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HHS Public Access

Author manuscript

AIDS. Author manuscript; available in PMC 2023 May 04.

Published in final edited form as:

AIDS. 2023 April 01; 37(5): 803–811. doi:10.1097/QAD.0000000000003464.

The role of social support on cognitive function among midlife and older adult MSM

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Conflicts of interest

The authors have no relevant financial interest or affiliations with any commercial interests related to the subjects discussed within this article.

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Abstract

Objective: This study examines the association between social support and cognitive function among midlife and older MSM living with or without HIV.

Design: We analyzed longitudinal data from participants enrolled from October 2016 to March 2019 in the Patterns of Healthy Aging Study, a substudy of the Multicenter AIDS Cohort Study.

Methods: We conducted a cross-sectional analysis to estimate the association between social support and three measures of cognitive function [Trail Making Test (TMT) Part A, TMT Part B to A ratio, and Symbol Digit Modalities Tasks (SDMT)]. We also used linear mixed-effects models to estimate the association between baseline social support and cognitive function across four subsequent time points. We evaluated a multiplicative interaction term between baseline social support and time, in order to determine whether cognitive trajectories over time vary by baseline social support.

Results: Social support was associated with lower TMT Part A scores at baseline and over the subsequent 2 years, indicating better psychomotor ability. Social support was associated with higher SDMT scores at baseline and across 2 years, indicating better information processing. We observed no association between social support and TMT B to A ratio at baseline or across 2 years, indicating no effecton set-shifting ability. Longitudinal cognition outcome trajectories did not vary by the level of baseline social support.

Conclusion: Social support and cognitive function were associated in this sample over a short time period. Further research should explore causal relationships over the lifespan.

Keywords

cognitive decline; HIV/AIDS; MSM; psychosocial health conditions; social support

Introduction

Understanding cognitive function is critical in the study of healthy aging, especially among populations who face health disparities, such as gay, bisexual, and other MSM. Impairments in cognitive function, such as difficulty learning, remembering, concentrating, or making decisions, can interfere with a person's ability to complete daily activities, leading to decreased independence and well being [1]. Most of what is known about cognitive function in MSM has been studied in the context of HIV. Despite the increasing efficacy of combination antiretroviral therapy, people living with HIV still experience a high prevalence of cognitive impairment, from accelerated age-related cognitive decline to dementia; prevalence estimates range from approximately 30 to 60% [2–4].

Social support may positively affect cognitive health among MSM. *Social support* refers to a person's perception of the availability of help or support from other people in their network. It includes two aspects: perceived availability of support and received support [5]. Social support is known to have a positive effect on cognitive function by buffering stress and reducing loneliness [6–11]. Social isolation and loneliness affect the majority of aging gay and bisexual men living with HIV [12,13]. One study of aging gay and bisexual men showed that multilevel resiliencies, including high social support and strong connections to

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gay communities, were protective against loneliness [14]. Additional evidence has shown that social support positively impacts HIV viral load suppression [15], physical and mental health related quality of life [16], psychological distress [17], and depression [18]. It is currently unknown, but likely that this impact extends to cognitive function as well.

To our knowledge, no studies have investigated the effects of social support on the cognitive function of aging MSM. To address this gap in the literature, we evaluated the effects of social support on cognitive function in a cohort of midlife and older MSM. We conducted this research with the Multicenter AIDS Cohort Study (MACS), an observational cohort study of gay and bisexual men living with and without HIV [19]. The MACS, which has recently merged with the Women's Interagency HIV Study to become the MACS/WIHS Combined Cohort Study, is the oldest and longest-running cohort study of gay and bisexual men in the United States, and offers substantial opportunities for multidisciplinary research on aging-related outcomes in this population in the context of HIV [20]. This study had several goals. First, we examined the cross-sectional association of social support with cognitive function.

Second, we utilized longitudinal data to examine the association between baseline social support and cognitive function over four subsequent time points, for up to 2years of follow-up from baseline. Finally, we examined whether the trajectory of cognitive function over time differs by the level of social support at baseline.

Materials and methods

Study design

We conducted a secondary analysis of data from the Multicenter AIDS Cohort Study (MACS). The MACS is an ongoing study of the natural and treated history of HIV infection among gay, bisexual, and other MSM; its design has been described in several prior studies [19,21]. Briefly, participants were enrolled in one of the four sites (Los Angeles, California; Pittsburgh, Pennsylvania; Chicago, Illinois; and Baltimore, Maryland/Washington, District of Columbia) and return every 6 months for a battery of medical tests and behavioral surveys, physical and neuropsychological examinations, and specimen collection. All study procedures were approved by the institutional review boards at each of the local study sites. Informed consent was obtained from all participants at the beginning of each study visit.

