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Medication and finance management among HIV-infected adults: The impact of age and cognition

April D. Thames¹, Michelle S. Kim², Brian W. Becker², Jessica M. Foley³, Lindsay J. Hines¹,
Elyse J. Singer¹, Robert K. Heaton⁴, Steven A. Castellon^{1,2}, and Charles H. Hinkin^{1,2}

¹UCLA School of Medicine, Los Angeles, CA, USA

²VA Greater Los Angeles Healthcare System, Los Angeles, CA, USA

³Boston VA Healthcare System & Harvard Medical School, Boston, MA, USA

⁴UCSD School of Medicine, San Diego, CA, USA

Abstract

This study examined the effects of aging and cognitive impairment on medication and finance management in an HIV sample. We observed main effects of age (older < younger) and neuropsychological impairment on functional task performance. Interactions between age and cognition demonstrated that older impaired individuals performed significantly more poorly than all other comparison groups. There were no relationships between laboratory performance and self-reported medication and finance management. The interaction of advancing age and cognitive impairment may confer significant functional limitations for HIV individuals that may be better detected by performance-based measures of functional abilities rather than patient self-report.

Keywords

Neuropsychology; HIV; Aging; Functional abilities; Medication management; Finance management

INTRODUCTION

Advances in pharmacotherapy have led to substantial health-related improvements for individuals living with HIV, resulting in a lifespan that may extend well into older adulthood.

The number of HIV-infected individuals 65 years of age and older has increased, from ~1,000 to >10,000 in the past decade, and it is predicted that approximately 50% of new AIDS cases will fall into this older age group within the next 10 years (Center for Disease Control, 2007; Valcour & Paul, 2006).

While it is now well established that age confers its own risks for cognitive decline, recent literature has documented an increased prevalence and severity of cognitive abnormality (corrected for normal aging) among older HIV-infected adults when compared to both younger HIV-seropositive (HIV+) and HIV-seronegative (HIV-) healthy elderly controls (Becker, Lopez, Dew, & Aizenstein, 2004; Cherner et al., 2004; Hardy et al., 1999; Hinkin,

Castellon, Atkinson, & Goodkin, 2001; Sacktor et al., 2007; Stoff, Khalsa, Monjan, & Portegies, 2004; Valcour, Shikuma, Watters, & Sacktor, 2004; van Gorp et al., 1994). Such declines range from mild deficits to frank dementia and may include notable declines in daily functional independence (for reviews see Grant, Heaton, & Atkinson, 1995; Heaton et al., 1995; Hinkin, van Gorp, & Satz, 1995).

An important, yet understudied qualitative marker of cognitive decline is an inability to independently and competently carry out daily functions. These functional abilities are most commonly evaluated through assessments of basic activities of daily living (BADLs), consisting of elementary self-care functions (e.g., bathing and dressing), and instrumental activities of daily living (IADLs), which require more complex, higher order skills such as managing finances, driving, and managing medications. Among individuals with HIV, neuropsychological impairment has been linked to functional declines in IADLs, including medication and finance management, cooking, and driving (Albert et al., 1999; Heaton et al., 2004a; Hinkin et al., 2002; Marcotte et al., 1999; Woods et al., 2008).

Methods used to assess functional status include self-report, caregiver ratings, and laboratory-based performance tasks of functional capacity (Antinori et al., 2007; Heaton et al., 2004a). Although those who candidly admit to poor adherence to their prescribed medication regimens may be accurately reporting their behavior, several studies have demonstrated that patients who self-report perfect or near-perfect adherence may be overestimating by 10–20% (Arnsten et al., 2001; Levine et al., 2006). The lack of association between objective findings and subjective ratings has been addressed in previous investigations and has been explained by psychiatric factors (Hinkin et al., 1996; Moore, van Gorp, Hinkin, Stern, & Swales, 1997; Rourke, Halman, & Bassel, 1999), impaired cognition (Reinhard et al., 2007), and poor insight (Gazelle et al., 2007). Given the limited validity of self-report of functional decline, it is now becoming increasingly common to incorporate performance-based tasks to assess functional abilities in HIV, since they have been shown to be more reliable and objective measures of “real-world” performance (Heaton et al., 2004a). Unlike survey methods, performance measures avoid effects of response biases or impaired recall (Chesney, Morin, & Sherr, 2000).

