Substance Use and Cognitive Function as Drivers of Condomless Anal Sex Among HIV-Positive Gay, Bisexual, and Other Men Who Have Sex with Men Aged 50 and Older: The Gold Studies

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Abstract

Purpose: Substance use has been linked to the sexual transmission of HIV among gay, bisexual, and other men who have sex with men (MSM) across the lifespan. Among older, HIV-positive, MSM populations, cognitive dysfunction associated with age and HIV disease progression also may play a role in sexual risk-taking. People aged 50 years and older represent a growing proportion of the overall HIV-positive population. This study aimed to explore relationships between substance use and cognitive function, and their impact on condomless anal sex (CAS) among HIV-positive gay, bisexual, and other MSM aged 50 years and older.

Methods: Data from a cross-sectional study of HIV-positive MSM, aged 50 and older ($N = 169$) were gathered using a computer-assisted survey, researcher-administered behavioral and neurocognitive measures.

Results: More than 50% of the men used substances and had one or more cognitive impairments. However, only 25% were at higher risk for dementia (i.e., two or more cognitive impairments). Multivariable modeling indicated that use of alcohol to intoxication and date of HIV diagnosis were the strongest predictors of CAS in both a model that included dementia risk and a model that included impaired executive function risk. Current illicit substance use was a significant predictor of CAS only in the model that included dementia risk. Those with better cognitive and executive function had higher odds of CAS. However, only executive function was a significant cognitive predictor of CAS.

Conclusion: Further research is needed to clarify the impact of cognitive function and substance use on sexual risk behaviors as these HIV-positive men achieve normal life expectancies, while continuing to use substances and engage in CAS. Furthermore, addiction treatment remains a critical need for this group even as they transition into later adulthood.

Keywords: aging, cognitive function, gay, HIV, sexual risk, substance use

Introduction

IN 2014, 17% of HIV-positive people in the United States were aged 50 and older.¹ HIV-positive gay, bisexual, and other men who have sex with men (MSM) continue to be

sexually active and engage in condomless anal sex (CAS)^{*} after the age of 50.²⁻⁵ Despite the fact that HIV transmission rates are low—effective antiretroviral therapy (ART) reduces the risk of HIV transmission to others by 96% and acquisition of HIV is reduced by 92% among HIV-negative individuals taking pre-exposure prophylaxis (PrEP)—concern for sexual transmission remains, perhaps due to fear and stigma stemming from the HIV epidemic.^{2,6-10} Not only can HIV-related fear and stigma affect ART uptake and adherence but also, when combined with poor adherence

^{*}The CAS term is used in lieu of the formerly used “unprotected sex” to acknowledge nuances born out of the HIV pharmacological innovations of Preexposure Prophylaxis (PrEP) and Treatment as Prevention (TasP).

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due to substance use and poor cognitive function, it can reduce medication effectiveness and increase the risk of HIV transmission.¹¹ Thus, a vast majority of prevention efforts still focus on CAS among HIV-positive MSM.

High rates of substance use across the lifespan contribute to higher incidence of condomless sex among MSM.^{5,12} Although lesbian, gay, bisexual, and transgender (LGBT) identified people comprise only 3.8% of the population,¹³ they have been affected disproportionately by substance abuse,^{3,14} perhaps due to stigma and discrimination related to their sexual orientation or gender identity.^{3,14,15} Studies of LGB individuals^{16,17} and transgender women¹⁸ have found that 25%–39% of LGB individuals and 26.7% of transgender women use illicit substances, which is greater than the 7.7%–17% observed in the general population.^{16,17} A high prevalence of substance abuse among MSM continues across the lifespan and into late adulthood.^{3,5,19–21} The compound effects of substance use and aging may increase the risk of cognitive impairment among people aging with HIV.^{20–24}

