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Health Locus of Control and Neurocognitive Function in Latinx and Non-Latinx White People Living With HIV: A Cross-Sectional Study

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Abstract

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Author Contributions

M. Aghvinian was responsible for the conceptualization, methodology, and formal analysis of the study, wrote the original draft, and oversaw all revisions. E. Morris, M. J. Savin, A. Summers, C. Crook, and J. Stiver all provided support with conceptualization, methodology, and writing of the original draft, as well as draft review and editing. J. Gonzalez and D. Byrd were responsible for supervision of data acquisition in addition to draft review and editing. M. Rivera Mindt contributed to the manuscript's conceptualization, methodology, funding acquisition, supervision, draft review, and editing.

Disclosures

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Research suggests that health locus of control (HLOC) is related to important health and neurocognitive outcomes in people living with HIV (PLWH). However, the role of ethnicity in these relationships remains poorly understood. This study explored the role of HLOC on neurocognition in a diverse sample of 134 PLWH (Latinx: $n = 96$; non-Latinx White [NLW]: $n = 38$) who completed comprehensive neurocognitive evaluations and the Multidimensional Health Locus of Control Scale-Form C (MHLS-C). Results indicate no ethnocultural differences in HLOC beliefs (p's > .05). External HLOC (i.e., chance and powerful others) related to worse neurocognition in the Latinx group and contributed to significant variance in global neurocognition and learning, memory, and verbal fluency, underscoring the role of external HLOC beliefs on neurocognition, particularly for Latinx individuals. Additional research is needed to better characterize the mechanistic relationship between HLOC beliefs and neurocognitive function and to further explore this relationship among other underrepresented populations also disproportionately impacted by HIV.

Keywords

health locus of control; HIV; Latinx; neurocognition; neuropsychology

Introduction

Health locus of control (HLOC) refers to the degree to which individuals believe their health is contingent on their own behaviors and actions (internal HLOC) or contingent on external forces, such as luck, chance, fate, or the influence of powerful others (external HLOC) (see Table 1 for further description of internal and external HLOC; Wallston & Wallston, 1982; Norman et al., 1998). Individuals with high internal HLOC may believe that their behaviors directly impact their health status and tend to be motivated to take deliberate, voluntary action to promote positive health behaviors (e.g., healthy diet, exercise). Internal HLOC has been associated with a number of positive health outcomes, including better cognitive functioning, health literacy, self-reported health, and increased medication adherence across various health conditions (e.g., depression, hypertension, HIV; Chuang et al., 2016; Nafradi et al., 2017; Omeje & Nebo, 2011). Conversely, those with high external HLOC may believe that the actions of influential individuals (e.g., family members; Powerful Others HLOC) or external forces (e.g., luck, fate; Chance HLOC) can markedly impact their health status. Research suggests that external HLOC is associated with negative health outcomes (e.g., worse quality of life, medication nonadherence), presumably due to lower engagement in health-promoting behaviors (Cvengros et al., 2004; West et al., 2018; Wielenga-Boiten et al., 2015). Therefore, some HLOC beliefs (e.g., higher internal HLOC and lower external HLOC) may enhance overall functioning in relation to one's physical, mental, and psychosocial well-being (Fernández -Abascal & Martin-Diaz, 2015; Takahashi et al., 2013).

Research suggests that significant differences in HLOC beliefs among ethnoculturally diverse groups and non-Latinx White individuals may contribute to health disparities in the United States. Compared to non-Latinx Whites (NLW), individuals from diverse ethnocultural groups (e.g., Black/African American, Latinx) may be more likely to report high external locus of control (Cohen & Azaiza, 2007; Wright et al., 2019), such that they

may feel less in control of their health outcomes. Diverse ethnocultural groups are also more likely to believe that powerful others (e.g., physicians and health care professionals) are responsible for their health and well-being, underscoring the importance of promoting preventive health care in these populations (Pieterse & Carter, 2010; Roncancio et al., 2011). This greater belief in external HLOC may be related to more exposure to systemic inequities (e.g., racism and oppression), stress, and cultural factors, which may impact how causality and treatment for medical conditions are viewed (e.g., religiosity, *fatalismo* [Latinx cultural construct emphasizing the influence of higher powers, destiny, or luck in controlling life events]; Anastasia & Bridges, 2015; Pieterse & Carter, 2010; Ross et al., 1983).

