RESEARCH ARTICLE

Factors Associated with ART Adherence among MSM Receiving Medical Care in Texas: An Analysis of the Texas Medical Monitoring Project Data

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ABSTRACT

Objective(s): To examine the sociodemographic, behavioral, and clinical characteristics associated with 100% ART adherence and sustained viral suppression (SVS) among men who have sex with men (MSM) living with HIV and receiving HIV-related medical care in Texas.

Design: A cross-sectional, three-stage design was used to sample jurisdictions, facilities, and HIV patients receiving medical care, using probability-proportional-to-size methods.

Methods: Medical record abstraction and interview data (n = 1,426) from the 2009-2014 Medical Monitoring Project (MMP) cycles were used for this analysis. The associations between the sociodemographic, behavioral, and clinical characteristics with both 100% ART adherence and SVS were assessed using Rao-Scott chi-square tests. Multivariable logistic regression models were derived to estimate adjusted prevalence ratios (aPR) and corresponding 95% confidence intervals (CI) for 100% ART adherence and SVS.

Results: Of the MSM participants, 84% reported 100% ART adherence and 65% had SVS. Younger (age <55 years) and Black MSM who reported housing/food/income unmet needs were less likely to be 100% ART adherence or attain SVS (p<0.05 for all). Conversely, those who were 100% ART adherent were more likely to have SVS (p<0.05). Compared to MSM ≥55 years, those 18-34, 35-44, and 45-54 years were 34%, 23%, and 15% less likely to achieve SVS, respectively. Additionally, compared to White MSM, Black MSM were 13% less likely to achieve SVS and with adjustment of ART adherence, this association remained statistically significant (p<0.05). MSM who were 100% adherent to ART were 24% more likely to achieve SVS compared to those who were not completely adherent.

Conclusions: Our study identified age, race/ethnicity, homelessness, and unmet needs for housing/food/income as major predictors of 100% ART adherence and SVS among MSM living with HIV and receiving medical care in Texas. Since MSM comprise the majority of people living with HIV in Texas, addressing these differences in SVS and ART adherence based on their sociodemographic, behavioral, and HIV-related characteristics is critical to meeting goals set to end the HIV epidemic in Texas.

Introduction

Within the last two decades, HIV has become a manageable chronic condition due to the introduction of antiretroviral therapy (ART) for people living with HIV (PLWH) [1]. Maintaining daily adherence to ART can lead to undetectable levels of viral load (<200 copies/ml) as soon as six months from the start of ART treatment [2]. Achieving sustained viral suppression (SVS) has important impacts to both clinical outcomes for PLWH and reduction in community HIV transmission and incidence [3,4]. A person with an undetectable viral load has effectively no risk of sexually transmitting HIV [5]. Furthermore, PLWH with an undetectable viral load can have life expectancies similar to the general population [6]. Since ART use does not cure HIV, it is imperative that PLWH adhere to daily ART regimens to reduce morbidity, mortality, and further transmission of the virus [1,7]. One nationally representative study among PLWH in care found that 86% of all those surveyed were 100% adherent to ART [8].

In spite of the aforementioned benefits of attaining SVS, only 61% of men who have sex with men (MSM) living with HIV in the U.S. achieved SVS, with Black, Hispanic and younger (<35 years) MSM having significantly lower prevalence of viral suppression compared to White and older MSM, respectively [9]. Although the viral suppression rates improved among MSM between 2010 and 2015, 52% of young MSM (aged 13-24 years) living with HIV are unaware of their status [10]. This highlights the importance of routine testing and it has been shown that more

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frequent screening (every 3-6 months) may be linked with improved care outcomes such as increased ART adherence and viral suppression [11] among sexually active MSM [12].

In the U.S., MSM are most affected by HIV, representing 67% of all new HIV diagnoses and 56% of PLWH [13]. In addition to MSM, Americans living in the South experience a high burden of HIV. More than half of all new HIV diagnoses and almost half of all PLWH are in the southern U.S. [14]. PLWH in the South face many unique barriers, such as lack of public transportation in urban and rural areas, making it difficult to get to the doctor [15]. Texas has one of the highest rates of new HIV diagnoses in the South [14], ranking 7th with a rate of 20/100,000 Texans [16]. In 2019, MSM accounted for 70% of new HIV diagnoses and 62% of all Texans living with HIV, with Black MSM accounting for 17% out of all Texans living with HIV and 28% of new HIV diagnoses [17] In terms of continuum of care in Texas, a lower proportion of Black MSM achieve viral suppression (55%) compared to White (70%) and Hispanic (64%) in Texas at the end of 2019 [18], which has been observed in other studies [19,20].