Now that HIV-positive people are aging, understanding about CAS behavior is complicated by the fact that cognitive function deficits due to HIV disease processes, age-related processes, and substance use may affect the decision-making process regarding condom use.^{25–30} In the general population, 13% of those aged 60 and older experience cognitive decline,³¹ which is lower than rates in HIV-positive populations (28%–88%).^{22,23,32–39} HIV-related cognitive decline can affect numerous domains, including executive function (i.e., impulsiveness, inhibition, sequencing, risk-taking, and consequential thinking), which are factors that influence activities of daily living and sexual decision-making.^{22,23,32–39} Results among MSM of all ages, regardless of HIV status, were mixed and, overall, researchers failed to find differences in risky sex (i.e., CAS) by sexual sensation-seeking and executive function.²⁶ However, relations were mediated by HIV status with those who were HIV-positive with better executive function having more risky sex (i.e., CAS) than those who had worse executive function.²⁶ In contrast, another study found that men with lower cognitive function had more sex regardless of substance use, but men who had higher cognitive function (i.e., executive function) also had more CAS.²⁵ Very little research has sought to understand how CAS is influenced by the interplay of cognitive function and substance use among older MSM.^{25,26} This analysis examines these associations among older HIV-positive MSM living in New York City (NYC).

Methods

Study design and sample

Data from this cross-sectional analysis were derived from Project Gold, a study examining older HIV-positive MSM in NYC. Participants ($N=169$) were recruited through a combination of in-person, paper-, and internet-based outreach methods between May 2010 and August 2011. Participants were eligible if they had sex with a man in the prior 6 months and if they were 50 years of age or older, HIV positive, assigned male at birth, and currently male-identified. MSM of color were oversampled (80%), because HIV has affected racial and ethnic minorities disproportionately.⁴⁰ All participants ($N=199$) provided written consent and were screened using the Ohio State University Traumatic Brain Injury

(OSU-TBI) Short Form, and 30 were excluded due to having a traumatic brain injury (TBI) (i.e., loss of consciousness of 30 or more minutes).^{41–43} As a result, the current analytic sample consisted of 169 participants. The New York University Institutional Review Board approved all protocols and forms.

Measures

Self-reported sociodemographics, including race, education, sexual orientation, and perceived socioeconomic status, were obtained using an audio computer-assisted self-interview. In addition, date of HIV diagnosis was dichotomized as pre-ART (on or before 1996, the year effective ART was available) or post-ART (1997 or later) to account for medical treatment and psychosocial history of those who lived with the disease before ART became widely available.

Behavioral measures

Data on current CAS and substance-use behaviors in the 30 days before the assessment were gathered using the face-to-face, calendar-based Time-Line Follow-Back measure. The measure has demonstrated good test-retest reliability and convergent validity, and the 30-day time frame demonstrated the highest level of recall compared to other time frames.^{44–47} Information regarding sexual positioning (i.e., insertive or receptive CAS) was captured during data collection. However, due to low frequency of occurrence of each position (i.e., insertive and receptive), the CAS variables were combined to create a total CAS variable. Data on the number of CAS and substance-use instances in the last 30 days were not normally distributed. Therefore, continuous variables were coded into nominal variables and nonparametric tests were used. CAS in the prior 30 days was dichotomized as none, or one or more instances. Dichotomized variables (i.e., zero to one instances vs. two or more instances in the last 30 days) were created for each of the following substances: alcohol to intoxication, marijuana, and other illicit substances (i.e., cocaine, crack, ecstasy, ketamine, gamma-hydroxybutyrate [GHB], methamphetamine, heroin, or hallucinogens).

Because cognitive function was a predictor of CAS, lifetime substance use also was included to control for substance use history. Participants were asked about lifetime use of marijuana, cocaine, crack, ecstasy, ketamine, GHB, methamphetamine, heroin, and hallucinogens. The number of different substances used in their lifetime was summed (range 0–9) to create the Lifetime Substance Use variable.

Cognitive and executive function measures

Trained research staff administered a battery of neuropsychological tests that measured cognitive domains often affected by HIV. The battery assessed overall cognitive function, attention, working memory, executive function, and verbal abstract reasoning.