The details of the neuropsychological testing have been described in detail elsewhere [22]. The MACS administers a brief battery of neuropsychological tests during each semiannual visit. The battery consists of the Standard Trail Making Test (TMT) Parts A and B and the Symbol Digit Modalities Tasks (SDMT) corresponding to attention and processing speed, executive function, and information processing, respectively.

The present analysis was restricted to participants enrolled in the Patterns of Healthy Aging Study, a substudy of the MACS. To be eligible for the study, participants had to be 40 years of age or older. Further details about the substudy can be found elsewhere [23]. A total of 1318 men participated in the Patterns of Healthy Aging Study between visits 66 (baseline) to 70 from October 2016 to March 2019.

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Measures

Demographic characteristics—Participants self-reported their sexual orientation, race and ethnicity, HIV status, employment, educational attainment, and relationship status at baseline. Other variables included in this analysis were study site, wave of enrollment, and age at the time of the study visit. These demographic characteristics were identified *a priori* to include as covariates in the analytic models based on prior results from this cohort suggesting potential confounding effects on neurocognition [24].

Social support—Social support was measured by the Social Provisions Scale (SPS) [25] at baseline. The instrument contains 24 items, four for each of the following subconstructs: attachment; social integration; reassurance of worth; reliable alliance; guidance; and opportunity for nurturance. The respondents indicated on a 4-point Likert scale the extent to which each statement describes their current relationships with all people in their lives (friends, family members, coworkers, community members). Responses ranged from 1 (strongly disagree) to 4 (strongly agree). After reversal of negatively worded items, a score was computed by averaging all items for each subscale individually, and then averaging the individual subscale scores to generate an overall total score. Scores ranged from 1 to 4, with higher scores indicating more social support. If participants were missing a response to any of the items, we calculated subscale averages using all available responses.

TMT parts A and B—The instructions for TMT A and TMT B require that the tests be performed as quickly and accurately as possible. In TMT A, participants are asked to draw lines sequentially connecting in ascending order 25 encircled numbers distributed on a piece of paper. In TMT B, participants are asked to connect numbers (1–13) and letters (A-L) while alternating between them (i.e. 1-A-2-B, etc.). The test proctor immediately stops the participant when a mistake occurs and prompts correction. The time to complete TMT A and TMT B is recorded as the main outcome. Lower TMT A scores indicate better psychomotor ability. We used the ratio of the TMT B to TMT A scores as a measure of executive function. The use of a ratio score ensures that slower performance on the TMT A does not account for differences in the TMT B [26]. Higher ratio scores indicate poorer set-shifting ability (an aspect of executive function).

SDMT—The SDMT asks participants to use a coded key to match nine abstract symbols paired with numerical digits. After completing the first 10 items with guidance, the participant is timed to determine how many responses can be made in 90 s. We used the SDMT as a measure of information processing ability. Lower scores indicate poorer information processing.

Missing data analysis

Of the 1318 eligible participants, 94 (7.13%) were missing sociodemographic data and were removed from the analysis. Of the remaining 1224 participants, 142 were missing all TMTA, TMT B, and SDMT scores in visits 66 to 70; these individuals were removed from the analysis. Of the remaining participants, 134 were missing SPS-24 at baseline and were also removed from the analysis, creating a final analytic sample of 948 midlife and older MSM.

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Among the overall sample of 948 men, 838 men contributed to the cross-sectional analysis at baseline, while 912 men contributed 2381 person-visits to the longitudinal analysis.

Statistical analysis

First, we generated descriptive statistics for sociodemographic, social support, and cognitive function variables at baseline and conducted linear regression to identify demographic factors associated with levels of social support and cognitive function variables at baseline. Next, we conducted cross-sectional analyses using multivariable linear regression models to test the associations between social support and the TMT A, TMT B to A ratio, and SDMT scores at baseline. We adjusted for age, education, race and ethnicity, sexual identity, employment status, relationship status, HIV status, enrollment wave, and study site.