One such study (Albert et al., 1999) utilizing a performance-based method of medication management in an HIV+ sample found that cognitively impaired adults performed more poorly than cognitively unimpaired adults, and in this particular instance performance was associated with self-reported adherence.

Similarly, Hinkin and colleagues (2002) found that cognitively compromised participants were twice as likely to fail to adequately adhere to their medication regimen (assessed by electronic confirmation of medication container use) than cognitively normal participants, and that neuropsychological deficits in executive functioning, attention, and verbal memory were significantly associated with poor adherence. These authors also found that cognitive compromise interacted with regimen complexity to increase the likelihood of suboptimal adherence. Consequently, cognitively impaired participants who were on complex dosing regimens were much more likely to be poor adherers.

The ability to competently handle finances also requires complex mental processes, such as keeping track of how much money is spent each month to ensure that one does not spend beyond one's means. The first comprehensive study to examine functional competency including financial management among HIV+ individuals was performed by the UCSD (University of California, San Diego) HIV Neurobehavioral Research Center, in which Heaton and colleagues (2004a) developed and validated a performance-based measure to assess finance management (entitled “Advanced Finances”). The Advanced Finances task

requires individuals to pay fictitious bills and manage a fictitious checkbook. In the first study to utilize this newly developed measure, high failure rates were associated with greater neuropsychological impairment, particularly in executive functioning (Heaton et al., 2004a). Apart from this study, no research to our knowledge has examined the impact of neurocognitive dysfunction on financial management in HIV+ adults, or how financial management may be impacted by aging and HIV.

Although several available studies have linked neuropsychological (NP) deficits to impaired functional abilities in relatively young cohorts (Albert et al., 1995; Benedict, Mezhir, Walsh, & Hewitt, 2000; Heaton et al., 1996; Heaton et al., 2001; Mapou et al., 1993; Marcotte et al., 1999; Stern et al., 1991), this work has yet to be extended to older HIV+ individuals. It is important to tailor investigations to the essential functional tasks (e.g., managing medications) required of this population. There were four primary hypotheses to the current study. First, we expected older HIV+ adults to perform more poorly on tasks of medication and finance management than younger HIV+ adults. Second, we expected that cognitively impaired HIV+ adults would perform more poorly on medication and finance management than cognitively unimpaired HIV+ adults. We also expected to find an interaction of age and cognition upon functional outcomes; specifically, older individuals with HIV-associated neurocognitive disorders (Antinori et al., 2007) would demonstrate greater impairment on the Medication Management Task–Revised (MMT–R) and Advanced Finances than would the other groups. Finally, we expected that performance on medication management and finances management would be weakly associated with self-reported difficulties with medication adherence and financial management.

METHOD

Participants

Participants included 51 HIV+ adults who were recruited from community agencies and medical centers within the Los Angeles area. Participants were excluded if they presented with a history of a severe psychiatric episode (mania, psychosis) within the past year or alcohol/illicit substance dependence within the last month according to data collected using the Structured Clinical Interview for DSM–IV, Axis I Disorders (SCID; First, Spitzer, Gibbon, & Williams, 1995). Participants were also excluded if they presented with medical comorbidities unrelated to HIV that may increase risk for cognitive impairment (e.g., brain anoxia, kidney dysfunction, seizures, or hepatitis C virus). Individuals with histories of known central nervous system (CNS) insults (e.g., stroke, brain tumor, or CNS-opportunistic infections) also were excluded.

The mean age for the total sample was 48.2 (*SD* 13.8) years, and the mean education level was 13.5 (*SD* 2.5) years; 76.9% were male; 42.3% were African American, and 32.7% were Caucasian. The mean nadir (lowest recorded) CD4 cell count was 195.1 (196.7) cells/mm³, and mean recent CD4 count was 492.3 (*SD* 278.1). All participants reported being prescribed combination antiretroviral therapy (cART), and 62% of the sample had an undetectable plasma viral load at the time of assessment. A total of 89% of participants reported managing their medications independently. See Table 1 for demographic descriptive statistics stratified by age (younger/older) and cognitive (impaired/unimpaired) groups.

