



Are We Still Having Sex? Results of Round Two of the *Love and Sex in the Time of COVID* Survey with Gay, Bisexual and Other Men Who Have Sex with Men

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Abstract

This paper presents data from the *Love and Sex in the Time of COVID* survey, an online survey with US gay, bisexual and other men who have sex with men. The first round of the *Love and Sex in the Time of COVID-19* survey was conducted online from April to May, 2020; the second round was collected November 2020 to January 2021. GBMSM were recruited through advertisements featured on social networking platforms. Analysis examines changes in self-reported measures of sexual behavior (number of sex partners, number of anal sex partners and number of anal sex partners not protected by pre-exposure prophylaxis (PrEP) or condoms) between those with complete data for round one and round two of the surveys ($n = 280$). While in round one, men reported a moderate willingness to have sex during COVID-19 (3.5 on a scale from 1 to 5), this had reduced significantly to 2.1 by round two. Men reported declines in the number of unprotected anal sex partners since pre-COVID. Perceptions of a longer time until the end of the COVID-19 pandemic were associated with increases in the number of sex partners and UAI partners. The results illustrate some significant declines in sexual behavior among GBMSM as the COVID-19 pandemic progressed. As vaccine programs continue to roll out across the U.S., as lockdowns ease and as we return to some normalcy, it will be important to continue to think critically about ways to re-engage men in HIV prevention.

Keywords COVID-19 · Sexual behavior · MSM · HIV prevention

Introduction

Since the start of the COVID-19 pandemic and the resultant social distancing orders, there has been significant scientific attention paid to how stay at home orders may shape sexual behavior [1–6]. Stay at home orders may create more opportunities for sex with partners at home, but may also limit the opportunities for sexual partners outside of the home. Several studies have focused on gay, bisexual and other men who have sex with men (GBMSM), primarily due to being the group most severely affected by HIV in the U.S., accounting for two-thirds of all new HIV infections each

year [7–9]. While some of these studies have focused on the impact of essential HIV prevention and care services closing due to the COVID-19 pandemic as a risk factor for increasing HIV transmissions among GBMSM [3, 10–12], others have examined shifts in sexual behavior and risk experienced by GBMSM during quarantine [1–6].

In a sample of 728 GBMSM, McKay et al. found that GBMSM were making changes to their sexual behavior and partner selection, with significant declines in the number of sexual partners relative to pre-pandemic times [1]. GBMSM in this sample also reported making changes to the kinds of sexual partners they chose and the types of sex they were having—for example, transitioning to virtual sex—as a means for reducing their risk of COVID-19 infection. Other studies have also found that GBMSM were reducing their number of sexual partners during the pandemic. In a survey of 10,079 GBMSM recruited through the Hornet app, Holloway et al. showed that men who reported practicing social distancing were more likely to report increased feelings of anxiety and loneliness, and to report that the pandemic had significantly

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impacted their sex life [4]. Similarly, GBMSM participants in an ongoing cohort study in Australia (n=940) surveyed during April 2020 reported a 82.4% reduction in casual sex partners relative to pre-pandemic times [13]. Reductions in the number of sexual partners among GBMSM have also been reported in samples of Latino GBMSM in Miami [14, 15], Hong Kong [16], and Brazil [6].

Several other studies have demonstrated that sexual behavior has either remained stable or increased for GBMSM during the pandemic. Sanchez et al. surveyed 1051 U.S GBMSM during April, 2020, and found that approximately half (48%) reported no change in their number of sex partners [2]. The use of apps and websites to find sex partners remained high, with 49% reporting no change in the use of these sites [2]. Starks et al. compared data from 455 adult respondents (surveyed May 2020) and a matched sample selected from 65,707 respondents surveyed pre-COVID, showing that the number of casual partners per month was stable, although the proportion reporting condomless anal sex with casual partners declined significantly during the pandemic [5].