We conducted a longitudinal analysis using linear mixed models with repeated measures adjusting for within-participant variation to assess the association between social support at baseline and the TMT A, TMT B to A ratio, and SDMT at up to four subsequent visits from 6 to 24 months later. All models included time and a random intercept to allow the baseline cognitive function scores to vary between participants. We also tested a multiplicative interaction term between baseline social support and time, in order to determine whether any effect of baseline support on cognitive outcomes varies over time. Using each cognitive outcome's raw score scale enabled a meaningful interpretation of the effect size of social support in relation to each outcome in the primary analyses. In order to compare the strength of the association between social support and each of the three outcomes, we repeated the cross-sectional and longitudinal regressions using mean-standardized cognitive outcomes and presented the results as a supplement. All analyses were conducted using Stata version 16.0; longitudinal analyses used the mixed procedure (StataCorp, College Station, Texas, USA).

Results

Table 1 provides the sociodemographic characteristics of our sample at baseline. Of the men included in this sample, 30.3% were 65 years or older. The sample was predominantly gay (90.3%), and had attended some college or more (88.8%); just over two-thirds were white (68.5%). Approximately half (49.9%) of the participants were married or partnered, 55% were employed, and half were living with HIV (50.3%). Finally, most of the sample was recruited prior to 1987 (62.9%) and around one-third attended the Baltimore/Washington study site (32.6%).

The mean (SD) scores on the SPS-24 at the baseline visit was 3.20 (0.45). Lower mean social support scores were found among bisexual, non-Hispanic black or Hispanic, unemployed, single, and HIV-positive men, as well as those with lower education attainment and those enrolled after 2001. No statistically significant differences were observed by age or study site. When evaluated together in a multivariable regression, social support scores were significantly lower among men who identified as bisexual, were unemployed, single, had lower educational attainment, and were at the Pittsburgh study site. The differences in social support by HIV serostatus attenuated, as did those for non-Hispanic white men, and

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the timing of cohort enrollment when controlling for other demographic factors (Supplement Table 1, http://links.lww.com/QAD/C771).

Table 2 presents the unadjusted mean (SD) scores for the cognitive function outcomes by time. The unadjusted mean (SD) score for TMT A ranged from 21.32 (8.50) to 22.56 (9.47) s, with higher scores indicating poorer psychomotor speed. The unadjusted mean (SD) for the TMT B to A ratio ranged from 2.28 (0.95) to 2.34 (0.92), with higher scores indicative of worse set-shifting performance. Finally, the unadjusted mean (SD) score for SDMT ranged from 53.23 (14.94) to 54.54 (13.98), with lower SDMT scores indicating poorer information processing.

Cross-sectional associations between social support and cognitive outcomes

Table 3 presents the adjusted cross-sectional associations between social support and the TMT A score, TMT B to A ratio, and SDMT score at baseline. Individuals who reported higher social support had lower TMT A scores, indicating better psychomotor ability [b = −2.01; 95% confidence interval (95% CI) = −3.24 to −0.77]. Lower mean TMT A scores were also associated with higher educational attainment and men from the Los Angeles study site, while higher mean TMT A scores were found among MSM who were older, non-Hispanic black or Hispanic, unemployed or retired, enrolled after 2001, and from the Chicago study site.

After adjusting for covariates, we observed no statistically significant association between social support and TMT B to A ratio (b = −0.08; 95% CI = −0.22 to 0.06). Higher TMT B to A ratio scores (indicative of worse set-shifting performance) were found among non-Hispanic black or Hispanic men, while lower scores were associated with higher educational attainment and men attending the Pittsburgh study site.

After adjusting for covariates, individuals who reported higher social support had higher SDMT scores, indicating better information processing ability (b = 2.28; 95% CI = 0.22–4.34). Higher SDMT scores were also associated with higher educational attainment. In contrast, scores were lower among MSM who were older, non-Hispanic black, unemployed, and from the Pittsburgh study site.

As expected, the inferences from the mean-standardized analysis were identical with the analysis on the raw scale, with a statistically significant association between social support and improved performance on TMT A and SDMT. However, the effect size of the association between social support and TMT A was larger relative to its association with SDMT than was apparent on the raw scale. Interpreting the standardized coefficients, for every one point increase in social support, we saw a 0.23 standard deviation decrease in TMT A time and a 0.16 standard deviation increase in SDMT number correct (see Supplemental Table 2, http://links.lww.com/QAD/C771).