According to the U.S. Interagency Council on Homelessness, Texas ranks as the state with the highest number of people experiencing homelessness as of January 2019 [21]. With lack of stable housing being linked with care retention [22], ART adherence [23] and SVS [24], studies that analyze care outcomes among PLWH in Texas experiencing homelessness are warranted.

A large body of public health literature has investigated sociodemographic and behavioral characteristics associated with medication adherence for PLWH [8, 25-34]. A nationally representative study of PLWH who are in HIV care in the U.S. found that persons age 18 to 29, women, those who were depressed, binge drank, used stimulant drugs, and who had been living with HIV for more than 10 years were less likely to be adherent to ART [8]. Those under the age of 29 may have a hard time with ART adherence because lifestyle alterations required for successful adherence may be more burdensome [35].

Additional studies found depression [32,34], binge drinking [25], discrimination [33], stigma [30], problems with insurance [31], and low income [26] are associated with suboptimal adherence to ART, and thus, lower rates of viral suppression. Depression has been found to be associated with low ART adherence because symptoms found in depressed patients such as hopelessness and negative expectations often dissuade patients from adhering to treatment and being virally suppressed [32].

To address care and engagement needs among PLWH, Texas has adopted the goals of U.S. National HIV/AIDS 95/95/95 Strategy. One of the goals states that by 2025, 95% of all people receiving antiretroviral therapy will have viral suppression [36]. Due to the disproportionate burden of HIV among MSM and those in the southern U.S., as well as sparse regional and state-level analyses of patterns and predictors of ART adherence and viral suppression, this analysis fills a gap in the current public health literature. The present study aims to examine the sociodemographic, behavioral, and clinical characteristics associated with complete ART adherence (100%) and SVS among MSM living with HIV and receiving medical care in Texas.

Methods

The Medical Monitoring Project (MMP) is an ongoing CDC surveillance system that assesses behaviors and clinical characteristics of PLWH who are receiving outpatient medical care [37-39]. At the time of data collection, a three-stage cluster sampling method was used to randomly select 23 city/state project areas (1st stage), healthcare facilities within those areas (2nd stage), and patients within facilities (3rd stage). Behavioral and clinical data from the study participants were collected using in-person and telephone interviews as well as medical record abstraction. Between 2009 and 2014, interviews and medical record abstractions were conducted for 2,595 participants. Non-MSM participants and those not currently on ART were not included in the final analytical sample (n=1,426). Data were weighted to account for probabilities of selection at each sampling stage and adjusted for nonresponse and multiplicity [40]. Nonresponse adjustments accounted for differing response at both facility and patient levels, while multiplicity adjustments accounted for patient's visits to more than one HIV care facility [41, 42]. After weighting for probability of selection and nonresponse, our population sample represented 19,788 Texan MSM living with HIV in Texas receiving medical care and currently taking antiretroviral medications.

Self-report 100% ART adherence was estimated using a measure of the dose adherence over the past three days from the AIDS Clinical Trials Group measures [43]. Participants were asked about each medication they were taking at the time of the interview and how often they missed a dose during the time frame. If a participant reported only taking part of a dose, they were instructed to report this as a missing dose. For the purposes of this study, participants who did not miss a dose over the past three days were considered to be 100% ART adherent. A participant was deemed to have SVS if each of their viral loads from their medical records within the past 12 months before the interview date was undetectable (≤ 200 copies/ml).

Behavioral and sociodemographic variables collected for MMP included: age, race/ethnicity, education, insurance, homelessness, binge drinking within past 30 days (defined as consuming five or more servings in one sitting), smoking status, any drug use within the past year, depression, experiences of discrimination, unmet need, and stigma. Insurance was categorized as receiving Ryan White coverage, having private or public insurance coverage excluding Ryan White coverage, and being uninsured in the past 12 months. Homelessness status was defined as participants who were homeless at any time in the past 12 months prior to the interview. Major or other depression was defined as a score of 10 or more on the Patient Health Questionnaire depression scale (PHQ-8) [44].