In 2020 we launched the *Love and Sex in the Time of COVID-19* study, an online survey of U.S GBMSM [17], to examine shifts in sexual behavior during the pandemic. In late 2020, we launched round two of the *Love and Sex in the Time of COVID-19* study, re-surveying the original participants. While previous studies have identified changes in sexual behavior among GBMSM using cross-sectional surveys [1, 4, 16], in this paper, we compare two rounds of data collection (April–May 2020 and November 2020 to January 2021) to explore whether there have been changes in sexual behavior as the COVID-19 pandemic progressed. Round two of the survey added questions measuring attitudes towards COVID-19 vaccines. It is possible that the advent of COVID-19 vaccines may shape men's willingness to re-engage in sexual activity. In this analysis we contrast attitudes towards sexual behavior and self-reported sexual behavior between rounds one and two of the survey, to understand not only if there were changes over a 6 month period during the pandemic, but to understand whether shifts in sexual behavior were associated with participant's willingness to take COVID-19 vaccines. A nuanced understanding of how the COVID-19 pandemic is not only shaping sexual behavior for GBMSM, but may be changing as vaccines become available, has the potential to inform the content and targeting of both HIV prevention interventions and vaccine promotion campaigns for U.S GBMSM.

Methods

The *Love and Sex in the Time of COVID-19* survey was first conducted online from April to May 2020: a second round of the survey with the same participants was conducted from

November, 2020 to January 2021. Details on the recruitment methods for the *Love and Sex in the Time of COVID-19* survey have been previously described [17]. Eligibility criteria included being over the age of 18, current residents of the U.S. and its dependent areas, assigned male sex at birth and currently identify as male, and reporting any type of sex with a cis-gender male in the past 12 months. For the first round of the survey, over a six week period during April to May 2020, we recruited a final sample size of 696 GBMSM. The consent form for the original survey described the potential for a second round of surveying in 6 months' time, and 100% of round one participants consented to be recontacted. Participants provided an email address at the end of the survey, as a means of re-contact for future rounds of the survey. Participants were not paid incentives. Ethical approval for this study was obtained from the University of Michigan Institutional Review Board.

The second round of data collection took place from November, 2020 to January 2021, over a period of approximately 8 weeks. The survey completion window was extended to account for anticipated slower rates of survey completion over the holiday season. All participants who completed round one of the survey were emailed a link to round two of the survey, along with a message explaining that the purpose of the survey was to follow-up on their experiences of love and sex during the ongoing COVID-19 pandemic. Reminders to complete the survey were sent out every 2 weeks.

Both surveys collected data on participant demographics: age, race and ethnicity, employment status, educational attainment, sexual orientation, gender identity, relationship status and recent experience of indicators of structural vulnerability (incarceration and homelessness). Both surveys assessed participant's experience of COVID-19, including: loss or reduction in employment, housing instability, and food insecurity. Participants reported their recent use of non-prescription drugs and alcohol using the ASSIST [18] and AUDIT [19] measures and were asked whether they felt their substance use or binge drinking (episodes of more than 5 alcoholic drinks) had increased during the COVID-19 lockdown.

To assess changes in sexual behavior, participants in the first survey were asked to report their sexual behavior for two periods: the 3 months prior to the COVID-19 epidemic and for the previous 3 months. In the second survey, participants were asked to report their sexual behavior for the prior 3 months (approximately August 2020–October 2020). For both periods, participants reported the number of sexual partners (including primary and casual partners), the number of episodes of anal sex, the number of condomless anal sex acts and participation in transactional sex. To address perceptions of changes in sexual behavior, participants were asked about their willingness to engage in sexual activity:

Compared to the 3 months before the COVID-19 outbreak, how has the COVID-19 pandemic affected your willingness to have sex? and Compared to the 3 months before the COVID-19 outbreak, how has the COVID-19 pandemic affected your willingness to have different types of sex? (kissing, oral sex, anal sex (top), anal sex (bottom) and rimming). The survey assessed whether participants felt it was possible to get COVID-19 through sex, and through each of these sex acts: kissing, oral sex, anal sex (top), anal sex (bottom) and rimming. Participants were asked how likely they thought they were to contract COVID-19 through sex and through each of the 5 sex acts (kissing, oral sex, anal sex (top), anal sex (bottom) and rimming).

For HIV prevention behaviors, participants were asked whether the COVID-19 epidemic had prevented access to HIV/STI testing and, for those on PrEP, access to prescriptions for PrEP. Participants were asked how likely they were to be tested for HIV/STIs during the pandemic. Participants were asked how important they felt it was to reduce their number of sexual partners during the COVID-19 epidemic: *How important do you think it is to reduce your number of sex partners during the COVID-19 pandemic?*

Participants were asked to report their experience of testing (and test results) for COVID-19, and participation in social distancing practices. To assess perceptions of the prevalence of COVID-19, the survey included: *Thinking of the U.S. as a whole, what percentage of the population has tested positive for COVID-19?* and participants recorded their response on a sliding scale from 0 to 100. This question was repeated for the perceived prevalence of COVID-19 in the participant's state, local county, among their friends, and their sex partners.