Procedure

Neurocognitive assessment—All participants completed a comprehensive neuropsychological test battery administered by trained psychometrists who were supervised

by a board-certified neuropsychologist (C.H.H.). See Table 2 for list of neuropsychological measures by domain.

In an effort to maximize age differences between groups, individuals were dichotomized by age (younger < 40 years, $n = 23$; older ≥ 55 years; $n = 28$). Test scores were converted to demographically corrected T scores (mean = 50, $SD = 10$) using published normative data (see Table 2) and were grouped by neurocognitive domain. Deficit scores were then calculated using an algorithm developed by Heaton and colleagues (Heaton, Miller, Taylor, & Grant, 2004b) that assigns an impairment rating to T scores as follows: $T > 39 = 0$; $39 \geq T > 35 = 1$; $34 \geq T > 30 = 2$; $29 \geq T > 25 = 3$; $24 \geq T > 20 = 4$; $T < 20 = 5$. Deficit scores from all neuropsychological tests were averaged into one score to reflect global impairment (Global Deficit Score, GDS); this reflects the number and severity of deficits across the entire battery. Individuals were then classified as either cognitively unimpaired ($n = 30$) or cognitively impaired ($n = 21$) based upon a deficit score cutoff of 0.5. The global deficit score approach has been demonstrated to have good predictive validity for detecting cognitive impairments in HIV-infected individuals (Carey et al., 2004).

Functional assessment

Self report: Self-reported medication adherence was defined by the percentage of antiretroviral medication doses taken over the last 30 days. This formula was calculated by subtracting the number of reported missed doses within the last 30 days from the total number of doses prescribed, dividing this number by the total number of doses prescribed, and multiplying by 100.

Self-reported financial management entailed participants' responses to whether they independently managed their finances and was rated according to scoring criteria from a modified version of the Lawton and Brody Activities of Daily Living Scale (Heaton et al., 2004; Lawton & Brody, 1969).

Laboratory assessment

Medication Management Task–Revised: Participants were administered the Columbia Medication Management Task–Revised (MMT–R; Heaton et al., 2004), which required them to respond to questions about five different medications based upon labels, the number of pills in each bottle, and directions on package inserts. Questions required participants to determine information such as when a refill was needed, which medications need to be taken with food, how many pills are required to take the correct dosage, and how to correctly place pills in a pill box based on the instructions on the labels. In addition, the revised version of this task added questions asked about the participant's own medication management, such as whether or not the participant receives assistance with remembering to take medications, or if they have recently run out of medications without a prior refill. Total points earned (out of a maximum of 18) was the outcome variable for the MMT–R task. The range of scores for the sample was 4–17 with a median score of 12.

Advanced Finances: The Advanced Finances task (Heaton et al., 2004) provides participants with blank checks, a checkbook register, a check to deposit, deposit slips, three bills to pay (phone, gas, credit card), a calculator, and paper and a pencil. Participants are asked to pay each bill, log transactions in their checkbook register, and pay as much of their credit card bill as possible while leaving exactly \$100 in their checking account. Scores on the task were determined based on the participant's ability to correctly complete checks and calculate totals in the checkbook register, while remembering to leave \$100 in their account for necessities during the rest of the month. Participants who had never had a checking account or balanced a checkbook were excluded from this task ($n = 14$). The total score (out

of a maximum of 13) earned on the Advanced Finances task was used to reflect overall task performance. The range of scores for the sample was 2–13 with a median score of 9.

Modified Lawton and Brody Instrumental Activities of Daily Living Scale (IADL): The Lawton and Brody IADL scale (Lawton & Brody, 1969) was developed to assess the more complex (i.e., instrumental) ADLs necessary for living independently in the community. Reported independence in tasks such as shopping, cooking, and managing finances were assessed. Participants' self-reported financial independence was rated on a modified scale: 0 = independent, 1 = needs some assistance, 2 = dependent, or 8 = independent, but someone else manages it for the participant. Although past history of management at one's best level of functioning was also rated, these ratings were not utilized for the purposes of this paper. Current ratings of financial independence were dichotomized into 0 = fully independent versus 1 = not fully independent.