Ethnocultural differences are also observed in the context of chronic health conditions, such as HIV. Despite the fact that Black/African American and Latinx individuals currently make up 13.4% and 18.5% of the U.S. population, respectively, Black/African Americans currently account for the largest proportion of PLWH, representing 42% of PLWH, while Latinx individuals account for nearly 23% of PLWH (Centers for Disease Control and Prevention, 2020a, 2020b; United States Census Bureau, 2019). The disproportionate burden of HIV borne by diverse ethnocultural groups is not explained solely by traditional behavioral risk factors (e.g., high number of sexual partners, low rates of condom use, and substance use). Instead, these disparities in HIV prevalence and outcomes are the result of a combination of behavioral and systemic factors (e.g., differences in educational attainment, educational quality, and income; Morris et al., 2009; Zahodne et al. 2015).

Research also indicates that ethnoculturally diverse (i.e., Latinx and Black/African American) PLWH may be at increased risk for worse neurocognitive outcomes, compared to non-Hispanic White PLWH (Marquine et al. 2016; Marquine et al. 2018). This increased vulnerability can be understood through a biopsychosociocultural theoretical framework (Rivera Mindt et al., 2008). This framework suggests that ethnoculturally diverse populations may have increased vulnerability for neurological sequelae due to a combination of biomedical (e.g., genetic, cardiovascular), psychosocial (e.g., stress exposure), and sociocultural (e.g., experiences of discrimination, quality of education) factors that may mediate the expression of neurological disease (Engel, 1980; Rivera Mindt et al., 2008). Despite evidence for greater risk of neurocognitive sequelae among ethnoculturally diverse PLWH, few studies have explored the relationship between HLOC and neurocognitive functioning within diverse samples of PLWH. Zahodne et al. (2015) evaluated a large community-dwelling sample of Black/African American and NLW older adults living without HIV participating in a cognitive training program to improve memory, reasoning, and speed and found that African Americans displayed less improvement in memory and reasoning scores after cognitive intervention compared to NLW. These differences were partially mediated by locus of control, such that African Americans reported significantly higher rates of external locus of control, and with higher external locus of control being associated with smaller training gains in reasoning. In another study examining mediators of racial disparities in neurocognition, higher endorsement of external locus of control was significantly associated with lower scores on tests of executive function and episodic memory among Black/African Americans (Zahodne et al., 2017). This effect was not observed for NLW individuals. Research has yet to examine the specific relationship between neurocognitive functioning and HLOC in a sample of PLWH, where the issue

of HLOC may have immediate ramifications for functional health outcomes. No studies to date have examined these issues in the Latinx population.

Given the current gaps in the literature, a better understanding of the association between HLOC and neurocognitive functioning in an ethnoculturally diverse sample of PLWH is needed. This may be especially germane for underrepresented populations (e.g., Latinx) who are disproportionately impacted by HIV and have worse health and neurocognitive outcomes than their NLW counterparts, as HLOC may be one pathway of explaining these disparate outcomes. Additionally, exploring associations between HLOC beliefs and neurocognitive functioning may elucidate the role that health beliefs have on neurocognitive functioning and health outcomes in this population. The aims of the present study were to examine: 1) ethnic group differences in HLOC beliefs, 2) the relationship between HLOC beliefs and neurocognitive functioning, and 3) whether specific HLOC beliefs uniquely predict neurocognitive functioning in a sample of Latinx and NLW PLWH. It was hypothesized that: 1) The Latinx group would endorse significantly higher external HLOC beliefs and lower internal HLOC beliefs compared to the NLW group; 2) higher endorsement of internal HLOC beliefs would be associated with better neurocognitive functioning; and 3) greater endorsement of specific HLOC beliefs (i.e., internal) would uniquely predict better neurocognitive functioning, even after considering Latinx ethnicity.

