)	3/47 (6.4%)	1.000
Family history of dementia, No. (%)	13/122 (11%)	8/77 (10%)	5/45 (11%)	1.000
History of brain injury, No. (%)	39/125 (31%)	31/78 (40%)	8/47 (17%)	.014
Smoking status, No. (%)				<.001
Past	14/124 (11%)	8/78 (10%)	6/46 (13%)	
Current	80/124 (65%)	66/78 (85%)	14/46 (30%)	
Mental health characteristics				
Drug-use disorder, No. (%)	47/125 (38%)	44/78 (56%)	3/47 (6.4%)	<.001
AUDIT score 8-40, No. (%)	31/125 (25%)	31/78 (40%)	0/47 (0%)	<.001
BDI score 0-16, No. (%)	86/119 (72%)	50/74 (68%)	36/45 (80%)	.208
GAD-7 score 10-21, No. (%)	24/113 (21%)	16/70 (23%)	8/43 (19%)	.764
Cognitive assessment scores, mean (SD)				
MoCA	20.4 (4.1)	20.2 (3.8)	20.9 (4.6)	.390
TMT A	51.5 (24.0)	52.9 (24.1)	49.2 (23.9)	.407
TMT B	127.3 (68.3)	132.9 (65.1)	118.8 (72.8)	.299
Letter fluency test	20.0 (8.6)	19.0 (7.7)	21.6 (9.8)	.123
Semantic fluency test	36.4 (10.2)	34.0 (10.3)	40.3 (8.9)	<.001
Stroop 1 test	80.3 (22.2)	75.5 (23.0)	88.1 (18.5)	.001
Stroop 2 test	52.1 (16.3)	49.9 (15.6)	55.6 (16.9)	.066
Stroop 3 test	30.8 (12.1)	30.4 (11.3)	31.4 (13.5)	.675
Grooved pegboard test	92.0 (27.5)	96.7 (26.1)	84.8 (28.4)	.023

ART, antiretroviral therapy; AUDIT, Alcohol Use Disorder Identification Test; BDI, Beck Depression Inventory; GAD-7, General Anxiety Disorder 7; HBV, hepatitis B virus; HCV, hepatitis C virus; MoCA, Montreal Cognitive Assessment; PLWH, people living with HIV; TB, tuberculosis; TMT, Trail Making Test

[a] Fisher exact test; Wilcoxon rank sum test; Pearson χ^2 test

among 24% of our study sample. Among those on OST, there was only 1 woman. Only 2 participants reported being solely on OST and not using any other substances (including marijuana), whereas others reported parallel drug use–related problems or drug dependence based on the DUDIT. AUDIT scores showed that 17% and 8% had hazardous or harmful alcohol consumption and alcohol use disorders, respectively. None of those showing hazardous or harmful alcohol consumption were women, whereas 40% of men reported this problem (P<.001).

Mild to extreme depressive symptoms were experienced by 51%, with 23% categorized as mild, 10% as borderline, 12% as moderate, and 6% as severe or extreme depressive symptoms. On the GAD-7, 47% had mild to severe anxiety, with 26% categorized as mild, 17% as moderate, and 4% as severe anxiety. Differences in mean scores on BDI and GAD-7 between men and women were not different.

Cognitive Performance

MoCA mean completion time was 13.3 minutes (SD=3.2 minutes). Cognitive impairment (MoCA<26) was observed among 89% (mean score 20.4 [SD=4.0]). No differences were observed in mean MoCA scores or completion times by sex at birth or by dichotomized drug use disorders, AUDIT, BDI, and GAD-7 scores.

Mean scores for TMT A and B were 51.5 (SD=24.0) and 127.3 (SD=68.3) seconds, respectively. TMT B mean score differences were found between groups with mild-minimal anxiety and more severe anxiety forms (134.0 vs 103.0 seconds, P=.04). No other differences were observed in TMT A and TMT B scores by sex or by dichotomized drug use disorders, AUDIT, BDI, and GAD-7.