Statistical analyses—Inspections of the distributions for Medication Management Task and Advanced Finances revealed negatively skewed distributions. Log 10 transformations were applied to both distributions, and primary analyses were performed on transformed data. Preliminary analyses using analysis of variance (ANOVA) revealed significant age group differences in Beck Depression Inventory–Second Edition (BDI–II) scores ($F = 4.04$; $MSE = 96.85$, $p = .05$) and education ($F = 8.99$; $MSE = 5.44$, $p = .004$). Specifically, older adults reported less depression than younger adults, and older adults reported higher education levels than younger adults (See Table 1). There were no significant ($p > .05$) differences between age (young vs. old) or cognitive status (impaired vs. unimpaired) groups with respect to gender, ethnicity, CD4 count, or viral load. Chisquare tests indicated no differences in the proportion of prior history of substance abuse/dependence, or prior history of psychiatric illness for the two age groups or the two cognitive impairment groups. There were no differences between participants with detectable versus undetectable plasma viral load on global NP scores, performance on MMT–R and Advanced Finances, or self-reported medication adherence and finance management. Furthermore, there were no significant relationships between CD4 count, MMT–R, and Advance Finance performance.

Analyses for the present study were conducted utilizing SPSS Version 15.0. Two-way analysis of covariance (ANCOVA) with age (younger/older) and cognitive status (impaired/unimpaired) as independent variables was conducted for both of the functional measures while controlling for depression (i.e., BDI–II score) and years of education. Pearson's bivariate correlations were conducted to examine relationships between neurocognitive domains (using NP domain mean T scores) and performance on MMT–R and Advanced Finances. A Pearson correlation was also used to examine MMT–R performance and self-reported medication adherence. Independent samples t tests were used to examine differences between subgroups with presence or absence of self-reported finance independence on NP functioning and performance on Advanced Finances. The correlational analyses between neurocognitive domains, MMT–R, and Advanced Finances were first performed for the entire sample and then separately by age group.

RESULTS

Age, cognitive status, and medication and finance management

As can be seen in Table 3, two-way ANCOVA results revealed that older HIV+ adults performed significantly more poorly than younger HIV+ adults on MMT–R ($F = 7.68$; $MSE = 0.013$, $p = .08$, $\eta^2_p = .41$) and Advanced Finances ($F = 4.57$; $MSE = 0.056$, $p = .04$, $\eta^2_p = .15$). Cognitively impaired HIV+ adults also performed more poorly than unimpaired HIV+ adults on MMT–R ($F = 19.74$; $MSE = 0.013$, $p < .001$, $\eta^2_p = .30$). There were no significant

cognitive impairment group differences for Advanced Finances. However, higher scores on Advanced Finances were positively correlated with spatial processing, $r(28) = .54, p = .003$, and executive functioning, $r(28) = .42, p = .02$. There was an interaction effect of age level and neurocognition status on medication management performance ($F = 6.71$; $MSE = 0.13$, $p = .01$, $\eta^2_p = .13$; see Figure 1), such that older adults with cognitive impairment performed worse than all other age/cognitive status groups. Better performance on MMT-R was associated with the cognitive domains of attention/working memory, $r(49) = .48, p < .001$, learning/memory, $r(49) = .58, p < .001$, verbal fluency, $r(49) = .41, p < .001$, spatial processing, $r(49) = .48, p < .001$, and executive functioning, $r(49) = .61, p < .001$; see Table 4). Interaction effects were not found for finance management performance.

Neuropsychological and functional performance among younger and older groups

When we examined the association between medication management and cognition (using NP domain mean T scores) separately by age groups, there were no significant relationships between NP functioning and MMT-R performance for younger adults. However, for older adults, worse performance on MMT-R was associated with greater impairments in attention/working memory, $r(26) = .61, p = .001$, learning and memory, $r(26) = .71, p < .001$, verbal fluency and naming, $r(26) = .50, p = .007$, spatial processing, $r(26) = .61, p < .0001$, and executive functioning, $r(26) = .69, p < .001$; see Table 5).