Methods

Participants

The study's sample was a subsample derived from the National Institute of Mental Health funded Medication Adherence (MAS) Study (K23MH078719) at the Icahn School of Medicine at Mount Sinai located in New York City, New York, USA. For the MAS parent study, participants were recruited through a community-based participatory research (CBPR) approach and word-of-mouth referral, primarily in Spanish Harlem in Manhattan and the Bronx, two boroughs of New York City.

For the parent study, participants were included if they were living with HIV, 18 to 80 years old, proficient in English (oral/written), and identified as either Latinx (any race) or NLW. Participants were required to be independently taking their prescribed antiretroviral medication for at least 12 weeks to be included due to the primary aims of the parent study (Rivera Mindt et al., 2020). Participants were excluded if they met DSM-IV criteria for a current or past psychotic disorder or bipolar disorder, as assessed by a structured clinical interview (Composite International Diagnostic Interview-CIDI; World Health Organization, 1993) administered by the study staff. For the current study, only participants with HLOC data were included. Thus, of the original 160 participants from the parent study, a total of 134 PLWH (96 Latinx and 38 NLW) were included in the current study.

Procedures

The study was approved by the institutional review board at Mount Sinai Hospital (HS#−11000176). All study participants provided written informed consent and completed neuromedical evaluation, psychiatric/substance use interviews, and demographic and

sociocultural questionnaires. Additionally, participants completed a comprehensive battery of neurocognitive assessments.

Neuromedical evaluation.—All study participants completed a brief neuromedical evaluation administered by trained research nursing staff that assessed HIV-related medical history (nadir and current CD4+ T-cell count, current viral load, date of diagnosis confirmed by medical record review), current and past general medical history, and current medications, including antiretroviral therapy (ART). Additionally, participants provided a serum sample to allow determination of current CD4+ T-cell count and plasma HIV viral load.

Neurocognitive assessments.—Table 2 provides a summary of the comprehensive neurocognitive evaluation participants completed. This battery has been validated for use in HIV research (Heaton et al., 2010) and assesses seven neurocognitive domains: executive function, attention/working memory, learning/memory, motor function, processing speed, and verbal fluency. The assessment battery was administered by trained psychometrists and research staff. All data collection and interpretation were overseen by a board-certified clinical neuropsychologist.

To obtain demographically corrected (i.e., age, education, gender) T-scores for individual tests, raw neurocognitive test scores were transformed using the most appropriate published normative data (Table 2). Individual test T-scores were then averaged to generate neurocognitive mean T-scores for each neurocognitive domain; all individual test T-scores were averaged to create a Global neurocognitive Average T-score to reflect global neurocognitive functioning (Heaton et al., 2010). The cutoff for impairment in global neurocognition and neurocognitive domain average T-scores was < 40, which is consistent with previous literature in the field (Heaton et al., 2004).

Multidimensional Health Locus of Control Scale–Form C (MHLC-C).—The Multidimensional Health Locus of Control (MHLC) Scale (Wallston et al., 1978) is one of the prime instruments of choice for health researchers examining perceived control of health and is applicable to a range of health-related behaviors and situations (Wallston, 2005). To more accurately assess individuals with existing medical or health-related conditions, Wallston et al. (1994) developed the Multidimensional Health Locus of Control Scale–Form C (MHLC-C), a condition-specific measure that is considered a useful tool for exploring health behaviors in order to better individualize treatment for individuals with existing, chronic health conditions (Lundgren et al., 2007).

The MHLC-C includes 18 items and comprises four subscales: *Internal* (the extent one believes health is dependent on one's own behavior; 6 items); *Powerful Others* (the extent one believes health is dependent on surrounding relationships, such as friends and family; 3 items); *Doctors* (the extent one believes health is dependent on doctors; 3 items); and *Chance* (the extent one believes that health is dependent on fate/luck; 6 items). Participants are asked to rate their beliefs regarding the degree of control they believed they had over their health condition on a six-point Likert scale (1 = strongly disagree, 2 = moderately disagree, 3 = slightly disagree, 4 = slightly agree, 5 = moderately agree, 6 = strongly agree).