Longitudinal analysis

Table 4 presents the adjusted longitudinal associations between social support at baseline and TMT A score, TMT B to A ratio, and SDMT score over the subsequent four visits. Participants who reported higher social support had lower TMT A scores, indicating better

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psychomotor ability over time (b = −2.55; 95% CI = −3.63 to −1.47). We observed no association between social support and TMT B to A ratio (b = 0.02; 95% CI = −0.12 to 0.08). Finally, participants who reported higher social support had higher SDMT scores, indicating better information processing ability over time (b = 2.18; 95% CI = 0.25–4.11). Time was associated with lower SDMT scores, but not with TMT A or the TMT B to A ratio. Multiplicative interaction terms indicated that the associations between baseline social support and the cognition outcomes did not significantly differ by time from baseline. These terms were not retained in the final regression models due to lack of statistical significance, but are shown in Supplement Table 4, http://links.lww.com/QAD/C771.

In the mean-standardized analyses, the longitudinal association shows that for every one point increase in social support at baseline, there was a 0.22 standard deviation decrease in TMT A time and a 0.19 standard deviation increase in SDMT number correct averaged across the four subsequent time points (see Supplemental Table 3, http://links.lww.com/QAD/C771).

Discussion

To our knowledge, this is the first study to test the effects of social support on cognitive function in a cohort of midlife and older MSM. We found that higher social support was positively associated with concurrent psychomotor and information processing abilities, but was not associated with set-shifting ability. Using longitudinal data, we found that the associations between higher social support at baseline and greater subsequent psychomotor and information processing ability were durable over a 2-year period. However, the multiplicative interaction terms between social support and time were not significant, indicating that baseline social support was not associated with the rate of cognitive change across this time period.

Although social support was positively associated with two aspects of cognitive function at baseline and this association was durable over four subsequent time points, lower baseline social support was not associated with greater decline in cognitive function. This is partially explained by the limited declines in cognitive function observed in our sample over the 2-year period overall; time was not independently associated with psychomotor ability, and was associated with small declines in information processing ability. Given the limited change in the cognitive outcomes observed in the longitudinal data, we cannot rule out that the direction of cause-and-effect could be reversed (i.e. reverse causality) whereby changes in cognitive function precede changes in social support prior to the baseline measurement. It is also possible that our model omitted an important confounder, such as depression. Among lesbian, gay, bisexual, and transgender (LGBT) adults, depression has been associated with both social support and cognitive outcomes [27,28]. However, the direction and timing of influence remains unclear, and depression was not included as a confounder in the present analysis due to its potential mediating role.

Overall, we found high levels of perceived social support among MSM in this sample, in contrast to extant research suggesting that older MSM lack adequate social support. Older MSM have been found to have less social support and smaller social networks compared

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with sexual minority women and heterosexual men [28]. Compared with their heterosexual peers, older MSM are less likely to have support from biological families, be married, or have children or grandchildren, and they are more likely to live alone [28–30]. On the contrary, our results were consistent with a study of a cohort of older gay and bisexual men that found that participants reported moderate to high levels of social support [31].

We found several significant differences among participants in perceived social support that must be contextualized with prior research. First, we found that HIV-negative MSM reported higher social support than MSM living with HIV, though significance was only marginal when adjusting for covariates. A recent study found that older HIV-positive MSM reported lower social support than HIV-negative MSM, which partially accounted for mental and physical health disparities [32]. Several studies have suggested that social isolation accounts for the low social support found among HIV-positive MSM [33]. Indeed, HIV-positive older adults reported being isolated from social support systems due to both HIV stigma and ageism [33]. We did not find significant effects by race or ethnicity on social support after adjusting for covariates; however, prior research in this cohort, using a sub-sample restricted to people living with HIV and a brief, one-item measure of social support, indicated that black and Hispanic MSM reported lower levels of social support than White MSM [15]. Earlier work from the MACS found that black MSM have more robust social networks than white MSM [18]. These inconsistent findings supported the idea that objective aspects of social relationships (e.g. network size) do not necessarily align with more subjective measures (e.g. support) [28]. Finally, our finding that gay-identified men report higher levels of social support than bisexual or other-identifying men is consistent with prior literature demonstrating that bisexually identifying and bisexually behaving men report lower levels of social support compared with gay-identifying men and MSM, respectively [15,34]. The consistency of these findings supports the need to design interventions tailored for bisexual men, especially those who are aging.

Results from this study can guide clinical practice. Although the effect sizes of approximately 2 s on Trails A time and approximately two to three items on the SDMT per unit increase in social support score are not large from a clinical standpoint, given that the sample is predominantly composed of men under age 65 without overt cognitive impairment, even associations of smaller magnitude are of interest. Speed and information processing ability decline in adulthood and this decline may underlie at least part of the broad cognitive changes seen in the normal aging process. As psychomotor speed and information processing ability, but not set-shifting, were sensitive to differences in social support, this confirms previous findings that social support is related to broader cognitive health and perhaps the aging process generally, rather than specific domains such as executive function [9].