Among younger adults, better performance on Advanced Finances was associated with verbal fluency and naming, $r(21) = .62, p = .03$, whereas for older participants, performance was positively correlated with spatial processing, $r(26) = .66, p = .03$.

Neuropsychological functioning and self-reported medication and finance management

There was no meaningful relationship between global neuropsychological functioning and self-reported medication adherence, $r(49) = .13, p = .39$. Similarly, there was no difference in global neuropsychological functioning between self-reported finance management groups, $r(49) = -.0212, p = .83$.

Self-report versus laboratory-based performance

As expected, there was no significant relationship between self-reported medication adherence and performance on the MMT-R, $r(49) = -.20, p = .16$, or differences between self-reported finance competence and performance on Advanced Finances, $r(28) = -.699, p = .49$.

DISCUSSION

The present study sought to examine the independent and synergistic effects of aging and cognitive impairment upon medication and finance management among HIV-infected adults. Additional, but related, aims were to examine the associations between specific neurocognitive domains and medication/finance management performance per age group. Finally, we examined the relationship between formal laboratory task performance of functional ability and subjective (i.e., self-reported) functional independence in the domains of medication and finance management. Although functional abilities have been evaluated among healthy elderly and younger HIV populations, to our knowledge this is the first study to examine the combined effects of aging and cognitive dysfunction on functional capacity in an HIV-infected sample. We hypothesized that advancing age and cognitive impairment would independently and synergistically impact medication and finance management abilities and that self-reported medication and finance management would not show reliable associations with either cognitive impairment or performance on objective measures of everyday functioning ability.

Consistent with our hypotheses, we found that older HIV+ adults performed worse than younger HIV+ adults on measures of medication and finance management and that cognitive status impacted medication management independent of age effects. However, there were no differences between global cognitive status groups (i.e., impaired vs. unimpaired) on financial management. Of greatest interest, we found an interaction between age and cognitive status on the medication management task. Specifically, older HIV+ adults with cognitive impairment performed worse than all other age/cognitive status groups. Although previous studies have typically found older age to be associated with higher rates of medication adherence (Barclay et al., 2007; Hinkin et al., 2004), when older adults present with neurocognitive impairment they appear to demonstrate the lowest adherence rates of any group (Ettenhofer et al., 2009; Hinkin et al., 2004). Our study supports that this interaction effect remains even when using a performance-based measure of medication management, which is also consistent with previous research documenting a relationship between cognitive impairment and poorer performance on laboratory-based measures of IADLs (Heaton et al., 2004) and with findings using other objective methods to assess medication adherence including electronic monitoring devices (Hinkin et al., 2002).

Neuropsychological domains of attention/working memory, verbal fluency and naming, learning and memory, spatial processing and executive functioning were associated with performance on the MMT-R for the total sample. However, when examining these associations as a function of age, we found that the prior associations for the total group were virtually all due to the older participants—that is, there were no significant relationships between NP domains and MMT-R performance among younger adults (Table 5). This suggests that the NP/MMT-R performance relationships observed among the entire sample were primarily driven by the older adult group. In fact, correlations between NP domains and MMT performance strengthened when we excluded younger adults from analyses. Interestingly, the NP domains associated with MMT-R task performance are typically involved in HIV-infection and normal aging, suggesting that older adults with HIV may be particularly vulnerable to cognitive and functional deficits. Based upon these findings, it is possible that neuropsychological (NP) functioning plays a greater role in executing complex functional tasks as individuals age.

Advanced Finances was positively correlated with spatial processing and executive functioning for the entire sample. However, when examining these relationships within age groups, we observed differential age-linked contributions of NP functioning to performance on finance management. For younger adults, performance on Advanced Finances was positively associated with verbal fluency whereas for older adults, performance was positively associated with visuospatial processing, a domain also associated with more advanced stages of dementia. Although we expected similar neurocognitive domains to be associated with task performance for both age groups, our findings suggest that neurocognitive functioning may contribute differentially to functional performance as individuals age. Older adults may actually be less vulnerable to functional impairments than younger adults in finance management due to greater years of experience in handling finances. Perhaps it is not until cognitive impairment becomes more severe are deficits in overlearned behaviors observable among older adults.