Overall cognitive function was assessed using the Mini-Mental State Examination (MMSE), which is a reliable and valid measure ($\alpha=0.81$).^{48–50} Participant MMSE results were compared to normative data from the general population.⁵¹ The Wechsler Adult Intelligence Scale-III (WAIS-III) Digit Span (r^c range=0.90–0.96) measures working memory and executive function and the WAIS-III Similarities (r^c range=0.74–0.94) measures verbal abstraction; both have

demonstrated reliability and validity.^{52,53} All the WAIS-III tests were compared to the normative data from the original testing materials.⁵²

The Trail Making Test A (TMT-A) measures simple attention and sequencing, and Trail Making Test B (TMT-B) measures set shifting or complex executive function. Unlike other cognitive tests where higher scores indicate better cognitive function, on TMT-A and TMT-B, higher scores/times indicate worse cognitive function. Both are reliable and valid measures of brain damage with good inter-rater reliability for both TMT-A (0.94) and TMT-B (0.90).^{54,55} Recent population norms for TMT-A and TMT-B were used.⁵⁴

Results from cognitive tests were compared to normative data using z-scores. For each of the cognitive tests, those with z-scores of 1.5 or greater below the mean were categorized as impaired, and those who had less than 1.5 z-scores from the mean were not impaired. A composite score ranging from 0 to 5 was calculated by summing the binary variables for each test resulting in the total number of cognitive tests that were in the impaired range. Because cognitive impairment among HIV-positive populations may have been over-reported in prior studies, for this study, participants were dichotomized as either having risk for dementia (i.e., two or more tests in the impaired range) or not (i.e., none or one test in the impaired range) to align with one of the standards for a dementia diagnosis outlined in the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-V).⁵⁶ Of note, a true dementia diagnosis also requires two or more impairments in activities of daily living, which was not assessed in this study. Therefore, only dementia risk can be suggested by this variable, not a true dementia diagnosis.

The three dichotomized executive function impairment variables (i.e., TMT-A, TMT-B, and WAIS-III Digit Span) were tallied and a composite score ranging from 0 to 3 was created. Those with two or more impaired executive function tests were categorized as having impaired executive function risk, while those who had no or only one impaired executive function test were categorized as not having impaired executive function. The term impaired executive function risk was used to connote the two-test requirement and align with the taxonomy for the dementia risk variable.

Analytic plan

Those who sustained a TBI with a loss of consciousness of 30 minutes or more were excluded from analyses, to mitigate the risk of overreporting cognitive impairments.^{42,43} Remaining participants in the analytic sample ($N=169$) were not significantly different from the original sample with regard to sociodemographics.

The univariate analysis included frequencies and proportions for categorical variables and means and standard deviations (SD) for continuous variables. Due to the relatively small sample size, significance level for all analyses was set at $P \leq 0.05$ to reduce the risk of a Type II error. Bivariable analysis compared those who had CAS in the last 30 days to those who did not with respect to current and lifetime substance use, cognitive function, executive function, and date of HIV diagnosis with χ^2 tests for categorical variables and independent sample t-tests for continuous variables. Additional analyses indicated multicollinearity was not problematic. Multivariable logistic regression assessed associations

between CAS and covariates that were significant in bivariable analyses. In addition, lifetime substance use was included in the model to account for differences in cognitive function that may be attributed to individual substance use history.

Results

The mean age of participants was 55.8 ($SD=4.6$), 76.9% identified as gay, 75.1% were men of color, and 46.2% had a high school education or less (Table 1). The mean number of years living with HIV was 20.3 ($SD=5.3$). Most (72.2%) were diagnosed with HIV pre-ART. Forty-six (27%) participants reported CAS ($M=1.6$ instances in prior 30 days, $SD=5.4$). There were no significant differences by main partner status. Therefore, this variable was not included in the final model.

Fourteen respondents (8.3%) reported alcohol use to intoxication at least twice in the last 30 days with a mean of 0.9 ($SD=3.7$) instances of alcohol use to intoxication (Table 2). Marijuana was the most frequently used substance with 36.1% reporting at least two instances of marijuana use; marijuana instances ($M=5.1$, $SD=9.4$). Other illicit substance use (i.e., methamphetamine, crack, cocaine, and heroin) was reported by 20.7% of participants and there were, on average, 2.1 other illicit substance use instances ($SD=5.7$). Across their lifetime, participants reported using 2.8 different drugs ($SD=2.0$).