In verbal fluency, means were 20.0 words (SD=8.7 words) for the letter fluency test and 36.5 (SD=10.2) for semantic fluency. A difference in semantic fluency scores was observed by sex (34.0 words for men, 40.3 words for women, P<.001) and between those with and without substance use disorders (32.0 words vs 39.0 words, P<.001). No other differences were observed in semantic and letter fluency test mean scores by sex, drug use disorders, AUDIT, BDI, or GAD-7 scores (see Methodology).

Stroop Tests 1, 2, and 3 showed mean words of 80.3 (SD=22.2), 52.1 (SD=16.3), and 30.8 (SD=12.1), respectively. Differences in Stroop 1 scores were observed by sex (75.5 words for men and 88.1 words for women, P=.01), and substance use disorder (72.2 words vs 85.1 words, P<.001). The Stroop Test 3 showed differences in those with mild-minimal anxiety vs more severe forms of anxiety (29.3 words vs 36.3 words, P=.03).

The mean completion time (seconds) for the dominant hand on the Grooved Pegboard Test was 92.0 (SD=27.5), varying by sex (96.7 seconds for men vs 84.4 seconds for women, P=.02) and drug use disorders (101.4 vs 86.9 seconds, P=.02).

Associations Between Mental Health and Cognitive Performance

Univariate regression analyses showed that drug use disorder and anxiety were associated with semantic fluency, Stroop Tests 1 and 3, and Grooved Pegboard (Table 2) scores. Specifically, drug use disorder was associated with worse performances on semantic fluency, Stroop Test 1, and Grooved Pegboard on both hands (P<.05). In contrast, more anxiety symptoms on GAD-7 were associated with better performance on Stroop Test 3 (P<.05). Age-adjusted regression analyses showed similar results, although there was a subtle reduction in strength of association.

The associations between drug use and cognitive assessments in univariate models were not observed in multivariable-adjusted models (Table 3). However, the BDI score was positively associated with Stroop Test 2 and both BDI and GAD-7 scores were positively associated with Stroop Test 3 (P<.05), such that those with more depressive and anxiety symptoms had better cognitive performance.

Finally, we conducted multivariable regression analyses stratified by sex. To ensure comparable models, we removed dichotomous AUDIT score and history of syphilis from the analyses, as none of the women had alcohol use disorder and there was a zero number of current/previous syphilis infections in some regression analyses. Men with a higher number of depressive symptoms were associated with higher Stroop 3 Test scores (P<.05). Additionally, higher scores on GAD-7 were associated with better Stroop 1, 2, and 3 tests (P<.05) (Table 4). Among women, only BDI scores were associated with MoCA scores, indicating that a higher number of depressive symptoms was associated with better global cognition (P<.05) (Table 5).

Discussion

To our knowledge, this is the first study in Georgia assessing both cognitive performance and mental health in older PLWH. Our findings reveal a high prevalence of mental health disorders and lower-than-expected cognitive performance measured by the MoCA. However, individual cognitive functions in our sample measured by standardized assessment tools align with existing literature. Contrary to our expectations, we did not find an association between mental health problems and poor cognitive performance. This unexpected finding could be due to limitations in our study design or unexplored characteristics within our sample, which we will discuss further. We believe that these

Table 2. Univariate regression analyses between mental health predictors and cognitive assessment among PLWH participants