Also consistent with expectations, there were nonsignificant associations between self-reported medication adherence and performance on laboratory medication management, and between self-reported finance competence and laboratory finance management. One plausible explanation for this discrepancy is the tendency for self-report to overestimate actual ability. Given the exceptionally high rates of self-reported medication adherence (97%) and finance independence (79%) in this particular sample, the lack of relationship between subjective and objective measures of medication and finance management may be

due to a lack of variability in self-report measures. However, in considering previous findings from studies that have found discrepancies between self-report and objective performance, particularly among cognitively impaired individuals (Reinhard et al., 2007), reasons other than lack of variability may explain our findings. Although lack of virologic control among a substantial minority of our participants on cART regimens could possibly reflect less complete adherence than was reported, we have no objective data to determine this; future studies should better establish validity of self-reported medication adherence through such means as electronically monitored pill dispensers. If this were the case, it would help to explain the lack of association between neuropsychological performance and self-reported medication and finance management. A substantial number of our participants ($n = 21$) were not administered the Advanced Finances task because either they reported that they have not used checkbooks ($n = 14$) or the task was discontinued ($n = 7$) because the participant either had refused to complete the task ($N = 1$) or had difficulty with understanding the task. As such, our sample size was reduced to 30 participants, with only 6 participants in the financial dependence group. Power reductions may also explain why we were unable to find differences between finance independence groups on the Advanced Finances Task. We were unable to document an association between global cognitive impairment and financial management. This is in contrast to findings by Heaton and colleagues (2004) and other recent research showing a relationship between cognitive impairment and declining ability to adequately manage finances in individuals with mild cognitive impairment (Triebel et al., 2009). The reason for the negative findings between cognitive status and Advanced Finance task performance is unclear, but may have resulted from the finance management methodology employed in the present study. In our study, we used total points earned on the Advanced Finances task to represent finance competence, whereas Heaton and colleagues (2004) converted raw scores into functional deficit scores derived from performance and percentile ranks of NP normal participants. Perhaps converting raw scores into deficit scores may have been more sensitive to detecting cognitive impairment. Therefore, we are in the process of gathering sufficient control participants to create norms for our functional measures in order to use the functional deficit score approach in future studies. Because we decided to exclude participants who recently abused substances, our study yielded a relatively small sample size ($N = 51$), which may have reduced the level of power for detecting differences between cognitive status groups on financial management. As mentioned previously, another possibility is that finances, similar to other overlearned behaviors such as driving, may be less vulnerable to the impact of early cognitive decline than more relatively novel activities such as complex medication management. Usually, when managing finances, one is responsible for a single checking account; whereas for managing medications, multiple medications are involved rendering medication management a more cognitively demanding task. As demonstrated in correlational analyses, fewer neurocognitive domains were associated with performance on finances than with performance on medication management. Perhaps it is not until patients develop more severe cognitive impairments that we can observe a decline in overlearned behaviors. Overall, our sample performed relatively well on Advanced Finances compared to the MMT suggesting that Advanced Finances may have been an easier task. Indeed, if this were the case, it suggests that certain functional abilities are more susceptible to decline with advanced age and cognitive impairment. This information would highly benefit the clinician who is challenged with determining whether a patient's cognitive abilities have declined over the course of age and illness.

Although performance-based measures and traditional neuropsychological tests target similar cognitive processes, as can be seen from correlational data in our older adult sample, performance-based measures target a collection of cognitive processes that are required to execute daily tasks. These measures provide reliable and ecologically valid data within a short period of time in comparison to the standard neuropsychological battery. This

statement is not to imply that performance-based measures should replace traditional neuropsychological tests; rather, it supports its utility when attempting to objectively assess functional ability. The information gathered from traditional neuropsychological assessment along with performance assessment would likely provide incremental validity to the clinician's diagnosis. Furthermore, medication management requires patients to remember a task at least twice a day regardless of how they feel (e.g., upset, sleepy, etc.). On the other hand, finance management is a task that is usually performed once in a while (usually at a selected time) when one feels well and can concentrate.