TABLE 1. SOCIODEMOGRAPHIC INFORMATION FROM THE ANALYTIC SAMPLE ($N=169$)

Characteristic	n (%)
Mean age (SD)	55.8 (4.6)
Race	
Black	82 (48.5)
White	42 (24.9)
Latino	22 (13.0)
Multiracial/other	23 (13.6)
Education	
Less than high school	16 (9.5)
High school/GED	62 (36.7)
Associate's degree	30 (17.8)
Bachelor's degree	40 (23.7)
Graduate degree	21 (12.4)
Sexual orientation	
Gay	130 (76.9)
Bisexual	27 (16)
Straight	4 (2.4)
Other	8 (4.7)
Perceived socioeconomic status	
Lower	73 (43.2)
Lower middle	56 (33.1)
Middle	34 (20.1)
Upper middle	5 (3.0)
Upper	1 (0.6)
Mean years living with HIV	20.3 (5.3)
Date of HIV diagnosis	
Pre-ART (≤ 1996)	122 (72.2)
Post-ART (1997 $\geq$)	47 (27.8)

ART refers to medication used to treat HIV that became widely available in 1996. Those diagnosed in 1996 and before are believed to have had a different psychosocial experience than those diagnosed in 1997 until present (2017).

ART, antiretroviral therapy; GED, graduate educational development; SD, standard deviation.

TABLE 2. CHARACTERISTICS OF SUBSTANCE USE AND FREQUENCY OF COGNITIVE IMPAIRMENT BY CONDOMLESS ANAL SEX

Participant characteristics	Total (N=169)	No. (%) of study participants		P
		No condomless anal sex (n=123)	Condomless anal sex (n=46)	
Substance use				
No. of reports of 2+ instances of substance use in last 30 days	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)	
Alcohol to intoxication	14 (8.3)	6 (4.9)	8 (17.4)	0.01
Marijuana	61 (36.1)	38 (30.9)	23 (50.0)	0.02
Other illicit substances	35 (20.7)	19 (15.4)	16 (34.8)	0.01
Mean substance use instances in last 30 days	<i>M</i> (<i>SD</i>)	<i>M</i> (<i>SD</i>)	<i>M</i> (<i>SD</i>)	
Alcohol to intoxication	0.9 (3.7)	0.4 (1.7)	2.2 (6.4)	NS*
Marijuana	5.1 (9.4)	4.1 (8.2)	7.8 (11.7)	0.05
Other illicit substances	2.1 (5.7)	1.5 (4.5)	3.9 (7.9)	NS*
Lifetime mean number of substances used	2.8 (2.0)	2.7 (2.0)	3.24 (2.0)	NS
Cognitive tests				
Number with cognitive tests with scores in the impaired range	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)	
MMSE	40 (23.7)	31 (25.2)	9 (19.6)	NS
WAIS-III Digit Span	15 (8.9)	13 (10.6)	2 (4.3)	NS
WAIS-III Similarities	11 (6.5)	10 (8.1)	1 (2.2)	NS
Trail Making Test A	31 (18.3)	24 (19.5)	7 (15.2)	NS
Trail Making Test B	58 (34.3)	48 (39.0)	10 (21.7)	0.04
Any cognitive impairment	89 (52.7)	70 (56.9)	19 (41.3)	NS
Dementia risk (2+ cognitive tests with scores in the impaired range)	43 (25.4)	35 (28.5)	8 (17.4)	NS
Impaired executive function risk (2+ executive function tests with scores in the impaired range)	27 (16.0)	25 (20.3)	2 (4.3)	0.01
Mean cognitive scores	<i>M</i> (<i>SD</i>)	<i>M</i> (<i>SD</i>)	<i>M</i> (<i>SD</i>)	
MMSE	27.3 (3.1)	27.0 (3.2)	28.0 (2.7)	NS
WAIS-III Digit Span	9.1 (3.1)	8.7 (2.8)	10.2 (3.6)	0.02
WAIS-III Similarities	9.4 (2.8)	9.1 (2.8)	10.2 (2.4)	0.02
Trail Making Test A	39.6 (18.3)	41.0 (18.8)	35.9 (16.7)	NS
Trail Making Test B	114.8 (65.4)	121.0 (69.1)	98.1 (51.0)	0.02
Mean number of cognitive tests with scores in the impaired range	0.9 (1.1)	1.0 (1.2)	0.63 (0.9)	0.04
Mean number of executive function tests with scores in the impaired range	0.62 (0.79)	0.69 (0.9)	0.41 (0.6)	0.02

**P* = 0.06.

MMSE, Mini-Mental State Examination; NS, not significant.