Future research may benefit from addressing our study’s limitations. First, our findings have limited external validity. The MACS uses a convenience sample of predominantly white, gay, and college educated MSM. Larger samples of racial and ethnic minority and bisexual men are needed to analyze within-group differences, particularly because these groups were found to have lower levels of social support and cognitive function scores.

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Second, although the MACS administers a full battery of neuropsychological tests every 2 years, the present analysis used only the brief battery, administered every 6 months, in order to have more observations within the 2-year period of data collection for the Healthy Aging Study.

Thus, we included only the TMT Parts A and B and the SDMT as tests of cognitive function. Set-shifting and processing speed are separate discrete cognitive processes that are mediated by different neural circuits [35]. Future studies should investigate other measures of cognitive function such as attention and working memory, learning, and motor skills. Although we used a classic, well validated measure of social support and neuropsychological tests, we were unable to examine the meaning and experience of social support and cognitive dysfunction that a qualitative approach could better illuminate.

Finally, our study did not seek to assess the variation in individual-level trajectories between participants over time. Variability in individual-level cognitive trajectories should be explored in more detail in future studies, particularly using a longer follow-up period. Declines in cognitive function typically develop over a longer period of time and occur later in the life course relative to other diseases of aging [36]; therefore, greater clarity regarding the effect of social support on cognitive function would emerge when using a longer follow-up. Many landmark studies of social support and cognitive function in the general population have utilized follow-up periods between 7.5 and 20 years [37–39]. Overall, social support may be a critical resource for promoting cognitive function across certain cognitive domains among midlife and older MSM, but important questions regarding the association remain unknown. Future analyses should clarify the directionality of this association, the role of other causal factors, and the mechanisms underlying the relationship.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgements

The authors are indebted to the participants of the MACS Healthy Aging Study. The authors thank the staff at the four sites for implementation support, and they thank John Welty, Montserrat Tarrago, and Katherine McGowan for data support in this study. This work was partially supported by the National Institute of Mental Health (T32MH094174 awarded to E.R.H.). De-identified data and coding scripts will be made available for all reasonable requests in keeping with internal procedures of the MWCCS.

E.R.H. conceptualized the study, conducted the statistical analysis, and drafted the initial manuscript. S.A.H., R.W. S.C., A.M.W., J.E.E., and M.R.F. contributed to the statistical analysis and manuscript writing. S.M., M.B.-I., M.J.M., J.M.T., B.T., L.A.T., and M.W.P. contributed to data collection and manuscript writing. All authors approved the final version of the manuscript.

This study was funded by the National Institute on Minority Health and Health Disparities (grant R01 MD010680; MWP and MRF). The contents of this publication are solely the responsibility of the authors and do not represent the official views of the National Institutes of Health. The Multicenter AIDS Cohort Study (MACS) and the Women's Interagency HIV Study Combined Cohort Study (principal investigators): Atlanta CRS (Ighovwerha Ofotokun, Anandi Sheth, and Gina Wingood), U01-HL146241; Baltimore CRS (Todd Brown and Joseph Margolick), U01-HL146201; Bronx CRS (Kathryn Anastos and Anjali Sharma), U01-HL146204; Brooklyn CRS (Deborah Gustafson and Tracey Wilson), U01-HL146202; data analysis and coordination center (Gypsyamber D'Souza, Stephen Gange, and Elizabeth Golub), U01-HL146193; Chicago–Cook County CRS (Mardge Cohen and Audrey French), U01-HL146245; Chicago-Northwestern CRS (Steven Wolinsky), U01-HL146240; Connie Wofsy Women's HIV Study, Northern California CRS (Bradley Aouizerat, Phyllis Tien, and Jennifer Price),