Round two of the survey also included questions on the perception of the duration of the COVID-19 pandemic, and their willingness to take a vaccine. Participants were asked, *“Do you think there will be an end to the COVID-19 pandemic?”*, and those responding yes were asked, *“When do you think the COVID-19 pandemic will end?”* with options: in the next 6 months, 6–12 months, 1–3 years, 3–5 years, and more than 5 years. All participants were asked: *“How likely are you to take a vaccine for COVID-19 if it were available?”* (very likely, somewhat likely, somewhat unlikely and very unlikely).

The analysis consisted of three phases. In *phase one* we compare the demographic and behavioral characteristics of those with complete data for round one and round two ($n=280$) (Table 1). In the *second phase* of analysis, we compare the sexual behaviors and HIV engagement behaviors for men with complete data for both survey rounds ($n=280$) (Tables 2 and 3). In phases one and two, appropriate statistical tests were used for the comparisons of the demographic and sexual behavior data between the two surveys (i.e. chi-square tests, Fisher's exact test (when cell sizes were small)

and t-tests). Of the 348 participants who completed the second survey, 68 participants had missing data: 14 participants had missing data for demographic or behavioral variables in both round one and round two of the survey. Fifty four participants had incomplete survey responses in round two for measures of sexual behavior, substance use and perceived prevalence of COVID-19. There were no differences in demographic (i.e. age, race, education or employment) and behavioral (i.e. substance and alcohol use) between those with and without missing data for these variables. As an additional quality check, we compared responses to questions that we would not expect to change between the two surveys for those who answered both surveys (i.e. race) and found no differences.

In phase three, we fit multivariable models for three continuous outcomes: (a) the difference in the number of self-reported sex partners between the 3 months prior to COVID-19 lockdown (round one) and the 3 months prior to survey two, (b) the difference in the number of self-reported anal sex partners between the 3 months prior to COVID-19 lockdown and the 3 months prior to round two, and (c) the difference in the number of unprotected anal sex partners (unprotected by either condom or PrEP) between the 3 months prior to COVID-19 lockdown and the 3 months prior to round two. For example, if a participant reported having 3 sex partners in the 3 months prior to COVID-19 lockdown in survey one, and then in survey two reported 4 sex partners in the last 3 months, then they had an increase in sex partners ($4 - 3 = 1$) in survey two relative to the pre-COVID behavior reported in survey one.

Models include demographic characteristics (age, education, employment, race and relationship), vulnerabilities experienced during the COVID-19 epidemic (increases in substance use or alcohol consumption, increases in food insecurity or homelessness), and perceptions of the timing of the end of the COVID-19 pandemic, and likelihood of taking the vaccine using data from round two of the survey. The selection of variables for the multivariate models was driven by factors that were significantly associated with sexual behavior in analysis of the first round of survey data. The models fit in phase 3 were restricted to those reporting being HIV-negative at round two ($n=279$): the one participant who reported sero-converting between the surveys was removed from the analysis.

Results

Of the 696 GBMSM who completed round one of the survey, 695 (99.9%) had consented to be recontacted and were emailed survey links (one email bounced back). Of these, 348 (50.1%) completed round two of the survey. While this follow-up rate was lower than expected the demographic

Table 1 Demographic and behavioral characteristics of an online sample of gay, bisexual and other men who have sex with men (GBMSM) (Survey One n = 280, Survey Two n = 280)