To determine the unmet needs among the participants, a 19-question needs assessment regarding services that were needed but not received within the past 12 months was used. The participants were first asked whether they received services. If they did not receive the service, they were then asked if they needed the service. Participants were asked

about the services displayed in Supplemental Table 1. These questions were used to create four composite unmet need: housing/food/income, health/medical, HIV-related services, and barriers. If a participant responded to having an unmet need to any of the services for each category, they were assigned one point. Each of the four unmet need scores were dichotomized as none and ≥1. Next, a composite stigma score was created from the following six questions: (1) "Being HIV positive makes me feel dirty." (2) "I feel guilty that I am HIV positive." (3) "I am ashamed that I am HIV positive." (4) "I sometimes feel worthless because I am HIV positive." (5) "It is difficult to tell people about my HIV infection." (6) "I hide my HIV status from others." A participant was given a point for each of the above six statements if they responded with "somewhat agree" or "strongly agree." Each participant's score was summed to create a composite score, and tertiles were created to categorize the stigma score as either low (0-1), moderate (2-3), or high (4-6). Stigma-related questions were only available from 2011-2014 cycles. In addition, a measure of discrimination in health care settings was created. Participants who responded "yes" to any one of the following three questions were classified as having experienced discrimination in a health care setting: (1) "Exhibited hostility or a lack of respect toward you?" (2) "Given you less attention than other patients?" (3) "Refused you service?" Lastly, HIV-related clinical measures included duration of HIV diagnosis (years) and SVS.

Statistical analysis

Weighted prevalence and 95% confidence intervals (CI) of ART adherence and SVS among MSM participants were calculated as an overall measure and by each of the following categories of sociodemographic and HIV-related characteristics: age (18-34, 35-44, 45-54, or ≥55 years), race/ethnicity (non-Hispanic White, Black, Hispanic), education (<high school, high school or equivalent, or >high school), insurance (uninsured, on Ryan White, insurance but not on Ryan White), homelessness (ever vs. never homeless), binge drinking in past 30 days (yes vs. no), smoking status (never, former, current), any drug use in past year (yes vs. no), major or other depression (yes vs. no), ever experienced discrimination in a health care setting (yes vs. no), tertiles of a cumulative stigma score (low (0-1), moderate (2-3), or high (4-6)) and the four composite unmet need scores (no unmet need (0), one or more unmet needs), time since HIV diagnosis (<5 years, 5-9 years, or ≥10 years), and sustained viral load (undetectable (≤200 copies/ml) vs. detectable (>200 copies/ml)).

The outcome measures, 100% ART adherence and SVS were both established as dichotomous variables (100% ART adherent/not 100% ART adherent and SVS/no SVS). The associations between the sociodemographic, behavioral, and clinical characteristics with 100% ART adherence and SVS were assessed using Rao-Scott chi-square tests with $p<0.05$ used as threshold for determining statistical significance. Factors from the univariate analysis that met the entry criteria ($p<0.10$) were entered in two different multivariable logistic regression models – one to determine their predictability of 100% ART adherence and the other SVS, to estimate adjusted prevalence ratios (aPR) and corresponding 95% CIs.100% ART adherence was also added in the multivariable model for SVS

to estimate its impact. All analyses were performed using SAS 9.4 (SAS Institute, Cary, North Carolina, USA) and SAS-callable SUDAAN (RTI International, Research Triangle Park, NC, USA) and weighted to account for clustering, unequal selection probabilities, and non-response.

Results

Table 1 displays the distribution of the sample population. The majority of MSM (54%) is older than 44 years of age. Almost 40% were White, 63% had an education greater than a high school diploma, and nearly half of the sample reported receiving ART through Ryan White. Only 5% of the sample had been homeless within the past 12 months, while 26% reported drug use within the past 12 months. Major/other depression represented 22%. Over 80% of MSM reported at least one or more of the following three kinds of unmet need: housing/food/income, HIV services, and barriers. Supplemental table 1 illustrates what constitutes each of the unmet need categories. Half of the sample had at least one unmet need. About 63% of the sample reported a stigma score of moderate or high. The majority (53%) of our sample had been diagnosed with HIV for at least 10 years. Finally, 84% of our sample were 100% ART adherent and 65% achieved SVS.