On each subscale of the MHLC-C (i.e., Internal, Powerful Others, Doctors, Chance), a higher score indicates a stronger attribution of one's state of health to that type of locus of control. The MHLC-C has demonstrated adequate psychometric characteristics, including internal consistency and concurrent validity. Please see Wallston et al. (1994) for additional details. Moreover, this measure has been utilized in other studies with PLWH (Mostafavian et al., 2018; Yakob & Ncama, 2016).

Statistical Analyses

Statistical analyses were performed using IBM SPSS Statistics, Version 25. Most variables met homogeneity of variance of assumptions and followed a normal distribution. Those variables that did not meet these assumptions were analyzed using nonparametric tests. Due to the significant, positive skew of plasma HIV viral loads, this variable was logarithmically transformed.

Categorical variables were examined using Chi-square. For continuous variables, analysis of covariance (ANCOVA) and Mann-Whitney *U*-tests were used to analyze between-group differences (Aim 1). Pearson's correlations were used to examine linear relationships between neurocognitive average domain T-scores (e.g., Learning, Memory) and MHLC-C subscales (i.e., Internal, Powerful Others, Doctors, and Chance) (Aim 2). Further, a series of linear regressions were used to examine the predictive relationship between ethnicity and MHLC-C subscales, and neurocognitive domain scores (Aim 3). Covariates (e.g., age, sex, education) were added to relevant analyses (e.g., Pearson's correlation, linear regression) when demographic variables demonstrated significant group differences *and* were related to the outcome variables of interest consistent with previously published methods (West et al., 2014). A series of post-hoc power analyses revealed that with a total sample size of 134 participants, the primary regression analyses had power ranging from 82–100%.

Results

Demographic Characteristics

As detailed in Table 3, the sample was primarily male, Latinx, middle-aged, and had approximately a high school level of education. The Latinx group was significantly younger ($p = .01$) and completed significantly fewer years of education ($p < .01$) compared to NLW individuals. Therefore, these variables were included as covariates for between-group comparisons. Within the Latinx group, 82% identified as Caribbean (74% Puerto Rican, 5% Dominican, 2% Cuban), 6.5% identified as Mexican, 4% identified as South American, 6.5% identified as Central American, and 1% identified as "Other Latinx subpopulation."

Neuromedical characteristics.—Participants had been diagnosed with HIV for a mean of 16 years ($SD = 6$), with NLW participants having significantly longer disease duration than Latinx participants ($p = .01$). The Latinx group had a significantly higher current plasma HIV viral load, compared to the NLW group ($p = .01$). However, the two groups did not significantly differ on current CD4 count or nadir CD4 count (all p's > .10).

Neurocognitive characteristics.—Within the entire study sample, neurocognitive functioning fell within normal limits for Global functioning and all domains, except for Learning and Memory. Specifically, mean performance for Latinx individuals on Learning (M = 34.39, SD = 10.93) and Memory (M = 35.69, SD = 11.78) domains fell below normal limits (T < 40; Heaton et al., 2004). This was not observed in NLW individuals (Learning M = 42.77, SD = 13.45; Memory M = 42.72, SD = 13.48).

Between-group differences on MHLC-C.—As illustrated in Table 4, there were no significant differences between MHLC-C subscale endorsement between the Latinx and NLW group (all p's > .05).

Correlations between MHLC-C subscales and neurocognitive domains.—A series of partial correlations, controlling for age and education, were computed to examine potential associations between HLOC and neurocognitive domains (Table 5). The results revealed that a number of neurocognitive domains were significantly associated with MHLC-C subscales in the study sample.

In the Latinx group, Chance HLOC was negatively associated with Verbal Fluency, while Powerful Others was negatively associated with Global, Learning, and Memory, respectively (r = −.22 - −.29, all p's < .05), with effect sizes in the small range (Cohen, 1988). No other significant associations were found between any other neurocognitive domains and MHLC-C subscales among Latinx individuals (all p's >.05).

