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An Explanatory Factor Analysis of a Brief Self-Report Scale to Detect Neurocognitive Impairment among HIV-Positive Men Who Have Sex with Men and Transgender Women in Peru

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Abstract

Neurocognitive impairment (NCI) has been associated with poor clinical outcomes in various patient populations. This study used exploratory factor analysis (EFA) to examine the factor structure of the existing 95-item Neuropsychological Impairment Scale (NIS) to create a suitable NCI screening instrument for people living with HIV (PLH). In Lima, Peru, 313 HIV-positive men who have sex with men (MSM) and transgender women (TGW) prescribed antiretroviral therapy (ART) completed the NIS using computer-assisted self-interviews (CASI). The EFA used principal axis factoring and orthogonal varimax rotation, which resulted in 42 items with an 8-factor solution that explained 51.8% of the overall variance. The revised, 8-factor, Brief Inventory of Neurocognitive Impairment for Peru (BINI-P) showed a diverse set of factors with excellent to good reliability (i.e., $F_1 \alpha=0.92$ to $F_8 \alpha=0.78$). This EFA supports the use of the BINI-P to screen for NCI among Spanish-speaking, HIV-positive MSM and TGW. Future research should examine the effectiveness of the BINI-P in detecting NCI in clinical care settings and the impact of NCI on HIV health-related outcomes, including linkage and retention in care, ART adherence and HIV risk behaviors.

Keywords

Brief Inventory of Neurocognitive Impairment; neurocognitive impairment; explanatory factor analysis; HIV/AIDS; who have sex with men; transgender women

Introduction

While combination ART has dramatically reduced severe neurocognitive impairment (NCI) manifestations in people living with HIV (PLH), mild to moderate NCI still occurs, including among those who are virally suppressed (Boisse, Gill, & Power, 2008; Clifford & Ances, 2013; Spudich & Gonzalez-Scarano, 2012). Long-term HIV infection leads to genetically isolated populations of virus in the CNS (Brown et al., 2011; Thomas et al., 2007) and has been associated with decreased survival (Mind Exchange Working Group, 2013; Villa et al., 1996), reduced quality-of-life (Hinkin et al., 2004; Stern et al., 2001; van Gorp, Baerwald, Ferrando, McElhiney, & Rabkin, 1999), ART non-adherence (Anand, Springer, Copenhaver, & Altice, 2010; Fialho et al., 2016), increased HIV risk-taking behaviors (Anand et al., 2010; Shrestha & Copenhaver, 2016), and impaired neurocognitive abilities (Copenhaver, Shrestha, Wickersham, Weikum, & Altice, 2016; Ezeabogu, Copenhaver, & Potrepka, 2012). Although ART has also been shown to reduce the prevalence of severe NCI manifestations (Crum-Cianflone et al., 2013), limiting the progression of NCI should be addressed by more effective and briefer testing screening methods. NCI is of particular concern among PLH in Peru, where the epidemic remains concentrated in key populations, especially men who have sex with men (MSM) and transgender women (TGW) (Garcia et al., 2012). The extent of NCI in these communities is limited either due to under-recognition of NCI in PLH and/or underuse of screening methods that can be incorporated into clinical practice. Many NCI screening methods require significant time investment or resources, necessitating more self-report NCI screening tools (Copenhaver et al., 2016; Shrestha & Copenhaver, 2016). Therefore, we sought to address this deficit by introducing the Neuropsychological Impairment Scale (NIS), a self-report measure created to quickly determine global and subscale NCI symptoms like attention, memory, frustration tolerance, and learning ability (O'Donnell, DeSoto, & Desoto, 1994) in MSM and TGW in Peru.

Methods

This study is a subset of a larger study among HIV-positive Peruvian MSM and TGW (N=313) who were recruited from three HIV clinical sites that provide specialty services for MSM and TGW in Peru to examine factors associated with HIV treatment. Eligible participants were 18 years, born male, diagnosed with HIV for over 1 year, and currently taking ART. After providing written informed consent, participants completed a 60-minute computer-assisted self-administered interview (CASI) and were paid for their time and travel expenses. Ethical oversight was provided by the Institutional Review Boards at each clinical site and Yale University.

Neurocognitive Impairment Measure

NCI was assessed using the standardized, translated, and back-translated (Ferro et al., 2014), 95-item Neuropsychological Impairment Scale (NIS) (W. E. O'Donnell, De Soto, & De Soto, 1993). The original NIS is self-report measure developed to help elicit neurocognitive symptoms and rated on a 5-point scale, ranging from 0 (not at all) to 4 (extremely).

Participants were asked to read each statement and indicate the degree to which it applied to them during the past 30 days.