Table 2 shows the selected characteristics of MSM receiving medical care in Texas by ART adherence status. About 84% of MSM in care reported that they were currently on ART and were 100% adherent in the past three days ($p<0.001$). A lower proportion of MSM <35 years old were 100% adherent (76%) compared to those ≥35 (83%, $p <0.01$). We observed significant disparities in adherence by race/ethnicity, with Black MSM having significantly lower adherence to ART (79%) compared to White (86%) and Hispanic MSM (85%) ($p<0.01$). Significant differences were noted among MSM who were ever homeless, binge drinkers (past 30 days), ever reported using drugs (past year), reported depression, those who had one or more of each of the four unmet need categories (housing/food/income, health and medical, HIV-related services, and barriers), and those who had a sustained detectable viral load (>200 copies/ml) had a lower proportion who were not 100% adherent ($p <0.001$ for all) compared to their respective comparison groups.

Table 3 shows the aPRs and 95% CIs for 100% ART adherence after controlling for age, race/ethnicity, homelessness, binge drinking, depression, and unmet need for housing, food, or income assistance. Compared to White MSM, Black MSM were 8% (95% CI: 0.86-0.99) less likely to be 100% ART adherent. MSM who reported binge drinking in the past 30 days, had major/other depression, or had at least one unmet need for housing/food/income assistance need, 11%, 11%, and 9% less likely to be 100% ART adherent compared to non-binge drinkers, MSM who did not report depression, nor having any housing/food/income unmet need, respectively.

Table 4 illustrates the selected characteristic of MSM receiving medical care in Texas by viral suppression status. About two-thirds of our participants (65%) achieved SVS and we observed significant differences by age, race/ethnicity, insurance, homeless, smoking, any drug use, housing/food/income unmet needs, HIV diagnosis duration and 100% ART adherence. We

Table 1: Characteristics of MSM Receiving Medical Care – Texas Medical Monitoring Project, 2009-2014.

Characteristic	n	%	p-value
Age group (years)			
18-34	326	22	
35-44	399	25	<0.0001****
45-54	562	36	
≥55	277	18	
Race/ethnicity			
White	559	39	
Black	488	29	0.01**
Hispanic	517	32	
Education			
<High School	200	12	
High school/equivalent	400	25	<0.0001****
>High School	964	63	
Insurance			
Uninsured	92	6	
Not on Ryan White	724	46	
On Ryan White	744	48	<0.0001****
Homeless Status			
Not homeless	1,471	95	<0.0001****
Homeless	93	5	
Binge Drinking (30 days)			
No	1,228	78	<0.0001****
Yes	329	22	
Smoking Status			
Never	734	46	
Former	297	19	<0.0001****
Current	533	35	
Any Drugs Use (past 12 months)			
No	1,187	74	<0.0001****
Yes	376	26	
Depression			
None	1,213	78	<0.0001****
Major/other depression	344	22	
Discrimination			
None	891	77	<0.0001****
Discrimination	265	23	
Food/Housing/Income Unmet Need[1]			
No (0)	1261	81	<0.0001****
One or more (≥1)	303	19	
Health/Medical Unmet Need[2]			
No (0)	1015	66	<0.0001****
One or more (≥1)	549	34	
HIV Services Unmet Need[3]			
No (0)	1321	84	<0.0001****
One or more (≥1)	243	16	
Barriers Unmet Need[4]			
No (0)	1389	89	<0.0001****
One or more (≥1)	175	11	
Stigma Score			
Low (0-1)	423	37	
Moderate (2-3)	405	35	0.01**
High (4-6)	327	28	
HIV Diagnosis Duration			
<5 years	388	26	
5-9 years	334	21	<0.0001****
10+ years	842	53	
100% ART Adherence			
100% Adherent	1,191	84	<0.0001****
Not 100% Adherent	235	16	
Sustained viral load (copies/ml)			
Undetectable (≤200)	1,016	65	<0.0001****
Detectable (>200)	548	35	

[1]Includes social security/disability insurance, shelter, and meal services.
[2]Includes dentist visits, mental health, nutrition, eye/vision, and home health services.
[3]Includes ADAP, case management, prevention education, ART adherence, peer group services.
[4]Includes domestic violence, transportation, childcare, interpreter, and law services.
Note: The total sample size (n) within characteristic may vary slightly because of missing values or responses, and corresponding percentages may not add up to exactly 100 due to rounding.
Significance Level: **=p<0.01; ****=p<0.0001.

Table 2: Selected Characteristics of MSM Receiving Medical Care in Texas by ART Adherence Status.