Cognitive assessment[a]	Drug use[b]			AUDIT score[b]			BDI score[b]			GAD-7 score[b]		
	β coef.[c]	95% CI	P value	β coef.[c]	95% CI	P value	β coef.[c]	95% CI	P value	β coef.[c]	95% CI	P value
MoCA	−1.396	−2.874 to 0.083	.064	1.109	−0.561 to 2.779	.191	−0.058	−0.136 to 0.020	.143	−0.017	−0.168 to 0.134	.824
TMT A	1.266	−7.595 to 10.126	.778	−2.355	−12.234 to 7.524	.638	0.233	−0.220 to 0.687	.310	0.358	−0.537 to 1.253	.429
TMT B	14.796	−12.010 to 41.602	.276	20.37	−8.065 to 48.812	.159	0.140	−1.332 to 1.611	.851	−1.149	−3.910 to 1.612	.411
Letter fluency test	−0.753	−3.999 to 2.493	.647	−0.742	−4.359 to 2.875	.695	−0.056	−0.227 to 0.115	.517	0.056	−0.286 to 0.398	.743
Semantic fluency test	−6.451	−10.114 to −2.789	<.001	−2.278	−6.541 to 1.986	.292	−0.152	−0.354 to 0.051	.141	0.108	−0.287 to 0.503	.589
Stroop Test 1	−12.856	−20.793 to −4.918	.002	−4.256	−13.390 to 4.877	.358	−0.302	−0.740 to 0.136	.174	0.335	−0.540 to 1.210	.450
Stroop Test 2	−2.863	−8.925 to 3.199	.352	−3.040	−9.760 to 3.681	.372	−0.065	−0.384 to 0.255	0.689	0.442	−0.185 to 1.069	.165
Stroop Test 3	1.170	−3.349 to 5.688	.609	0.102	−4.911 to 5.115	.968	0.166	−0.063 to 0.396	.154	0.591	0.143 to 1.038	.010
Grooved Pegboard, dominant hand	14.498	4.338 to 24.657	.006	8.914	−2.527 to 20.355	.126	0.199	−0.334 to 0.732	.462	−0.246	−1.334 to 0.843	.655

AUDIT, Alcohol Use Disorder Identification Test; BDI, Beck Depression Inventory; coef., coefficient; GAD-7, General Anxiety Disorder 7; MoCA, Montreal Cognitive Assessment; PLWH, people living with HIV; TMT, Trail Making Test

[a] Cognitive assessment scores are raw scores

[b] Drug use is a binary variable, as a Drug Use Disorder Identification Test score ≥6 for men and ≥2 for women, or if participants were on opioid substitution therapy. AUDIT score is a binary variable, moderate to severe alcohol use disorder (8-40) vs no alcohol use disorder (0-8). Reference groups for drug use and AUDIT score variables are individuals without drug or alcohol use disorder. BDI and GAD-7 scores are continuous variables

[c] Coefficient estimates from the linear regression models

* Shaded cells indicate statistically significant values.

data on mental health and cognitive function in PLWH hold regional significance because the literature on aging and cognitive functions among PLWH is limited in the EECA region, which is currently experiencing the sharpest rise in the number of new HIV infections globally.[9]

A high prevalence of depression, anxiety, and alcohol- and drug-use disorders found in our sample is consistent with findings from other low and middle-income countries.[7,30-32] The observed sex differences in drug- and alcohol-use disorders, with older men living with HIV being more affected than their female counterparts, also align with current knowledge. The literature on sex differences in BDI and GAD-7 scores among PLWH is inconsistent; no differences were revealed in our study.[33]

A MoCA score of <26 in 89% of our sample is high compared with what is reported in the literature.[34-36] Although the MoCA is considered one of the best screening tools for measuring global cognitive performance in older PLWH,[37] our results may not be interpreted as cognitive impairment due to variable cross-cultural applicability, appropriateness for vulnerable underrepresented populations, and the necessity of complementary clinical judgment.[38] A study of the Georgian MoCA validated among the general population age ≥50 years recommended a lower cutoff of 22 for cognitive screening, which appeared to be more sensitive (100%) and specific (69%) for amnestic MCI.[39]

We analyzed and presented individual cognitive assessments as raw scores. This decision was made because there are no standardized adjustments that can be made based on local context, including sex, gender, education, age, ethnicity, and other factors in our population. The average TMT A and TMT B performance in our sample was worse than the data reported among older PLWH in other studies.[40,41] In contrast, we observed better performance on the

Table 3. Multivariable regression analyses between mental health predictors and cognitive assessments among PLWH participants