Participants scored on average 27.3 (*SD* = 3.1) on the MMSE (23.7% impaired range) (Table 2). Working memory and executive function (WAIS-III Digit Span) had an average scaled score of 9.1 (*SD* = 3.1) (8.9% impaired range). Only 6.5% of participants demonstrated impaired verbal abstraction on the WAIS-III Similarities test (mean scaled score = 9.4, *SD* = 2.8). On average, participants took 39.6 seconds (*SD* = 18.3) to complete TMT-A (18.3% impaired range). On TMT-B almost 34.3% performed in the impaired range and took 114.8 (*SD* = 65.4) seconds on average to complete the test. With regard to the total number of tests in the impaired range, 52.7% had at least one test in the impaired range. The average number of tests with scores in the impaired range was 0.9 (*SD* = 1.1). Approximately one-fourth of the sample was at risk of a dementia diagnosis.

Bivariable analyses were then conducted comparing those who reported one or more instances of CAS in the last 30 days to those who did not with respect to current and lifetime substance use, cognitive function, executive function, and date of HIV diagnosis. Those reporting CAS were significantly

more likely to report use of alcohol to intoxication as well as use of marijuana and other illicit substances in the last 30 days compared to those who did not report CAS. In addition, those who had engaged in CAS had a higher average number of marijuana instances in the prior 30 days than those who had not engaged in CAS. However, when evaluating the average number of instances of both alcohol to intoxication and use of other illicit substances for those who had versus had not engaged in CAS, the results failed significance testing and only approached significance (*P* = 0.06 both tests) (Table 2). There were no significant differences in mean lifetime number of substances used by CAS status. Bivariable pre-ART and post-ART analyses reported in the first author's dissertation* found that substance use

*Kupprat SA: The influence of substance use and cognitive functioning on condomless anal sex among HIV-positive gay, bisexual, and other men who have sex with men age 50 and older. Doctoral dissertation. ProQuest Dissertation Publishing. New York University, NY, 2016.

TABLE 3. MULTIVARIABLE LOGISTIC REGRESSION MODEL PREDICTING THE ODDS OF CONDOMLESS ANAL SEX USING DEMENTIA RISK, SUBSTANCE USE, AND DATE OF HIV DIAGNOSIS VARIABLES AMONG HIV-POSITIVE MEN AGED 50 TO 69, NEW YORK CITY, 2010–2011

Characteristic	Crude odds ratio (95% confidence interval)	Adjusted odds ratio (95% confidence interval)
Dementia risk ^a	0.5 (0.2–1.2)	0.4 [†] (0.1–1.0)
Alcohol to intoxication use	4.1** (1.3–12.6)	4.7* (1.2–17.8)
Marijuana use	2.2* (1.1–4.5)	1.7 (0.8–3.7)
Total 30-day illicit substance use	2.9** (1.3–6.4)	2.7* (1.0–6.9)
Lifetime illicit substance use	1.2 (1.0–1.4)	1.0 (0.8–1.2)
Pre-ART date of HIV diagnosis	2.9* (1.1–6.5)	2.8* (1.1–7.2)

^aDefined as impairment on two or more cognitive function tests:

Nagelkerke $R^2=0.19$.

Model Fit: $X^2(6)=23.17$, $P<0.001$.

[†] $P=0.06$.

* $P\leq 0.05$.

** $P<0.01$.

was similar between those who were diagnosed pre- and post-ART; however, those who were diagnosed with HIV pre-ART were more likely to report having engaged in CAS and had better cognitive function than those diagnosed post-ART.

A significantly lower proportion of those reporting CAS demonstrated impairment on the TMT-B test and in executive function. There were no significant differences by CAS in the proportion with impaired function on the MMSE, WAIS-III Digit Span, WAIS-III Similarities, TMT-A, and the dementia risk variable.

Compared to those not reporting CAS, those reporting CAS had significantly higher scores on the WAIS-III Digit Span and WAIS-III Similarities test, and faster times on the TMT-B. Those reporting CAS had an overall lower mean number of tests with scores in the impaired range as well as a lower mean number of executive function tests with scores in the impaired range. There were no significant differences by CAS for the MMSE and TMT-A.