Conversely, in the NLW group, only Chance HLOC was negatively associated with Learning (r = −.46, p = .01) and Memory (r = −.42, p = .02), with effect sizes in the small-to-medium range (Cohen, 1988). No other significant associations were found between any other neurocognitive domains and MHLC-C subscales (all p's >.05) among NLW individuals (all p's >.05).

MHLC-C subscales, ethnicity, and neurocognitive function.—As illustrated in Table 6, a series of eight linear regression models were computed to predict neurocognitive domain scores from MHLC-C Subscales and ethnicity. Based on the significant correlations between MHLC-Chance and MHLC-Powerful Others with neurocognitive domain scores, these two subscales were entered in the model. The linear regression models also included relevant covariates (e.g., age, education, HIV viral load) when these variables were associated with both ethnicity and the respective outcome variable (i.e., neurocognitive domain scores). The results of these regressions indicated that the model significantly predicted performance in several neurocognitive domains.

The model explained 10% of the variance and was significant for the prediction of Global neurocognition F(3, 125) = 4.39, p = .01. Both MHLC-C Chance (p = .04) scores and ethnicity (p = .05) significantly contributed to the model, with Latinx ethnicity resulting in a decrease in Global neurocognition (β = −2.74, p = 05). Similarly, the model explained 8% of the variance and was a significant predictor for Verbal Fluency F(3,124) = 3.65, p = .02. However, only ethnicity (p = .03) significantly contributed to the model, such that Latinx ethnicity also resulted in a decrease in Verbal Fluency (β = −4.75, p = .03).

Additionally, the model explained 32% of the variance in Learning $F(6,117) = 9.07$, $p = <.01$. MHLC-Chance ($p = .02$) and Powerful Others ($p = .04$) scores significantly contributed to the model, while ethnicity did not ($p = .16$). Conversely, the model significantly explained 27% of the variance in Memory $F(4,125) = 11.31$, $p = <.01$. Only MHLC-Chance ($p = .02$) scores significantly contributed to this model, while ethnicity ($p = .26$) and MHLC-C Powerful Others ($p = .25$) scores did not. The model was not significant for the remaining domains of Executive Function, Processing Speed, Motor, and Attention/Working Memory (all p's >.05).

Discussion

Although some studies within the HIV literature have evaluated the relationship between HLOC and health-related behaviors (Molassiotis et al., 2002; Barclay et al., 2007), there is limited research examining the relationship between HLOC and neurocognitive functioning, particularly among diverse ethnocultural groups (Zahodne et al., 2015). This study sought to examine ethnocultural differences in HLOC beliefs and how these potential differences related to neurocognitive functioning in a sample of Latinx and NLW PLWH. The results revealed no significant differences in HLOC beliefs between the two ethnic groups. However, external HLOC beliefs (i.e., chance and powerful others) related to worse neurocognitive functioning in numerous domains (i.e., verbal fluency, learning, and memory), with more widespread associations within the Latinx group.

In contrast, these effects were more circumscribed in the NLW group, with only the HLOC belief of chance negatively impacting learning and memory performance. Interestingly and contrary to the *a priori* hypothesis, internal HLOC was not associated with global or domain-specific neurocognitive performance in either ethnic group. Research suggests that individuals with greater internal HLOC (i.e., belief that one's success is largely because of one's own effort) may be expected to persevere during challenging cognitive tasks, while those with greater chance or powerful others HLOC may be less motivated to maintain sustained attention or problem-solving effort (Shelton et al., 1982). Thus, these findings suggest that the external HLOC beliefs of chance or powerful others may uniquely, negatively impact neurocognitive test performance in Latinx PLWH. Consistent with the biopsychosociocultural framework (Rivera Mindt et al., 2008) of this study, the current findings also highlight the need for incorporating the psychological and sociocultural levels of analysis into our understanding of brain-behavior relationships in the context of HIV.