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U01-HL146242; Los Angeles CRS (Roger Detels), U01-HL146333; Metropolitan Washington CRS (Seble Kassaye and Daniel Merenstein), U01-HL146205; Miami CRS (Maria Alcaide, Margaret Fischl, and Deborah Jones), U01-HL146203; Pittsburgh CRS (Jeremy Martinson and Charles Rinaldo), U01-HL146208; UAB-MS CRS (Mirjam-Colette Kempf, Jodie Dionne-Odom, and Deborah Konkle-Parker), U01-HL146192; and UNC CRS (Adaora Adimora), U01-HL146194. The MACS/Women's Interagency HIV Study (MWCCS) is funded primarily by the National Heart, Lung, and Blood Institute, with additional cofunding from the Eunice Kennedy Shriver National Institute of Child Health & Human Development, National Institute on Aging, National Institute of Dental & Craniofacial Research, National Institute of Allergy and Infectious Diseases, National Institute of Neurological Disorders and Stroke, National Institute of Mental Health, National Institute on Drug Abuse, National Institute of Nursing Research, National Cancer Institute, National Institute on Alcohol Abuse and Alcoholism, National Institute on Deafness and Other Communication Disorders, National Institute of Diabetes and Digestive and Kidney Diseases, National Institute on Minority Health and Health Disparities, and in coordination and alignment with the research priorities of the National Institutes of Health, Office of AIDS Research. MWCCS data collection was also supported by UL1-TR000004 (UCSF CTSA), P30-AI-050409 (Atlanta Center for AIDS Research [CFAR]), P30-AI-050410 (University of North Carolina CFAR), and P30-AI-027767 (University of Alabama in Birmingham CFAR).

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Table 1.

Sociodemographic characteristics of midlife and older MSM in the Multicenter AIDS Cohort Study at visit 66 (baseline), October 2016 through March 2017, $n = 948$.

Sociodemographic variables	Participants, n (%)
Age cohort	
Midlife (40–64 years)	661 (69.7)
Older (65+ years)	287 (30.3)
Sexual identity	
Gay	856 (90.3)
Bisexual	46 (4.9)
Other[a]	46 (4.9)
Race and ethnicity	
Non-Hispanic white	649 (68.5)
Non-Hispanic black	195 (20.6)
Hispanic/Latino	82 (8.6)
Non-Hispanic other races	22 (2.3)
Employment	
Employed	521 (55.0)
Unemployed[b]	159 (16.8)
Retired	268 (28.3)
Education	
High school or less	108 (11.4)
Some college or more	840 (88.6)
Relationship status	
Married or partnered	473 (49.9)
Single	475 (50.1)
HIV status	
Negative	471 (49.7)
Positive	477 (50.3)
Enrollment wave	
Before 1987	596 (62.9)
After 2001	352 (37.1)
Study site	
Baltimore, Maryland/Washington, DC	309 (32.6)
Chicago, Illinois	193 (20.4)
Pittsburgh, Pennsylvania	229 (24.2)
Los Angeles, California	217 (22.9)

MACS, Multicenter AIDS Cohort Study.

[a] Includes queer, pansexual, and heterosexual.

[b] Includes people who were unemployed, students, or unable to work due to disability.

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Table 2.

Cognitive function scores of MSM in the Multicenter AIDS Cohort Study from visits 66 to 70, October 2016 through March 2019.

		TMT A	TMT B	TMT B to A ratio	SDMT
Study visit (time)	***n*** [a]	**Mean**[a] **(SD)**	**Mean**[b] **(SD)**	**Mean (SD)**	**Mean**[c] **(SD)**
66 (baseline)	832–834	21.32 (8.50)	48.42 (26.07)	2.31 (0.91)	54.54 (13.98)
67 (6 months)	558–560	21.44 (8.04)	49.16 (25.24)	2.33 (0.93)	53.96 (14.40)
68 (12 months)	643–646	22.32 (9.16)	49.57 (27.58)	2.28 (0.95)	53.72 (14.32)
69 (18 months)	649–655	21.98 (9.10)	50.79 (30.28)	2.33 (0.89)	53.23 (14.94)
70 (24 months)	515–516	22.56 (9.47)	50.83 (28.14)	2.30 (0.94)	53.59 (14.37)

MACS, Multicenter AIDS Cohort Study; SDMT, Symbol Digit Modalities Tasks; TMT, Trail Making Test.

[a] Range in the number of observations for the four cognitive function scores per visit

[b] Measured in seconds.

[c] Number of correct responses.

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Table 3.

Adjusted cross-sectional associations of sociodemographic variables and social support on cognitive function among MSM in the Multicenter AIDS Cohort Study at visit 66 (baseline), October 2016 through March 2017.