Procedures and analyses

Statistical analyses were completed in SPSS 20.0. Descriptive analyses summarized participant characteristics. After confirming that the data were suitable for factor analysis, exploratory factor analysis (EFA) was conducted on the full 95-item NIS using principal axis factoring (PAF) (Kahn, 2006) and orthogonal varimax rotation. The number of factors to be retained was determined using two rules: Kaiser's criterion (eigenvalues >1) (Kaiser, 1960) and inspection of the scree plot. The reliability of the subscales was measured using Cronbach's alpha coefficients. Pairwise deletion was used in the final analysis as missing data were <1%.

Results

Participants were in their mid-thirties (mean=34.3 years), had completed high school (69.3%), employed full-time (52.1%) and earned more than Peru's minimal wage (57.8%). TGW represented 6.1% of our sample. Nearly half of the sample met screening criteria for an alcohol use disorder (41.9%) and moderate to severe depression (42.5%), while 10.5% reported recreational drug use. The average score for the global measure of neurocognitive impairment was 8.8 ± 7.7 .

Inspection of the correlation matrix revealed the presence of many coefficients of 0.3 and above. The Kaiser overall Kaiser-Meyer-Olkin (KMO) value was 0.940, exceeding the recommended value of 0.6 (Kaiser, 1974) and Bartlett's test of Sphericity reached statistical significance (Bartlett, 1954), thus supporting the factorability of the correlation matrix. Prior to conducting factor analyses, we consulted the NIS user manual and the peer-reviewed literature on the development and validation of the original NIS (William E. O'Donnell, de Soto, & Reynolds, 1984; William E. O'Donnell, Reynolds, & de Soto, 1983, 1984). We noted that 15 of the 95 items were designed to function as "validity checks" to address a number of factors that shape the context for interpreting the impairment scores and are unrelated to neuropsychological symptoms. Thus, these items were removed from the EFA.

The rotated solution of the remaining 80 items revealed a 16-factor solution that accounted for 54.4% of the variance. Twenty-seven items showed loadings below 0.40. Given the high number of items retained, items with loadings below 0.40 or items with shared loadings of equal strength across multiple factors were eliminated, leaving 42 items. The same EFA procedure was repeated on the 42 retained items, resulting in an 8-factor solution that explained 51.8% of the overall variance (Table 1). Examination of the scree plot suggested that an eight-factor solution provided the best fit. The suitability of an eight-factor solution

was also evident from initial eigenvalues and total variance associated with the eight individual factors.

The revised 42-item, 8-factor NIS includes a diverse set of factors with excellent overall reliability ($\alpha=0.94$). The reliability of the 8 factors ranged from excellent to good (by factor: $F_1 \alpha=0.92$; $F_2 \alpha=0.84$; $F_3 \alpha=0.83$; $F_4 \alpha=0.69$; $F_5 \alpha=0.75$; $F_6 \alpha=0.77$; $F_7 \alpha=0.67$; and $F_8 \alpha=0.78$). All the subscales were analyzed as continuous variables, with higher score as an indication of higher degree of NCI.

Discussion

To our knowledge, this is the first study investigating the extent and subscale assessment of NCI among HIV-positive MSM and TGW in Latin America. This work builds on a recent revision of the NIS, renamed the Brief Inventory of Neurocognitive Impairment (BINI) (Copenhaver et al., 2016), in patients with opioid use disorders that showed a diverse set of factors with excellent overall reliability. This validation, however, did not include MSM or TGW. Our EFA in Peru shows that the revised-NIS, now called the BINI-P, also has excellent overall reliability and is structured to detect NCI in our sample, ranging from generalized neurocognitive symptoms (e.g., Global) to more specific forms of impairment (e.g., Learning-related; Psychomotor; Pain-related). Given its brevity, self-administration procedure, excellent psychometric properties, and straightforward interpretation, the BINI-P could be used to screen for NCI in HIV-positive MSM and TGW in the Latin American context. More consistent use of this scale in research and clinical practice will help identify neurocognitive deficits and provide insights for intervention that can be deployed to overcome the potential detrimental HIV-related consequences that might occur if NCI is not addressed. Furthermore, elevated scores on any of the subscales could guide providers to further assess the patient with more in-depth neuropsychological testing in order to better understand and accommodate deficits in the context of treatment (Copenhaver et al., 2016). Given that NCI disrupts several cognitive domains (Ezeabogu et al., 2012), future studies should explore the relationship between NCI and HIV continuum of care outcomes among MSM and TGW in Latin America.

Some limitations of this study warrant careful interpretation of results. The convenience sampling strategy may have introduced sampling bias and limit the generalizability of the findings to the overall population of PLW. Data were collected using self-reports, which is vulnerable to social desirability bias. Additionally, factor loading of <0.40 on one of the items (i.e., PAIN) and low reliability (<0.67) of F_7 factor may limit precise measurement of NCI. Nonetheless, the study provides new information about the psychometrically valid factor structure of the revised NIS among a portion of the population wherein very limited research has been conducted.