Characteristic	ART Adherence Status				Test Statistics	
	Not 100% Adherent		100% Adherent			
	n	%‡	n	%‡	χ² Value	p-Value
Total MSM	235	16	1,191	84	561.8	<0.001***
Age group (years)						
18-34	68	24	218	76		
35-44	60	17	291	83		
45-54	77	15	449	85		
≥55	30	11	233	89	12.6	<0.01**
Race/ethnicity						
White	71	14	440	86		
Black	92	21	346	79		
Hispanic	72	15	405	85	10.4	<0.01**
Education						
<High School	38	21	141	79		
High school/equivalent	71	20	287	80		
>High School	126	14	763	86	6.0	0.05*
Insurance						
Uninsured	7	15	39	85		
Not on Ryan White	104	16	554	84		
On Ryan White	124	17	594	83	2.3	0.31ns
Homeless Status						
Not homeless	209	16	1138	84		
Homeless	26	33	53	67	18.2	<0.001***
Binge Drinking (30 days)						
No	154	14	968	86		
Yes	80	27	217	73	23.4	<0.001***
Smoking Status						
Never	94	14	577	86		
Former	45	16	235	84	6.7	0.03*
Current	96	20	379	80		
Any Drugs Use (past 12 months)						
No	144	13	948	87		
Yes	91	27	243	73	29.3	<0.001***
Depression						
None	148	13	971	87		
Major/other depression	85	28	216	72	34.9	<0.001***
Discrimination						
None	136	17	686	83	<0.01	0.98ns
Discrimination	44	18	202	82		
Housing/food/income unmet need[1]						
None	1002	86	163	14	18.8	<0.001***
One or more	189	72	72	28		
Health and medical unmet need[2]						
None	798	86	126	14		
One or more	393	78	109	22	13.7	<0.001***
HIV-related services unmet need[3]						
None	1031	85	176	15		
One or more	160	73	59	27	18.3	<0.001***
Barriers to unmet need[4]						
None	1083	85	188	15		
One or more	108	70	47	30	22.4	<0.001***
Stigma Score						
Low (0-1)	50	13	345	87		
Moderate (2-3)	68	18	305	82		
High (4-6)	62	21	238	79	5.6	0.06ns
HIV Diagnosis Duration						
<5 years	60	18	279	82		
5-9 years	48	16	256	84		
10+ years	127	16	656	84	1.1	0.56ns
Sustained viral load (copies/ml)						
Undetectable (≤200)	129	13	864	87		
Detectable (>200)	106	24	327	76	27.4	<0.001***

‡Denotes row %

Note: The total sample size (n) within characteristic may vary slightly because of missing values or responses, and corresponding percentages may not add up to exactly 100 due to rounding.

[1]Includes social security/disability insurance, shelter, and meal services.

[2]Includes dentist visits, mental health, nutrition, eye/vision, and home health services.

[3]Includes ADAP, case management, prevention education, ART adherence, peer group services.

[4]Includes domestic violence, transportation, childcare, interpreter, and law services.

Significance Level: *=p<0.05; **=p<0.01; ***=p<0.001; ****=p<0.0001; ns= Not significant (p>0.05).

Table 3: Prevalence of 100% ART Adherence Among MSM Receiving Medical Care in Texas.

Characteristic	aPR	95% CI
Age group (Years)		
18-34	0.92	0.84-1.00[ns]
35-44	0.97	0.90-1.05[ns]
45-54	0.98	0.92-1.05[ns]
≥55 (ref)	1.00	-
Race/ethnicity		
White (ref)	1.00	-
Black	0.92	0.86-0.99*
Hispanic	1.01	0.95-1.07[ns]
Homelessness		
Not homeless (ref)	1.00	-
Homeless	0.89	0.79-1.00[ns]
Binge Drinking (30 Days)		
No (ref)	1.00	-
Yes	0.89	0.79-0.93*
Depression		
None (ref)	1.00	-
Major/other depression	0.89	0.81-0.99*
Housing/food/income unmet need		
Yes (≥1)	0.91	0.84-0.99*
None (ref)	1.00	-

*aPR: Adjusted Prevalence Ratio, 95%CI: 95% Confidence Interval, Ref: Referent. Significance Level: * Significance based on 95% confidence interval; ns=Not Significant (p>0.05).*

observed an increase of SVS by increase in age (p<0.001): only about half of MSM <35 years of age achieved SVS compared to 79% among MSM ≥55 years old. Black MSM had significantly lower prevalence of SVS (54%) compared to White (68%) and Hispanic MSM (70%). Two-thirds of MSM who reported no housing/food/income unmet needs achieved SVS while, of the MSM who reported at least one unmet need for housing/food/income only 53% of them achieved SVS. Finally, 73% of MSM who were 100% ART adherent achieved SVS, whereas only 55% of MSM who were not 100% ART adherent had SVS (Table 4).