Characteristic	Survey One: April–May 2020 (n = 280)	Survey Two: November 2020– January 2021 (n = 280)	Difference between Survey One & Two
	% (N)	% (N)	p-Value
Age			
18–24	17.5 (49)	14.3 (40)	0.845
25–34	48.6 (137)	46.4 (130)	
35–44	25.2 (71)	27.9 (78)	
> 45	8.7 (23)	11.4 (32)	
Education			
High school	25.4 (71)	20 (56)	0.451
Some college	39.8 (111)	44.6 (125)	
College graduate or graduate school	34.8 (98)	35.4 (99)	
Employed			
Yes	81.2 (227)	85.7 (240)	0.045
No	18.8 (53)	14.3 (40)	
Race			
Black/African American	4.8 (13)	3.9 (11)	0.084
White	76.2 (214)	81.1 (227)	
Other	19.0 (53)	15.0 (42)	
Sexual identity			
Gay/homosexual	82.9 (232)	85.4 (239)	0.175
Bisexual	12.4 (35)	10 (28)	
Other	4.7 (13)	4.6 (13)	
HIV sero-status			
HIV-negative/unknown	92.2 (258)	91.8 (257)	
HIV-positive	7.8 (22)	8.2 (23)	
Relationship status			
Single	47.6 (133)	46.8 (131)	
Has partner (i.e. boyfriend)	36.5 (102)	38.5 (108)	
Married to male partner	15.9 (45)	14.6 (41)	
Changes in substance use during lockdown			
Increased	22.1 (62)	21.4 (60)	0.076
Decreased	30.9 (87)	28.9 (80)	
Stayed the same	47.0 (131)	49.7 (140)	
Changes in binge drinking during lockdown			
Increased	28.7 (80)	33.6 (94)	0.056
Decreased	37.2 (104)	38.2 (107)	
Stayed the same	34.1 (96)	28.2 (79)	
Have skipped meals due to COVID-19			
Yes	10.6 (30)	8.2 (23)	0.089
No	89.4 (250)	91.8 (257)	
Have experienced homelessness during COVID-19			
Yes	4.3 (12)	3.2 (9)	0.148
No	95.7 (268)	96.8 (271)	
Has participated in transactional sex during COVID-19			
Yes	1.3 (4)	1.1 (3)	0.264
No	98.7 (276)	98.9 (277)	
Region of the US			
North	15.6 (44)	15.8 (44)	0.458

Table 1 (continued)

Characteristic	Survey One: April–May 2020 (n = 280)	Survey Two: November 2020– January 2021 (n = 280)	Difference between Survey One & Two
	% (N)	% (N)	p-Value
East	29.5 (83)	31.5 (88)	
South	24.2 (68)	24.6 (69)	
West	30.7 (85)	28.1 (79)	

**p-values are a paired t-test comparison between those with complete data at survey rounds one and two (n = 280)

Table 2 Sexual behaviors and perceptions of COVID-19 related sexual risks among an online sample of gay, bisexual and other men who have sex with men for those with complete data for Survey One and Survey Two (n = 280)

	Survey One: April–May 2020	Survey Two: Novem- ber 2020 – January 2021	p-Value**
	% (N) or Mean (range)	% (N) or Mean (range)	
Possible to contract COVID-19 through sex	66.9 (187)	70.7 (198)	0.372
Possible to contract COVID-19 through			
Kissing	94.8 (265)	95.7 (268)	0.218
Oral sex	59.1 (166)	53.2 (149)	
Insertive anal sex	41.7 (117)	36.8 (103)	
Receptive anal sex	45.2 (127)	39.6 (111)	
Oral-rectal sex (rimming)	57.3 (161)	55.0 (154)	
How important is it to reduce your number of sex partners during COVID-19	1.8 (1–5)	1.9 (1–5)	0.193
Have you reduced your number of sex partners during	2.1 (1–5)	2.1 (1–5)	0.898
Compared to pre-COVID-19, how willing are you to have sex during COVID-19	3.5 (1–6)	2.1 (1–5)	<i>0.043</i>
Compared to pre-COVID-19, how willing are you to [act] during COVID-19			
Kissing	2.6 (1–6)	2.2 (1–6)	0.326
Oral sex	2.4 (1–6)	2.4 (1–6)	
Insertive anal sex	2.9 (1–6)	2.8 (1–6)	
Receptive anal sex	2.9 (1–6)	2.8 (1–6)	
Oral-rectal sex (rimming)	2.9 (1–6)	2.8 (1–6)	
How likely do you think you are to get COVID-19 through sex	3.3 (1–6)	3.3 (1–6)	0.097
How likely do you think you are to get COVID-19 through			
Kissing	3.9 (1–6)	4.0 (1–6)	0.417
Oral sex	3.1 (1–6)	3.1 (1–6)	
Insertive anal sex	3.0 (1–6)	2.9 (1–6)	
Receptive anal sex	3.1 (1–6)	3.2 (1–6)	
oral-rectal sex (rimming)	3.7 (1–6)	3.4 (1–6)	
Difference in number of sex partners reported in 3 months prior to COVID-19 and during COVID-19	2.3 (– 19–38)	1.7 (– 7–36)	0.056
Difference in number of anal sex partners reported in 3 months prior to COVID-19 and during COVID-19	2.1 (– 40–70)	0.15 (– 97–88)	<i>0.031</i>
Difference in number of unprotected anal sex partners reported in 3 months prior to COVID-19 and during COVID-19	0.15 (– 5–14)	– 0.15 (– 30–15)	<i>0.021</i>