Cognitive assessment[a]	Drug use[b] β coef.[c]	Drug use[b] 95% CI	Drug use[b] P value	AUDIT score[b] β coef.[c]	AUDIT score[b] 95% CI	AUDIT score[b] P value	BDI score[b] β coef.[c]	BDI score[b] 95% CI	BDI score[b] P value	GAD-7 score[b] β coef.[c]	GAD-7 score[b] 95% CI	GAD-7 score[b] P value
MoCA	−0.989	−3.221 to 1.244	.398	1.176	−0.777 to 3.128	.235	0.040	−0.046 to 0.127	.356	0.076	−0.085 to 0.238	.350
TMT A	−5.168	−18.227 to 7.892	.434	2.278	−9.113 to 13.669	.692	−0.335	−0.831 to 0.161	.182	0.100	−0.829 to 1.029	.830
TMT B	13.379	−30.367 to 57.124	.544	29.308	−6.425 to 65.040	.106	−0.443	−2.139 to 1.252	.604	−1.997	−5.998 to 1.004	.189
Letter fluency test	2.777	−2.321 to 7.875	.282	−2.117	−6.613 to 2.380	.352	0.054	−0.153 to 0.260	.607	0.165	−0.213 to 0.544	.387
Semantic fluency test	−4.708	−10.252 to 0.835	.095	2.058	−2.885 to 7.002	.410	0.038	−0.184 to 0.260	.734	0.128	−0.266 to 0.523	.519
Stroop Test 1	−1.484	−13.642 to 10.674	.809	−6.651	−17.111 to 3.810	.210	0.217	−0.267 to 0.701	.375	0.863	−0.006 to 1.733	.052
Stroop Test 2	−3.231	−12.483 to 6.021	.489	−1.128	−9.180 to 6.924	.781	0.271	−0.088 to 0.630	.137	0.673	0.026 to 1.320	0.042
Stroop Test 3	−2.303	−9.973 to 5.367	.552	−0.235	−6.908 to 6.438	.944	0.369	0.094 to 0.643	.009	0.653	0.125 to 1.181	.016
Grooved Pegboard, dominant hand	10.408	−5.763 to 26.578	.204	12.664	−0.886 to 26.204	.066	−0.143	−0.740 to 0.454	.636	−0.828	−10.982 to 0.326	.157

In each multivariate regression analysis, the following covariates were controlled: age, sex, education, employment, income needs, place of residence, smoking status, and history of COVID-19, hepatitis C, hepatitis B, tuberculosis, syphilis, stroke, and diabetes. Additionally, laboratory results including high-density lipoprotein, erythrocyte sedimentation rate, C-reactive protein, and body mass index were included. These covariates demonstrated statistical significance ($P<.1$) with at least 3 outcome variables

AUDIT, Alcohol Use Disorder Identification Test; BDI, Beck Depression Inventory; coef., coefficient; GAD-7, General Anxiety Disorder 7; MoCA, Montreal Cognitive Assessment; PLWH, people living with HIV; TMT, Trail Making Test

[a] Cognitive assessment scores are raw scores

[b] Drug use is a binary variable, as a Drug Use Disorder Identification Test score $\geq$6 for men and $\geq$2 for women, or if participants were on opioid substitution therapy. AUDIT score is a binary variable, moderate to severe alcohol use disorder (8-40) vs no alcohol use disorder (0-8). Reference groups for drug use and AUDIT score variables are individuals without drug or alcohol use disorder. BDI and GAD-7 scores are continuous variables

[c] Coefficient estimates from the linear regression models

* Shaded cells indicate statistically significant values.

verbal fluency, Grooved Pegboard, and Stroop Tests than has been reported in some literature among older PLWH.[41]

Although literature suggests mental health problems contribute to poor cognitive performance, particularly in the older population,[41,42] our study did not find significant associations between the two for most cognitive assessments. This null effect might be explained by the predominant influence of HIV-associated factors on cognitive function in PLWH, with mental health disorders having no additional impact, as supported by other studies.[40] Moreover, several factors related to the study design and sample may have contributed to these observations. These include small sample size, convenience sampling, missing data in some predictor and outcome variables, and cultural characteristics. Of note, missing data from 6 participants on the BDI and 12 on the GAD-7, along with exclusions from the TMT B due to unfamiliarity with the Georgian alphabet order or tiredness, could have introduced bias, as those who did not complete assessments might share certain characteristics. Additionally, the cross-sectional design of our study limits our ability to capture the longitudinal impact of mental health on cognitive function. The long-term effects of mental health disorders could potentially manifest in cognitive performance over time, but may not be apparent in a single snapshot. Lastly, participants' motivation, potentially influenced by sociocultural factors (eg, gender, age, substance use, education, residence), could have affected both mental health and cognitive assessment scores resulting in false positive/negative results. Although we adjusted for these factors in our multivariable models, their impact warrants further investigation.