	TMT A[a] *n* = 834	TMT B to A ratio[a] *n* = 833	SDMT[a] *n* = 832
	b **(95% CI)**	***b*** **(95% CI)**	***b*** **(95% CI)**
Social support	−2.01 (−3.24 to −0.77)***	−0.08 (−0.22 to 0.06)	2.28 (0.22−/4.34)*
Age cohort			
Midlife (40–64 years)	Ref.	Ref.	Ref.
Older (65+ years)	4.69 (3.26–6.11)***	0.09 (−0.07 to 0.26)	−7.31 (−9.68 to −4.93)***
Sexual identity			
Gay	Ref.	Ref.	Ref.
Bisexual	2.30 (−0.10 to 4.70)	0.08 (−0.20 to 0.36)	−3.65 (−7.66 to 0.36)
Other[b]	1.36 (−1.29 to 4.01)	−0.005 (−0.31 to 0.31)	−1.99 (−6.42 to 2.44)
Race and ethnicity			
Non-Hispanic white	Ref.	Ref.	Ref.
Non-Hispanic black	3.66 (2.08–5.23)***	0.30 (0.11 –0.48)***	−7.42 (−10.06 to −4.79)***
Hispanic/Latino	2.46 (0.44–4.48)*	0.37 (0.13–0.60)***	−2.24 (−5.64 to 1.16)
Non-Hispanic other	0.79 (−2.65 to 4.22)	0.28 (−0.12 to 0.68)	−2.03 (−7.77 to 3.71)
Employment			
Employed	Ref.	Ref.	Ref.
Unemployed[c]	3.29 (1.66–4.91)***	0.02 (−0.16 to 0.21)	−4.49 (−7.21 to −1.77)***
Retired	2.32 (0.89–3.74)**	−0.16 (−0.18 to 0.15)	−1.08 (−3.46 to 1.29)
Education			
High school or less	Ref.	Ref.	Ref.
Some college or more	−2.14 (−3.93 to −0.35)*	−0.38 (−0.59 to −0.17)***	6.78 (3.81–9.75)***
Relationship status			
Married or partnered	Ref.	Ref.	Ref.
Single	0.39 (−0.72 to 1.51)	−0.06 (−0.19 to 0.06)	−0.13 (−1.99 to 1.73)
HIV status			

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	TMT A[a] *n* = 834	TMT B to A ratio[a] *n* = 833	SDMT[a] *n* = 832
	b **(95% CI)**	***b*** **(95% CI)**	***b*** **(95% CI)**
Negative	Ref.	Ref.	Ref.
Positive	0.22 (−0.91 to 1.35)	0.01 (−0.12 to 0.14)	−1.02 (−2.90 to 0.87)
Enrollment wave			
Before 1987	Ref.	Ref.	Ref.
After 2001	1.53 (0.23–2.82)*	0.12 (−0.03 to 0.27)	−1.66 (−3.84 to 0.51)
Study site			
Baltimore, Maryland/Washington, DC	Ref.	Ref.	Ref.
Chicago, Illinois	2.51 (0.94–4.08)**	−0.18 (−0.36 to 0.004)	1.12 (−1.52 to 3.75)
Pittsburgh, Pennsylvania	1.37 (−0.02 to 2.76)	−0.24 (−0.40 to −0.08)**	−2.49 (−4.81 to −0.17)*
Los Angeles, California	−1.56 (−3.02 to −0.10)*	−0.01 (−0.18 to 0.15)	0.01 (−2.42 to 2.45)
Intercept	18.10 (15.92–20.28)***	2.60 (2.34–2.85)***	55.49 (51.86–59.12)***

MACS, Multicenter AIDS Cohort Study; SDMT, Symbol Digit Modalities Tasks; TMT, Trail Making Test.

*$P < 0.05$

**$P < 0.01$

***$P < 0.001$.

[a]All models were adjusted for age, sexual identity, race and ethnicity, educational attainment, employment status, relationship status, HIV status, enrollment wave, and study site. SPS score was centered on its median value; 3.25. Each outcome was in its raw scale, with units of seconds for Trial Making Test and number of correct responses for SDMT. The model intercept is therefore the estimated population mean of each outcome raw score among participants with a social support score of 3.25, in midlife (40–64years old), gay, non-Hispanic white, employed, maximum educational attainment of high school or less, married/partnered, without HIV infection, enrolled in the cohort before 1987, and at the Baltimore/ Washington, DC, site.

[b]Includes queer, pansexual, and heterosexual.

[c]Includes people who were unemployed, students, or unable to work due to disability.

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Table 4.