In summary, this study underscores the importance of using performance-based measures to detect functional limitations associated with aging and HIV. An ongoing difficulty in accurately detecting HIV-related neurocognitive diagnoses is obtaining valid and reliable information pertaining to patient's IADLs. For example, differentiating among the varying diagnostic categories in the recently developed classification system for HIV-associated neurocognitive disorders (HAND) requires establishing the presence or absence of functional decline, and use of objective assessments such as those in the current study was specified as a method for detecting symptomatic forms of HAND (as opposed to "asymptomatic neuropsychological impairment"; Antinori et al., 2007). Given the limited reliability of self-report, performance-based measures of everyday functioning capacity appear to have stronger ecological validity than traditional NP tests and can be easily included in a overall patient assessment given their relatively brief administration times. Furthermore, such functional measures may be useful for creating cognitive rehabilitation programs designed to help individuals compensate for their IADL dysfunction. Future research should explore the efficacy of these measures for such potential use.

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Figure 1. Age and cognitive group differences on Medication Management Task (mean scores represented for ease of interpretation). GDS = Global Deficit Score.

TABLE 1

Participant characteristics according to group membership

Variable	Age group		Cognition group	
	Younger (<40 years)	Older (≥ 55 years)	Unimpaired (GDS <0.5)	Impaired (GDS ≥ 0.5)
<i>n</i>	23	28	30	21
Age (years)	33.8 (4.9)	59.4 (7.1) *	43.7 (13.4)	49.2 (14.5)
Education (years)	12.3 (2.2)	14.3 (2.3) *	13.6 (2.9)	3.2 (1.7)
Male (%)	73.9	79.3	80.0	72.7
Ethnicity (%)				
Caucasian	26.1	38.0	40.0	22.8
African American	34.8	48.3	40.1	45.5
Hispanic	26.1	10.3	13.3	22.7
Asian	4.3	0	3.3	0
American Indian/Alaskan Native	0	3.4	0	4.5
Other	8.7	0	3.3	4.5
Recent CD4 count	522.8 (256.0)	469.2 (296.1)	460.6 (248.6)	534.0 (472.5)
Nadir CD4 count	161.0 (140.0)	220.2 (227.3)	176.9 (185.0)	219.3 (150.0)
Undetectable viral load (%)	63	69	74	63
Meets AIDS criteria based on opportunistic infection or CD4<200 (%)	60.9	55.2	60.0	54.5
Prior substance abuse/dependence (%)	21	35	30	31
BDI-II	15.3 (11.0)	9.8 (8.8) *	11.6 (9.7)	13.1 (10.8)

Note. Valid *N* = 51. GDS = Global Deficit Score. BDI-II = Beck Depression Inventory, Second Edition. Standard deviations in parentheses.

* *p* < .05.

TABLE 2

Neuropsychological battery

Domain	Test name and citation	Variable used	Normative data
Language	Controlled Oral Word Association Test	FAS/Animals	Heaton, Miller, Taylor, & Grant, 2004b
	Boston Naming Test	Total Score	Heaton, Miller, Taylor, & Grant, 2004b
Executive functioning	Trail Making Test	Part B	Heaton, Miller, Taylor, & Grant, 2004b
	Wisconsin Card Sorting Test	Perseverative Errors	Heaton, Chelune, Talley, Kay, & Curtiss, 1993
	Stroop Color and Word Test	Interference	Golden, 1978
Information-processing speed	Trail Making Test	Part A	Heaton, Miller, Taylor, & Grant, 2004b
	WAIS-III	Digit Symbol Coding	Taylor & Heaton, 2001
	WAIS-III	Symbol Search	Taylor & Heaton, 2001
	CPT-II	Reaction Time	Conners and MHS Staff, 2000
Attention and working memory	PASAT	Total Score	Diehr et al., 2003
	CPT-II	Omissions and Commissions	Conners and MHS Staff, 2000
	WAIS-III	Letter-Number Sequencing	Taylor & Heaton, 2001
Learning and memory	HVLT-R	Total Learning Score and Recall	Brandt & Benedict, 2001
	BVMT-R	Total Learning Score and Recall	Benedict 1997
Visuospatial functioning	WAIS-III	Block Design	Taylor & Heaton, 2001
Motor functioning	Grooved Pegboard	Dominant and Nondominant Hand Score	Heaton, Miller, Taylor, & Grant, 2004b

Note. WAIS-III = Wechsler Adult Intelligence Scale-Third Edition. CPT-II = Conners' Continuous Performance Test-2. PASAT = Paced Auditory Serial Addition Test. HVLT-R = Hopkins Verbal Learning Test-Revised. BVMT-R = Brief Visual Memory Test-Revised.