Multivariable logistic regression models estimated the independent associations between CAS and dementia risk (Table 3) and CAS and impaired executive function risk (Table 4). Those with dementia risk were 96% less likely to report CAS (Adjusted Odds Ratio (AOR)=0.4, $P=0.06$) compared to those without dementia risk after controlling for use of alcohol to intoxication, marijuana, other illicit sub-

stances, and date of HIV diagnosis. However, this did not reach statistical significance. Similarly, those with impaired executive function risk were 99% less likely (AOR=0.1, $P=0.01$) to have had CAS compared to those who did not exhibit executive function risk. In addition, alcohol to intoxication (AOR=4.7, $P=0.02$; AOR=4.7, $P=0.03$), other illicit substance use (AOR=2.7, $P=0.05$; AOR=2.5, $P=0.07$), and pre-ART HIV diagnosis (AOR=2.8, $P=0.04$; AOR=3.0, $P=0.03$) were also associated with increased odds of CAS after controlling for dementia risk or impaired executive function risk, respectively. However, use of other illicit substances was only significant in predicting CAS in the model that included the dementia risk variable and not the impaired executive function risk variable. Marijuana use was not a significant predictor of CAS when controlling for the other variables.

Discussion

Both dementia risk and impaired executive function risk were significant predictors of CAS, when controlling for date of HIV diagnosis and past 30-day and lifetime substance use. Those who were at risk for dementia and/or impaired executive function were significantly less likely to have had CAS than those who were not at risk for dementia and/or did not have impaired executive function risk. In the

TABLE 4. MULTIVARIABLE LOGISTIC REGRESSION MODEL PREDICTING THE ODDS OF CONDOMLESS ANAL SEX USING IMPAIRED EXECUTIVE FUNCTION RISK, SUBSTANCE USE, AND DATE OF HIV DIAGNOSIS VARIABLES AMONG HIV-POSITIVE MEN AGED 50 TO 69, NEW YORK CITY, 2010–2011

Characteristic	Crude odds ratio (95% confidence interval)	Adjusted odds ratio (95% confidence interval)
Impaired executive function risk ^a	0.2* (0.0–0.8)	0.1* (0.0–0.7)
Alcohol to intoxication use	4.1** (1.3–12.6)	4.7* (1.2–18.4)
Marijuana use	2.2* (1.1–4.5)	1.8 (0.8–3.9)
Total 30-day illicit substance use	2.9** (1.3–6.4)	2.5 (0.9–6.7)
Lifetime illicit substance use	1.2 (1.0–1.4)	1.0 (0.8–1.2)
Pre-ART date of HIV diagnosis	2.9* (1.1–6.5)	3.0* (1.1–8.0)

^aDefined as impairment on two or more executive function tests:

Nagelkerke $R^2=0.22$.

Model Fit: $X^2(6)=28.36$, $P<0.001$.

* $P\leq 0.05$.

** $P<0.01$.

Gonzalez study, both executive function and sensation seeking were associated with more CAS only among the HIV-positive MSM in the study, which is somewhat similar to findings in our study in that of the cognitive function tests only executive function remained a significant predictor of CAS.²⁶ The current study found that those with better cognitive function (marginally) and executive function, those who used alcohol to intoxication, and those who had an HIV diagnosis pre-ART (1996 and before) were more likely to engage in CAS. However, results for cognitive function strengthened when honing in on the construct of executive function which was similar to the Golub study in which men who scored higher on a test of executive function had more risky sex (i.e., CAS) than those who scored lower.²⁵ However, the Golub study included only HIV-negative men, which may account for the differences seen when compared to this study.²⁵ Furthermore, both prior studies had samples of men across a broad age range,^{25,26} whereas this study included only HIV-positive men aged 50 and older.