Conclusion

While NCI among HIV-positive individuals continues to an important area of investigation, contributions of NCI in the Latin American context and among MSM and TGW is understudied. The BINI-P is a briefer and more robust screening instrument that has

excellent psychometric properties and better equips HIV clinicians and researchers to identify NCI among HIV-positive MSM and TGW to inform enhanced treatment approaches. Future research is needed to explore the effectiveness of BINI-P as a tool for NCI screening and to examine the impact of NCI on HIV medical care outcomes.

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Table 1: Factor loadings from exploratory factor analysis of the original 95-item Neurocognitive Impairment Scale (N=313)

Items	Factors/Labels							
	1	2	3	4	5	6	7	8
My reactions are slow.	.692	.241	.117	.075	.197	.111	.156	.199
I have trouble remembering.	.613	.185	.178	.337	.104	.120	.007	.152
My judgment is poor.	.581	.207	.238	.161	.132	.172	.026	.096
My mind is dull	.556	.113	.261	.213	.024	.196	.008	.103
Something is wrong with my mind.	.538	.108	.190	.085	.168	.162	.201	-.002
I do things slowly.	.535	.088	.062	.032	.145	.067	.153	.048
My mind works slowly	.534	.344	.096	.112	.105	.073	.084	-.075
My brain becomes tired easily.	.529	.293	.233	.317	.024	.034	.098	.144
I have trouble remembering important things.	.500	.399	.168	.116	.089	.175	.104	.136
I have trouble concentrating.	.494	.441	.165	.266	.216	.079	.065	.307
I get confused easily.	.489	.476	.160	.049	.197	.236	.128	.159
I forget what I read.	.488	.319	.154	.088	.110	.162	.186	.222
I have trouble writing sentences.	.476	.294	.140	.244	-.075	.188	-.047	-.038
My mind won't stay on any one thing.	.423	.190	.220	.027	.077	.084	.168	.289
My mind tends to wander.	.411	.127	.172	.053	.159	.292	.259	.142
I forget where I put things.	.126	.708	.150	.005	.155	.092	.059	.124
I am forgetful	.190	.680	.086	.048	.069	.054	.081	-.021
I have serious memory problems.	.331	.585	.015	.051	-.005	.154	.215	.030
I often lose things.	.320	.571	.109	.089	.093	.174	.129	.181
I have a hard time remembering people's names.	.123	.491	.063	.023	.148	.191	.072	.141
I have difficulty paying attention.	.318	.466	.174	.260	.083	.068	.040	.353
My words get mixed up.	.272	.403	.285	.187	.016	.340	.108	.017
I feel easily annoyed and irritable.	.247	-.015	.752	.093	.104	.062	.061	.113
I have a bad temper.	.155	.063	.687	.139	.089	.036	-.037	.029
I get into arguments frequently.	.130	.112	.651	.103	.198	.154	.086	.132
I have urges to break and smash things.	.154	.180	.597	.030	.032	.113	.142	.031

Items	Factors/Labels							
	1	2	3	4	5	6	7	8
	GLOB	MEMR	FRUS	PSYP	LEARN	LANG	PAIN	ATTN
I fall apart under pressure.	.185	.262	.554	.137	.182	.087	.181	.108
Part of my body is paralyzed.	.057	.055	.128	.679	.050	.118	-.008	.121
I fall down sometimes.	.159	.090	.139	.594	-.067	.110	.159	-.010
I have been knocked unconscious.	.126	-.017	.008	.540	.118	.050	.139	.087
I have trouble with the right side of my body.	.358	.113	.141	.488	.053	.115	.100	-.196
Doing simple math problems in my head is difficult.	.256	.190	.200	.082	.797	.044	.055	.091
My arithmetic is poor.	.158	.102	.141	-.009	.728	.054	.085	.075
I count with my fingers.	.133	.223	.222	.252	.377	.019	.028	-.014
My speech has become worse.	.264	.311	.140	.124	.027	.689	.071	.019
I have trouble spelling.	.218	.160	.086	.263	.105	.585	.009	.171
I have trouble talking.	.346	.228	.207	.130	-.001	.492	.088	-.011
I have severe headaches.	.201	.238	.297	.071	.021	.029	.654	.057
I suffer from severe pain.	.270	.257	.301	.137	.040	.007	.550	-.038
I have had a head injury.	.061	.037	-.042	.130	.067	.058	.450	.079
I am easily distracted.	.303	.336	.288	.096	.121	.112	.106	.602
I am absent - minded.	.278	.337	.206	.112	.121	.117	.167	.471

Legend:

GLOB: Global impairment

MEMR: Memory-related impairment

FRUS: Frustration Tolerance-related impairment

PSYP: Psychomotor-related impairment

LEARN: Learning-related impairment

LANG: Language-related impairment

PAIN: Pain-related impairment

ATTN: Attention-related impairment