Implications of External HLOC

Existing research examining external HLOC endorsement among diverse ethnocultural groups underscores the critical role of inequity and racism, which may result in socioeconomic burden and can lead to demoralization and fatalism (Zahodne et al., 2017). The endorsement of external HLOC beliefs, such as chance and powerful others, aligns with the Latinx cultural construct of *fatalismo* (fatalism), which emphasizes the limited control over individual life events and a belief in a higher power, destiny, or luck (Anastasia & Bridges, 2015). The present findings indicate that greater endorsement of external HLOC beliefs may disparately impact neurocognitive performance in Latinx individuals

compared to their NLW counterparts. Greater endorsement of fatalismo is also associated with underutilization of medical and psychiatric services in Latinx individuals, which can exacerbate cognitive decline and has been cited as a barrier for health-related screenings (Abraido-Lanza et al., 2015; Rosales & Calvo, 2017).

The results of multivariable models that included ethnicity and the HLOC beliefs of chance and powerful others revealed that, together, these predictors contributed to significant variance in global neurocognition and the neurocognitive domains of learning, memory, and verbal fluency. Although both ethnicity and chance significantly contributed to global neurocognition and verbal fluency, only chance contributed to memory. Conversely, both chance and powerful others significantly contributed to learning. These findings emphasize the important role that external HLOC beliefs (i.e., chance and powerful others) may have on neurocognitive functioning, particularly for the domains of memory and learning, in which the model significantly predicted between 27% and 32% of the variance, respectively. Additionally, they highlight differential neurocognitive outcomes based on ethnicity, such that Latinx ethnicity was associated with decreases in some domains, such as global neurocognition and verbal fluency.

Implications of Internal HLOC

In the current study, internal HLOC was not associated with any aspect of neurocognitive functioning in either the Latinx or NLW groups. To our knowledge, no other studies to date have reported significant associations between internal HLOC and neurocognition among PLWH. However, some studies evaluating the effectiveness of cognitive training among older adults indicate significant improvements in internal LOC for several cognitive domains (i.e., reasoning, processing speed; Anderson et al., 2018; Wolinsky et al., 2010). Thus, further research is warranted to better understand the relationship between internal HLOC and neurocognition.

Study Strengths and Limitations

The current study has a number of key strengths and limitations. Regarding strengths, to our knowledge, this is the first study to report significant negative associations between external HLOC beliefs (i.e., chance and powerful others) and neurocognitive domains in a sample of Latinx and NLW PLWH. Moreover, this study included a well-characterized diverse sample and utilized a comprehensive, well-validated neurocognitive battery that has been used extensively in HIV research. Overall, these findings support the utility of assessing patient HLOC beliefs in PLWH to better understand the relationship between illness-related beliefs and neurocognitive functioning to inform evidence-based, culturally tailored interventions.

Despite the strengths of this study, a number of limitations must be considered. First, the non-Latinx White group was relatively small ($n = 38$) compared to the Latinx group ($n = 96$), which may impact statistical power for within-group analyses. Second, because of the geographic location of the study in a large, urban city (New York City), the present findings may not be generalizable to suburban or rural populations. Further, the demographic breakdown within the Latinx group was primarily Caribbean (82%), which is consistent with New York City demographics in the region where this study was conducted ("*El*

Barrio," also known as Spanish Harlem). Given the relative homogeneity of the Latinx sample, the generalizability of the present findings may be limited to English-speaking Latinx individuals of Caribbean origin. Third, PLWH with neurocognitive impairment were not excluded from the study. However, notably, the inclusion of PLWH with neurocognitive impairment adds to the generalizability of this study based on the high prevalence of HIV-associated neurocognitive disorders in this population (~ up to 50%; Heaton et al., 2010). Fourth, the MHLC-C is a self-report measure of HLOC beliefs and may be impacted by factors such as perceived social desirability. Furthermore, this study did not include assessment of personality characteristics, which may also contribute to individual differences in HLOC beliefs.

Future Directions

Additional research is needed to better characterize the mechanistic relationship between HLOC beliefs and neurocognitive function. Moving forward, it is critical for studies to include larger, well-characterized samples from other underrepresented populations that are also disproportionately impacted by HIV (e.g., lesbian, gay, bisexual, transgender, queer people of color, Black/African American, American Indian/Alaska Native) and additional measures assessing HLOC beliefs to increase convergent validity.