The aPRs and corresponding 95% CIs of SVS among MSM receiving medical care in Texas are shown in Table 5. After adjusting for age, race/ethnicity, unmet need for housing, food, or income assistance, Black MSM were 13% (95% CI: 0.79-0.97) less likely to achieve SVS compared to white MSM. As age decreases, the prevalence of SVS also decreased: 18-34, 35-44, and 45-54-year-old MSM were 34%, 23%, and 15% less likely to achieve SVS compared to MSM age ≥55 years. After adding 100% ART adherence to the multivariable model, the aforementioned aPRs were attenuated but statistical significance was retained. Compared to white MSM, Black MSM were 14% less likely to achieve SVS. Additionally, those who had at least one unmet need for housing/food/income assistance were 13% less likely to have SVS. Finally, those who reported 100% ART adherence were 24% more likely to have SVS compared to those who were not 100% ART adherent.

Discussion

We found that 76% of MSM living with HIV in care in Texas were 100% adherent on ART and 65% achieved SVS. Similar findings on ART Adherence were observed in a recent nationally representative study using 2009 MMP data that found 86% of PLWH in care were 100% ART adherent [8]. Consistent with previous studies, adherence was independently associated

with race, education, homeless status, binge drinking, smoking, drug use, depression, and stigma [7, 26, 32, 34, 45, 46]. While our findings support others that depression and binge drinking are independently linked with ART adherence among PLWH [8, 25, 32, 34] and MSM living with HIV in Texas, our finding that having more than one unmet need, especially those relating to assistance in housing/food/income, are associated with lower adherence as well as SVS, which may be unique to this population. Findings from this study present potential areas for intervention among MSM in care.

For both adherence and SVS, we observed that having housing/food/income unmet needs were negatively associated with achieving 100% ART adherence and SVS. People who are low income and who do not have insurance are less likely to be adherent to their ART medication [26, 31]. Rudy et al. found that in youth living with HIV, lack of income and insurance served as structural barriers to ART adherence [31]. Low income PLWH may have trouble paying for ART and become non-adherent when medication runs out. Homeless MSM in the Miami-Dade County Ryan White Program were less likely to achieve SVS compared to MSM who were not homeless [24]. Additionally, Ryan White Part-A Care Coordination Program participants who were homeless at the start of a prospective analysis but who obtained stable housing at the end of follow-up achieved higher rates of viral suppression compared with those who remained homeless [47]. Our study adds more evidence that unmet housing needs are crucial to ensuring ART adherence and SVS among PLWH.

One of our key findings was adherence is one of the strongest predictors of SVS among MSM living with HIV. This has been observed in several studies [48-51] and identified as a key measure in the US Ending the Epidemic HIV Plan [52]. We observed that age was the biggest predictor of SVS but when ART adherence was added in the multivariable model, the effects of age on SVS were attenuated, suggesting that ART adherence explains some of the associations of age with SVS. Other studies have observed a similar trend on the relationship of age and SVS – younger PLWH were less likely to achieve SVS compared to older PLWH [53, 54]. This could be partly explained with young PLWH having lower rates of ART adherence compared to older PLWH [55]. Additionally, we observed Black MSM had significantly lower likelihoods of achieving SVS compared to White MSM, even after adjusting for ART adherence. Taken together, our results add to an existing body of literature that young MSM, especially young Black MSM, are vulnerable to lower ART adherence [56], and thus, having a detectable viral load.

Our findings support Beer and Skarbinski's conclusion that addressing psychosocial comorbidities such as depression and binge drinking will likely improve adherence [8]. They argue that providing PLWH-appropriate referrals to mental health and substance abuse treatment improve not only adherence to ART but also overall health. Tailoring programs addressing psychosocial comorbidities to meet the needs of MSM living with HIV could help achieve rates of adherence and viral suppression necessary to meet the goals of the Texas Community Plan for Ending the Epidemic [57]. These findings also suggest the importance of ensuring all the needs, such as professional help with HIV medications, mental health services,

Table 4: Selected Characteristics of MSM Receiving Medical Care in Texas by Viral Suppression Status.