Adjusted longitudinal associations of baseline social support, sociodemographic variables, and time on cognitive function among MSM in the Multicenter AIDS Cohort Study from visits 66 to 70, October 2016 through March 2019

	TMT A[a] *n* = 912/2377	TMT B to A ratio[a] *n* = 911/2371	SDMT[a] *n* = 907/2366
	b **(95% CI)**	***b*** **(95% CI)**	***b*** **(95% CI)**
Social support	−2.55 (−3.63 to −1.47) **	−0.02 (−0.17 to 0.17)	2.18 (0.25–4.11) *
Age cohort			
Midlife (40–64 years)	Ref.	Ref.	Ref.
Older (65+ years)	4.38 (3.10–5.66) ***	0.20 (0.07–0.32) **	−7.52 (−9.79 to −5.25) ***
Sexual identity			
Gay	Ref.	Ref.	Ref.
Bisexual	1.25 (−0.94 to 3.44)	0.02 (−0.19 to 0.23)	−2.17 (−6.07 to 1.73)
Other[b]	0.90 (−1.35 to 3.16)	0.09 (−0.12 to 0.30)	−0.18 (−4.17 to 3.81)
Race and ethnicity			
Non-Hispanic white	Ref.	Ref.	Ref.
Non-Hispanic black	3.68 (2.33–5.04) ***	0.20 (0.07–0.33) **	−7.57 (−9.99 to −5.16) ***
Hispanic/Latino	2.88 (1.04–4.73) **	0.30 (0.12–0.47) ***	−3.29 (−6.57 to −0.01) *
Non-Hispanic other	−1.18 (−4.22 to 1.85)	0.67 (0.39–0.96) ***	−2.32 (−7.71 to 3.06)
Employment			
Employed	Ref.	Ref.	Ref.
Unemployed[c]	3.52 (2.10–4.95) ***	0.24 (0.10–0.37) ***	−5.96 (−8.50 to −3.43) *
Retired	1.99 (0.72–3.27) **	−0.02 (−0.14 to 0.10)	−1.08 (−3.34 to 1.19)
Education			
High school or less	Ref.	Ref.	Ref.
Some college or more	−2.31 (−3.87 to −0.76) **	−0.27 (−0.42 to −0.13) ***	6.56 (3.80–9.32) ***
Relationship status			
Married or partnered	Ref.	Ref.	Ref.
Single	0.39 (−0.60 to 1.38)	−0.02 (−0.12 to 0.07)	−0.91 (−2.68 to 0.85)

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	TMT A[a] *n* = 912/2377	TMT B to A ratio[a] *n* = 911/2371	SDMT[a] *n* = 907/2366
	b **(95% CI)**	***b*** **(95% CI)**	***b*** **(95% CI)**
HIV status			
Negative	Ref.	Ref.	Ref.
Positive	0.11 (−0.89 to 1.11)	0.06 (−0.03 to 0.16)	−0.93 (−2.70 to 0.84)
Enrollment wave			
Before 1987	Ref.	Ref.	Ref.
After 2001	1.17 (0.03–2.31)*	0.14 (0.03–0.25)**	−0.97 (−3.00 to 1.06)
Study site			
Baltimore, Maryland/Washington, DC	Ref.	Ref.	Ref.
Chicago, Illinois	1.64 (0.34–2.93)**	−0.07 (−0.19 to 0.05)	2.15 (−0.16 to 4.47)
Pittsburgh, Pennsylvania	0.07 (−1.18 to 1.32)	−0.04 (−0.16 to 0.08)	−1.65 (−3.88 to 0.58)
Los Angeles, California	−2.22 (−3.57 to −0.87)**	0.13 (0.00–0.26)*	0.77 (−1.62 to 3.16)
Time[d]	0.01 (−0.02 to 0.04)	0.00 (−0.00 to 0.01)	−0.03 (−0.07 to −0.00)*
Intercept	19.48 (17.50–21.46)***	2.25 (2.05–2.44)***	55.42 (51.94–58.89)***

MACS, Multicenter AIDS Cohort Study; SDMT, Symbol Digit Modalities Tasks; TMT, Trail Making Test.

*P<0.05

**P<0.01

***P<0.001.

[a]All models adjusted for age, sexual identity, race and ethnicity, educational attainment, employment status, relationship status, HIV status, enrollment wave, and study site. SPS score was centered on its median value; 3.25. Each outcome was in its raw scale, with units of seconds for Trial Making Test and number of correct responses for SDMT. The model intercept is therefore the estimated population mean of each outcome raw score among participants with a social support score of 3.25, in midlife (40–64years old), gay, non-Hispanic white, employed, maximum educational attainment of high school or less, married/partnered, without HIV infection, enrolled in the cohort before 1987, and at the Baltimore/ Washington, DC site.

[b]Includes queer, pansexual, and heterosexual.

[c]Includes people who were unemployed, students, or unable to work due to disability.

[d]Coded as 0, 6, 12, 18, and 24 months.