Overall, this study represents an important first step toward a better understanding of the relationship between HLOC and neurocognition in PLWH. Over time, a more comprehensive exploration of HLOC beliefs in PLWH may lead to improvements in clinical care through the use of evidence-based, culturally tailored interventions to improve cognitive health outcomes among ethnoculturally diverse individuals.

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Key Considerations

- Current findings indicate that greater external health locus of control (HLOC) beliefs may disparately impact neurocognition in Latinx people living with HIV (PLWH), compared to non-Latinx White PLWH. Greater external HLOC has been associated with worse health outcomes and underutilization of medical services among Latinx individuals.
- Additional exploration is needed to better understand the relationship between internal HLOC and neurocognition, particularly because internal HLOC has been associated with improved functional outcomes in PLWH.
- Future research may consider utilizing patient HLOC beliefs to develop targeted health communications and evidence-based, culturally tailored interventions that may improve cognitive health outcomes among ethnoculturally diverse PLWH.

Table 1.

Health Locus of Control Types and Descriptions (Wallston & Wallston, 1982; Norman et al. 1998)

HLOC Type	Description
Internal HLOC	The belief that one's health and well-being is the direct result of one's own actions
External HLOC	The belief that one's health and well-being is the result of external circumstances. Some subtypes of external HLOC include: • Chance HLOC: fate, luck, or chance • Doctors HLOC: doctors or medical professionals • Powerful Others HLOC: family members or friends

Note. HLOC = health locus of control.

Table 2.

Neurocognitive Measures and Normative Data Sources

Neurocognitive Domains and Tests	Normative Data Sources
Executive Function	
Wisconsin Card Sorting Task-64 Item	Kongs et al. (2000) [a,b]
Trail Making Test (Part B)	Heaton et al.(2004) [a,b,c]
Attention/Working Memory	
WAIS-III Letter Number Sequencing	Heaton et al. (2003) [a,b,c]
PASAT Total Correct	Heaton et al. (2004) [a,b,c]
Learning/Memory	
Hopkins Verbal Learning Test-Revised (Total Recall; Delayed Recall)	Benedict et al. (1998) [a]
Brief Visuospatial Memory Test-Revised (Total Recall; Delayed Recall)	Benedict (1997) [a]
Motor Function	
Grooved Pegboard Time (dominant hand and nondominant hand)	Heaton et al. (2004) [a,b,c]
Processing Speed	
WAIS-III Digit Symbol	Heaton et al. (2003) [a,b,c]
WAIS-III Symbol Search	Heaton et al. (2003) [a,b,c]
Trail Making Test (Part A)	Heaton et al. (2003) [a,b,c]
Verbal Fluency	
Controlled Oral Word Association (Letter Fluency) and Category Fluency Test (Animals)	Heaton et al. (2004) [a,b,c]

Note. WAIS-III = Wechsler Adult Intelligence Scale, 3rd edition. Normative data correct for the following demographic characteristics, indicated by superscript number

a. age

b. education

c. gender.

Table 3.

Demographic and Clinical Characteristics for Study Sample (N = 134)

	Full Sample (N = 134) *M (SD)*/%	**Latinx (n = 96) *M (SD)*/%**	**NLW (n = 38) *M (SD)*/%**	***t*/*X*** ^{2}
Age (years)	47.28 (8.20)	46.01 (7.08)	50.47 (9.92)	**2.53** *
Education (years)	12.80 (2.75)	12.18 (2.39)	14.34 (3.01)	**3.96** **
HIV duration (years)	16.15 (6.22)	14.84 (5.84)	19.10 (6.18)	**2.66** *
% Male	70%	67%	79%	.21
	Sample Median (IQR)	**Median (IQR)**	**Median (IQR)**	***U*** ^{a}
Current CD4+ T-cell count	455 (450)	424 (400)	645 (615)	1412.00
Nadir CD4+ T-cell count	166 (214)	180 (241)	155 (148)	1170.50
HIV viral load$_{log10}$	1.38 (1.05)	1.61 (1.40)	1.38 (0.36)	**1163.00** **

Note. IQR = interquartile range; NLW= non-Latinx White

[a]Mann-Whitney *U*-test

*$p < .05$

**$p < .01$.

Table 4.