Characteristic	Viral Suppression Status				Test Statistics	
	Not Sustained		Sustained			
	n	%‡	n	%‡	χ^2 Value	p-Value
Total MSM	546	35	1,016	65	97.4	<0.001***
Age group (years)						
18-34	160	49	166	51		
35-44	156	39	243	61		
45-54	175	32	387	68		
≥55	57	21	220	79	48.5	<0.001***
Race/ethnicity						
White	182	32	377	68		
Black	215	46	273	54		
Hispanic	151	30	366	70	25.6	<0.001***
Education						
<High School	68	35	132	65		
High school/equivalent	159	40	241	60		
>High School	321	34	643	66	4.4	0.11ns
Insurance						
Uninsured	59	64	33	36		
Not on Ryan White	248	34	476	66		
On Ryan White	241	32	503	68	24.4	<0.001***
Homeless Status						
Not homeless	494	34	977	66		
Homeless	54	61	39	39	25.2	<0.001***
Binge Drinking (30 days)						
No	421	34	807	66		
Yes	127	39	202	61	2.0	0.15ns
Smoking Status						
Never	250	34	484	66		
Former	86	29	211	71		
Current	212	40	321	60	10.4	<0.01**
Any Drugs Use (past 12 months)						
No	382	32	805	68		
Yes	165	44	211	56	14.7	<0.001***
Depression						
None	397	33	816	67		
Major/other depression	146	42	198	58	9.3	<0.01**
Discrimination						
None	286	32	605	68		
Discrimination	81	31	184	69	<0.01	0.98ns
Housing/food/income unmet need[1]						
None	409	33	852	67		
One or more	139	47	164	53	18.0	<0.001***
Health and medical unmet need[2]						
None	340	33	675	67		
One or more	208	38	341	62	3.1	0.08ns
HIV-related services unmet need[3]						
None	453	34	868	66		
One or more	95	39	148	61	1.2	0.28ns
Barriers unmet need[4]						
None	473	34	916	66		
One or more	75	43	100	57	6.8	<0.01**
Stigma Score						
Low (0-1)	143	34	280	66		
Moderate (2-3)	124	31	281	69		
High (4-6)	99	30	228	70	1.7	0.43ns
HIV Diagnosis Duration						
<5 years	174	45	214	55		
5-9 years	112	34	222	66		
10+ years	262	31	580	69	22.3	<0.001***
ART Adherence						
100% adherent	327	27	864	73		
Not 100% adherent	106	45	129	55	27.4	<0.001***

‡Denotes row %
Note: The total sample size (n) within characteristic may vary slightly because of missing values or responses, and corresponding percentages may not add up to exactly 100 due to rounding.
[1]Includes social security/disability insurance, shelter, and meal services.
[2]Includes dentist visits, mental health, nutrition, eye/vision, and home health services.
[3]Includes ADAP, case management, prevention education, ART adherence, peer group services.
[4]Includes domestic violence, transportation, childcare, interpreter, and law services.
Significance level: *=p<0.05; **=p<0.01; ***=p<0.001; ns= Not significant (p>0.05).

Table 5: Prevalence of Sustained Viral Load Among MSM Receiving Medical Care in Texas.

Characteristic	aPR (95% CI)[1]	aPR (95% CI)[2]
Age group (Years)		
18-34	0.66 (0.58-0.76)*	0.76 (0.67-0.86)*
35-44	0.77 (0.69-0.86)*	0.84 (0.76-0.93)*
45-54	0.85 (0.78-0.94)*	0.88 (0.81-0.96)*
≥55 (ref)	1.00	1.00
Race/ethnicity		
White (ref)	1.00	1.00
Black	0.87 (0.79-0.97)*	0.86 (0.78-0.96)*
Hispanic	1.11 (1.01-1.21)[ns]	1.06 (0.97-1.17)[ns]
Housing/food/income unmet need		
None (ref)	1.00	1.00
Yes (≥1)	0.81 (0.72-0.92)*	0.87 (0.78-0.98)*
100% ART Adherence		
No (ref)	-	1.00
Yes	-	1.24 (1.09-1.40)*