TABLE 3

Age and cognitive group differences on functional measures and neuropsychological domains

Task	Age group		p	Cognitive group		p
	Younger (n = 23) ^a	Older (n = 28) ^a		Unimpaired (n = 30) ^a	Impaired (n = 21) ^a	
MMT-R	14.2 (0.65)	12.1 (0.57)	.02 *	15.1 (0.52)	11.1 (0.63)	<.001 ***
Advance Finances	11.6 (0.81)	8.3 (0.66)	.009 **	10.4 (0.60)	9.5 (0.85)	.400
Attention/working memory	43.8 (11.2)	40.2 (11.9)	.26	46.2 (8.8)	39.5 (6.2)	.001 ***
Information processing	44.91 (8.7)	45.46 (9.8)	.83	49.5 (7.4)	39.6 (8.2)	<.001 ***
Language	49.2 (8.0)	46.9 (9.4)	.21	51.2 (6.0)	42.7 (9.9)	<.001 ***
Spatial processing	54.9 (12.1)	47.5 (10.0)	.02 *	54.9 (12.3)	44.9 (6.8)	.002 **
Learning and memory	43.2 (10.2)	38.1 (12.2)	.11	47.9 (7.1)	30.1 (7.7)	<.001 ***
Executive function	48.3 (6.4)	44.4 (11.1)	.13	49.6 (7.2)	41.3 (10.1)	.001 ***
Motor	44.2 (9.8)	43.7 (9.4)	.84	46.33 (8.2)	40.5 (10.3)	.002 **

Note. T-scores. Standard deviations in parentheses. Analyses performed on transformed scores for Advanced Finances and MMT. Mean raw scores reported for ease of interpretation. MMT-R = Medication Management Task-Revised.

^aValid N = 51.

*
p .05.

**
p .01.

p .001.

TABLE 4

Correlations between neurocognitive domains and medication and finance management: Whole sample

NP domain	Task			
	MMT-R		Advanced Finances	
	r	p	r	p
Attention/working memory	.48	<.001 ***	.22	.24
Information processing	.28	.04	-.21	.27
Verbal fluency	.41	.003 **	.12	.53
Learning/memory	.58	<.001 ***	.18	.36
Spatial processing	.48	<.001 ***	.54	.003 **
Executive functioning	.61	<.001 ***	.42	.02 *
Motor	.23	.11	.23	.11

Note. Valid $N = 51$. NP = neuropsychological. MMT-R = Medication Management Task-Revised.

* $p < .05$.

** $p < .01$.

*** $p < .001$.

TABLE 5

Correlations between neurocognitive domains, MMT-R, and Advanced Finances

NP domain	Younger (n = 23)				Older (n = 28)			
	MMT-R		Advanced Finances		MMT-R		Advanced Finances	
	r	p	r	p	r	p	r	p
Attention/working memory	.13	.55	.07	.82	.61	.001***	.21	.41
Information processing	.24	.26	-.12	.26	.37	.057	-.22	.37
Verbal fluency	.14	.52	.62	.03*	.50	.007**	.13	.61
Learning/memory	.19	.39	.21	.59	.71	<.001***	.18	.48
Spatial	.15	.51	-.20	.53	.61	.001***	.66	<.03*
Executive functioning	.16	.47	.24	.47	.69	<.001***	.39	.11
Motor	.014	.95	-.35	.25	.34	.08	.21	.27

Note. Valid $N = 51$. MMT-R = Medication Management Task-Revised. NP = neuropsychological.

* $p < .05$.

** $p < .01$.

*** $p < .001$.