Regardless of limitations, our study may have valuable insights into the

Table 4. Multivariable regression analyses between mental health predictors and cognitive assessments among male participants

Cognitive assessment[a]	Drug use[b]			BDI score[b]			GAD-7 score[b]		
	β coef.[c]	95% CI	P value	β coef.[c]	95% CI	P value	β coef.[c]	95% CI	P value
MoCA	−0.550	−3.435 to 2.336	.708	0.013	−0.095 to 0.120	.812	0.188	−0.018 to 0.395	.073
TMT A	−15.416	−32.651 to 1.818	.078	−0.492	−1.109 to 0.124	.115	−0.733	−2.063 to 0.599	.272
TMT B	−2.056	−62.964 to 58.854	.946	−1.061	−3.249 to 1.125	.331	−3.628	−7.575 to 0.318	.070
Letter fluency test	4.152	−1.854 to 10.159	.171	0.105	−0.126 to 0.335	.364	0.230	−0.243 to 0.704	.331
Semantic fluency test	−2.107	−9.677 to 5.463	.578	−0.037	−0.336 to 0.263	.806	0.045	−0.528 to 0.617	.876
Stroop Test 1	3.112	−14.490 to 20.714	.723	0.311	−0.348 to 0.970	.346	1.568	0.370 to 20.767	.012
Stroop Test 2	−0.227	−12.514 to 12.061	.971	0.261	−0.198 to 0.720	.258	1.286	0.463 to 2.109	.003
Stroop Test 3	1.173	−8.681 to 11.026	.812	0.359	0.016 to 0.701	.041	0.833	0.122 to 1.544	.023
Grooved Pegboard, dominant hand	9.121	−12.533 to 30.776	.400	−0.129	−0.812 to 0.554	.705	−1.527	−3.081 to 0.027	.054

Covariates: age, sex, education, employment, income needs, place of residence, smoking status, and history of COVID-19, hepatitis C, hepatitis B, tuberculosis, stroke, and diabetes. Additionally, laboratory results including high-density lipoprotein, erythrocyte sedimentation rate, C-reactive protein, and body mass index were included. These covariates demonstrated statistical significance (P<.1) with at least 3 outcome variables

AUDIT, Alcohol Use Disorder Identification Test; BDI, Beck Depression Inventory; coef., coefficient; MoCA, Montreal Cognitive Assessment; TMT, Trail Making Test

[a] Cognitive assessment scores are raw scores

[b] Drug use is a binary variable, as a DUDIT score ≥6 for men and ≥2 for women, or if participants replied were on OST. Reference groups for a drug use variable are individuals without drug or alcohol use disorder. BDI and General Anxiety Disorder 7 scores are continuous variables

[c] Coefficient estimates from the linear regression models

* Shaded cells indicate statistically significant values.

mental health and cognitive function of older PLWH in Georgia, a population understudied in the EECA region. To our knowledge, this is the first study in Georgia to comprehensively assess mental health, various domains of cognitive performance, and a wide range of sociodemographic, behavioral, medical, and HIV-associated characteristics among PLWH ≥40 years. Study findings confirming the high burden of mental health and cognitive disorders underscore the importance of future long-term, large-scale studies to provide deeper insights into the complex interplay of age-associated comorbidities and HIV in this context. Given the shared sociopolitical and cultural characteristics,

Table 5. Multivariable regression analyses between mental health predictors and cognitive assessments among female participants