[1]Multivariable model adjusting for age, race, housing/food/income unmet need
[2]Multivariable model adjusting for age, race, housing/food/income unmet need, and ART adherence
aPR: Adjusted Prevalence Ratio, 95%CI: 95% Confidence Interval, Ref: Referent. Significance Level: * Significance based on 95% confidence interval; ns=Not Significant (p>0.05).

drug/alcohol counseling, and shelter or housing services, are met for MSM living with HIV. Our results show patients with unmet needs are less likely to be adherent and achieve SVS, which warrants limiting the burden of compounding unmet needs among MSM living with HIV. Finally, binge drinking (≥5 drinks in one sitting), does not properly address chronic binge drinking as participants are characterized as binge drinker if this behavior occurs once in the 30 days prior to interview.

While recent literature finds insurance type, discrimination, stigma, and HIV diagnosis duration are independently associated with adherence [8, 30, 31, 33], this differed from our findings. For PLWH, insurance type could be a barrier to accessing medication; however, our sample does not address access to medication as all participants are currently taking ART. Furthermore, while trouble filling prescriptions due to difficulty with insurance has been found to be a barrier to adherence [27], it is unlikely a three-day assessment of dose adherence would properly address such association. Our self-reported insurance measure also does not consider that patients who are receiving medication might not know how their HIV medication is being paid for and may over report being uninsured. A 2014 study found that discrimination and stigma were key barriers to engagement in care [58]. It is possible that many PLWH who experience higher levels of stigma and discrimination are less likely to be engaged in care, and thus may have not have been included in our sample.

Our study had several strengths including the in-depth medical record abstraction and interview data which allowed us to examine a variety of sociodemographic as well as clinical characteristics associated with ART Adherence. With its three-stage sampling design, MMP is a representative sample of PLWH in care, which allows us to draw population-level conclusions among MSM living with HIV in Texas. We had full records of viral loads for all our participants which allowed us to accurately estimate the SVS. Some key limitations of our analysis include: the limited time frame of our ART adherence

outcome (three days). This limits the interpretability of our associations to longer-term ART adherence. Additionally, the ART adherence outcome is self-reported and as such is subject to social desirability and recall bias. Although we've accounted for a whole host of potential risk factors for ART adherence, residual confounding is always a possibility with an observational study. The cross-sectional nature of our analysis also restricts our ability to draw causality between the risk factors considered and both SVS and ART adherence outcomes.

Conclusion

With HIV disproportionately affecting MSM and PLWH in Texas, our study fills gaps in knowledge on sociodemographic factors that affect ART adherence and SVS. We found that age, race/ethnicity, homelessness, and unmet needs for housing/food/income are major predictors of 100% ART adherence and SVS. Furthermore, 100% ART adherence is a significant predictor of SVS among MSM living with HIV in care in Texas. Our findings support the importance of addressing housing-related unmet needs to improve adherence and attaining SVS for MSM living with HIV in care. Addressing these sociodemographic, behavioral, and HIV-related characteristics is critical to meeting goals set to end the epidemic in Texas.

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Disclaimer

The findings and conclusions of this article are solely the responsibility of the authors and do not necessarily represent the official position of the U.S. Centers for Disease Control and Prevention or Texas Department of State Health Services or Houston Health Department.

Authors' Contributions

All authors made substantial contributions to the conception and design, data analysis and interpretation, preparation, critical review and revision of the manuscript; granted the permission to submit the article to the Journal of Behavioral Health, and agreed to be accountable for all aspects of the work.

Competing Interests

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Supplemental Table 1: Makeup of each unmet need composite scores.

Services needed but not received within the past 12 months:
Food, housing, and income
Shelter or housing services?
Meal or food services?
Public benefits including Supplemental Security Income (SSI) or Social Security Disability Insurance (SSDI)?
Health and medical
Dental care?
Mental health services?
Drug or alcohol counseling or treatment?
Eye or vision services?
Home health services?
Nutritional services?
HIV services
HIV case management services?
Counseling about how to prevent the spread of HIV?
Medicine through the AIDS Drug Assistance Program (ADAP)?
Professional help remembering to take your HIV medicines on time or correctly?
HIV peer group support?
Barriers
Domestic violence services?
Transportation assistance?
Childcare services?
Interpreter services?
A lawyer or legal services?