Ethnic Group Differences on MHLC-C Subscales ($N = 134$)

	Study Sample ($N = 134$) *M* (*SD*)	**Latinx ($n = 96$) *M* (*SD*)**	**NLW ($n = 38$) *M* (*SD*)**	***t*** [a]
Internal	25.18 (5.50)	25.58 (5.48)	24.16 (5.49)	−1.36
Chance	14.61 (6.55)	15.06 (6.99)	13.47 (5.21)	−1.44
Doctors	14.99 (2.95)	15.02 (2.95)	14.92 (3.00)	−0.18
Powerful Others	10.87 (3.14)	11.06 (3.21)	10.37 (2.92)	−1.16

Note. NLW = non-Latinx White

[a] Independent samples *t*-test

* $p < .05$

** $p < .01$.

Table 5.

Partial Correlations Between Neurocognitive Domains and MHLC-C Subscales, Controlling for Age and Education

	Study Sample *N* = 134				Latinx *n* = 96				NLW *N* = 38			
HLOC Domain	**Internal**	**Chance**	**Doctors**	**Powerful Others**	**Internal**	**Chance**	**Doctors**	**Powerful Others**	**Internal**	**Chance**	**Doctors**	**Powerful Others**
Global	−.11	**−.19** *	.02	**−.20** *	−.08	**−.17** †	.07	**−.22** *	−.11	−.23	−.18	−.09
Executive function	**−.21** *	−.02	−.10	−.08	−.20†	−.02	−.11	**−.17** †	−.23	−.06	−.11	.14
Attention/working memory	−.06	−.10	−.03	−.13	−.10	−.10	.03	−.14	.08	−.11	−.22	−.11
Learning	−.12	**−.28** **	.03	**−.28** **	−.03	**−.21** †	.04	**−.28** *	−.18	**−.46** *	−.12	−.22
Memory	−.06	**−.24** **	.08	**−.23** **	.04	−.15	.12	**−.24** *	−.10	**−.42** *	−.14	−.10
Motor	−.02	−.06	.03	<.01	.01	<−.01	.05	−.06	−.08	−.27†	−.02	.14
Processing speed	−.11	.78	.01	−.12	−.11	−.06	.07	−.12	−.09	.07	−.21	−.11
Verbal Fluency	−.01	**−.19** *	.08	−.13	−.05	**−.30** *	.11	−.15	.11	.13	−.02	−.07

Note. HLOC = health locus of concern; MHLC-C = Multidimensional Health Locus of Control-Form C; NLW = non-Latinx White

† $p < .10$

* $p < .05$

** $p < .01$.

Table 6.

Linear Regression Models Predicting Neurocognitive Domains from Ethnicity and MHLC-C Subscales

		Ethnicity		MHLC-C-Chance		MHLC-C-Powerful Others	
	R^2	*B*	*SE B*	*B*	*SE B*	*B*	*SE B*
Global	0.10	**−2.74** *	1.39	**−0.23** *	0.11	−0.21	0.22
Executive function	0.02	−2.54	2.11	0.08	0.16	−0.30	0.33
Attention/WM	0.03	0.50	1.73	−0.11	0.14	−0.33	0.28
Learning[a,b,c]	0.32	−3.24	2.31	**−0.04** *	0.17	**−0.73** *	0.34
Memory[b]	0.27	−2.59	2.29	**−0.40** *	0.17	−0.39	0.34
Motor	0.02	2.81	1.99	−0.15	0.16	0.13	0.32
Processing speed	0.03	−2.06	1.79	<.10	0.14	−0.41	0.28
Verbal fluency	0.08	**−4.75** *	2.17	**−0.34** *	0.17	−0.05	0.34

Note. MHLC-C = Multidimensional Health Locus of Control Scale-Form C; WM = working memory.

[a.] controlling for age

[b.] controlling for education

[c.] controlling for viral load.

† $p < .10$

* $p < .05$

** $p < .01$.