Cognitive assessment[a]	Drug use[b]			BDI score[b]			GAD-7 score[b]		
	β coef.[c]	95% CI	P value	β coef.[c]	95% CI	P value	β coef.[c]	95% CI	P value
MoCA	2.551	−8.833 to 13.934	.643	0.323	0.091 to 0.554	.009	0.145	−0.336 to 0.628	.529
TMT A	−6.455	−74.108 to 61.199	.843	0.257	−1.399 to 1.914	.747	0.348	−1.771 to 2.486	.725
TMT B	−23.051	−191.716 to 145.614	.777	−0.208	−4.787 to 4.372	.925	−0.06	−6.647 to 6.635	.999
Letter fluency test	−4.327	−34.652 to 25.972	.768	0.353	−0.409 to 1.114	.342	0.407	−0.785 to 1.599	.478
Semantic fluency test	−0.885	−24.221 to 22.452	.938	0.304	−0.268 to 0.875	.278	0.676	−0.163 to 1.515	.107
Stroop Test 1	−1.715	−50.023 to 46.593	.941	0.443	−0.839 to 1.725	.476	0.656	−1.516 to 2.829	.530
Stroop Test 2	−7.458	−50.164 to 35.245	.718	0.847	−0.156 to 1.850	.093	0.919	−0.917 to 2.756	.303
Stroop Test 3	7.764	−27.869 to 43.396	.653	0.572	−0.291 to 1.434	.180	1.210	−0.233 to 2.655	.094
Grooved Pegboard, dominant hand	11.169	−34.407 to 56.745	.613	−0.562	−1.754 to 0.629	.333	−1.246	−3.110 to 0.618	.175

Covariates: age, sex, education, employment, income needs, place of residence, smoking status, and history of COVID-19, hepatitis C, hepatitis B, tuberculosis, stroke, and diabetes. Additionally, laboratory results including high-density lipoprotein, erythrocyte sedimentation rate, C-reactive protein, and body mass index were included. These covariates demonstrated statistical significance (P<.1) with at least 3 outcome variables

AUDIT, Alcohol Use Disorder Identification Test; BDI, Beck Depression Inventory; coef., coefficient; MoCA, Montreal Cognitive Assessment; TMT, Trail Making Test

[a] Cognitive assessment scores are raw scores

[b] Drug use is a binary variable, as a Drug Use Disorder Identification Test score ≥6 for men and ≥2 for women, or if participants were on opioid substitution therapy. Reference groups for a drug use variable are individuals without drug or alcohol use disorder. BDI and GAD-7 scores are continuous variables

[c] Coefficient estimates from the linear regression models

* Shaded cells indicate statistically significant values.

study results may be relevant for other countries across the EECA region.

Subjective Reflections About the Interview Process Summarized by the Author

Regardless of strictly following data collection instructions, the participant characteristics, presumably driven by social, gender-associated, and cultural factors, influenced participants' responses during the cognitive assessments. Women seemed to be more enthusiastic and responsive to performing assessments compared with men. Often, this led them to be anxious and more motivated to complete the tasks perfectly without mistakes. Conversely, men, especially those on OST or with substance use disorder, needed to receive their drugs (opioids, or other substances) and possibly rushed through tasks to complete them as soon as possible. These differing approaches could influence performance, as only completion time was recorded, not errors or overall performance, even though errors were resolved, as instructed. Anxiety-induced word-finding difficulties were common among women, whereas few of those with substance use disorder experienced lapses during verbal fluency tasks—switching from letter to letter, from category to category. However, such episodes are unaccounted for in the analysis and findings. We involved a neuropsychologist to assist with aspects of data interpretation.

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Disclaimer

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Conflict of Interest

No conflicts of interest reported by authors.

Author Contributions

Research concept and design: Imerlishvili, Gustafson, Baliashvili, Karaulashvili, DeHovitz, Djibuti; Acquisition of data: Imerlishvili, Baliashvili; Analysis and interpretation of data: Imerlishvili, Gustafson, Baliashvili, Karaulashvili, Djibuti; Drafting of manuscript: Imerlishvili, Gustafson, DeHovitz; Statistical expertise: Baliashvili; Obtaining funding: Gustafson, DeHovitz, Djibuti; Administrative, technical, or material support: Imerlishvili, Gustafson, DeHovitz, Djibuti; Supervision: Gustafson, Karaulashvili, Djibuti.

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