Among these HIV-positive men aged 50 and older, 53% had at least one cognitive test with scores in the impaired range, which falls within the range (28%–88%) found in prior research.^{22,23,32–39} However, in clinical practice, having only one cognitive impairment is considered normal cognitive function or is simply described as a cognitive weakness. Furthermore, some have argued that existing research tends to overreport cognitive impairment in HIV-positive populations.⁵⁷ To combat this argument, dementia risk was held to a higher threshold (i.e., two or more impaired cognitive domains), which aligned with standards in the DSM-V and mirrored clinical practice.⁵⁶ Using this higher threshold, only 25% of the sample had impaired scores on two or more cognitive tests and only 16% demonstrated having impaired executive function risk (i.e., two or more tests of executive function in the impaired range), which is lower than the aforementioned studies.^{26,27,35–39}

Overall substance use in Project Gold (56%)³ and illicit substance use (21%) were higher than in the general population (7.7%–17%).^{16,17} However, illicit substance use in Project Gold was lower than in studies of people from LGB communities (25%–39%),^{16,17} as well as among transgender women (26.7%).¹⁸ At the bivariable level, current marijuana use was significantly higher for those who had CAS. However, in the final model, marijuana was not a significant predictor of the odds of having CAS, which differed from prior research that showed positive correlations between marijuana use and sexual risk-taking.⁵⁸ In both models predicting the odds of CAS, use of alcohol to intoxication was significant. In addition, the illicit substance use variable was a significant predictor of the odds of CAS in the broader dementia risk model, but not in the more narrow impaired executive function risk model. These mixed results for illicit substance use as a predictor of CAS suggest that perhaps using alcohol to intoxication is a more problematic behavior for this population. Furthermore, these results point to the need to further study the combination of impaired executive function risk and illicit substance use to gain clarity into relationships between these two variables when predicting CAS.

Before drawing final conclusions, study limitations should be noted. This study relied on self-reports of sexual and substance-use history, which may have resulted in underreporting and responder bias. In addition, the cross-

sectional design of this study limits the ability to ascertain causal conclusions and the date of data collection prevents us from analyzing the impact of more recent innovations such as Treatment as Prevention (TasP) and PrEP. Previous reports have demonstrated that using the MMSE in general HIV-positive populations is not ideal because it lacks the sensitivity to detect cognitive decline in this population.³² However, among older populations, the MMSE is standard practice for detecting dementia and, thus, is appropriate for this age group.⁴⁹ Moreover, due to the small sample size and low frequency of CAS, condomless insertive and receptive anal sex had to be combined. Therefore, analyses lacked the ability to hone in on receptive anal sex, which has higher odds of HIV transmission.² Furthermore, due to the restricted age range of the sample, our findings cannot be generalized to HIV-positive populations of all ages. In addition, information regarding activities of daily living was not collected, which limited the ability to better diagnose dementia. However, the fact that dementia risk variables required two or more tests in the impaired range is a nuance that addresses the argument that cognitive impairments are overreported in this population.⁵⁷ Finally, while efforts were made to recruit participants from a variety of socioeconomic backgrounds, more than half of the participants in this analysis were of lower or lower middle socioeconomic status and had low educational attainment, which may have contributed to lower scores on cognitive tests.⁵⁹

Conclusions

Positive associations between cognitive and executive function and CAS were counter to what we hypothesized. In addition, the relatively low proportion of men reporting CAS in this population, calls into question the assumption that HIV-positive MSM aged 50 years and older are a major source of disease transmission in this age bracket. However, despite the fact that cognitive dysfunction had little to do with CAS, it may still have deleterious effects on activities of daily living, quality of life, and mental and physical health among HIV-positive men aged 50 years and older. This population could benefit from cognitive rehabilitation to develop cognitive compensatory strategies to prolong health and independent living. From a counseling perspective, these findings underscore that substance use continues to be a life-long struggle for HIV-positive men aged 50 years and older, and highlight the need for addiction and mental health treatment that is informed by the contextual and historical experiences of this unique cohort of men who are the first to live into later adulthood with HIV. In addition, the existing infrastructure contains gaps in service delivery that fail to respect the nuances of the LGBT community and aging HIV-positive MSM, in particular, due to having been built during the preceding eras when discriminatory, hegemonic, and heteronormative assumptions shaped policy and funding. Future funding and research efforts could benefit from focusing on more palliative and tertiary prevention efforts to improve quality of life among this aging cohort of MSM, as well as interventions to improve life management skills.

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Disclaimer

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