Figures in italics are significant at the 5% level

**p-values are a paired t-test comparison between those with complete data at survey rounds one and two (n = 280)

Table 3 Engagement in HIV prevention, COVID-19 testing and perceptions of COVID-19 among an online sample of gay, bisexual and other men who have sex with men with complete data for Survey One and Survey Two (n=280)

	Survey One: April–May 2020	Survey Two: November 2020–January 2021	p-Value
	% (N) or mean (range)	% (N) or mean (range)	
Received test for COVID-19 in past 3 months	7.9 (22)	13.6 (38)	<i>0.043</i>
Received a HIV test			
Past 6 months	37.8 (106)	43.6 (122)	0.056
6–12 months	34.0 (95)	22.5 (63)	
1–3 years	14.0 (39)	15.7 (44)	
> 3 years	8.2 (23)	12.1 (34)	
Never	6.0 (17)	6.1 (17)	
COVID-19 prevented you from testing for HIV	32.2 (90)	18.9 (53)	
Likelihood of receiving an HIV test during COVID-19	3.5 (1–5)	2.6 (1–5)	<i>0.035</i>
COVID-19 prevented you from testing for STIs	29.3 (82)	17.9 (50)	0.075
Likelihood of receiving an STI test during COVID-19	3.5 (1–5)	3.5 (1–5)	<i>0.032</i>
Has taken PrEP in the past 3 months	27.3 (76)	24.6 (69)	0.543
Currently taking PrEP	18.0 (51)	21.8 (61)	0.178
COVID-19 has prevented access to PrEP prescription	8.9 (27)	2.5 (7)	0.097
Perceived prevalence of COVID-19 among US population	13.9 (0–100)	17.9 (1–91)	0.356
Perceived prevalence of COVID-19 among state population	12.9 (0–94)	18.4 (1–90)	0.082
Perceived prevalence of COVID-19 among county population	11.6 (0–100)	17.4 (0–93)	<i>0.035</i>
Perceived prevalence of COVID-19 among friends	4.7 (0–100)	10.1 (0–80)	<i>0.041</i>
Perceived prevalence of COVID-19 among sex partners	3.3 (0–100)	6.3 (0–100)	<i>0.028</i>
When will the COVID-19 pandemic end			
Within the next 6 months	–	5.0 (14)	<i>0.023</i>
Within the next 6 months to 1 year	–	42.5 (119)	
In 1 to 3 years	–	38.2 (107)	
In 3 to 5 years	–	0.4 (1)	
How likely are you to take the COVID-19 vaccine		13.9 (39)	
Very likely	–	75.7 (212)	
Somewhat likely	–	19.3 (54)	
Somewhat unlikely	–	3.2 (9)	
Very unlikely	–	1.8 (5)	

Figures in italics are significant at the 5% level

**p-values are a paired t-test comparison between those with complete data at survey rounds one and two (n=280)

and behavioral profiles of participants with complete data for rounds one and two of the survey were similar (Table 1).

As in the first round of data collection, a large proportion of the sample in round two was aged between 25 and 44 (46.4%), were White (81.1%), gay identifying (85.4%) and reported some college education (44.6%). The majority self-reported being HIV-negative (91.8%), and 46.4% reported being single, although 14.6% reported being married to a male partner. A very small percentage of participants (1.1%) reported participating in transactional sex, and 8.2% reported that they had to skip meals more frequently during the period of lockdown, and 3.2% reported experiencing homelessness during the lockdown period. Participants

from the Northern region of the US represented the smallest percentage of participants.

There were small, but not significant, increases in the percentage of participants reporting that their binge drinking had increased: in round two of the survey, 33.6% reported their binge drinking had increased (compared to 28.7% in round one), 38.2% reported it has decreased and 28.2% reported it had stated the same. The percentage of participants reporting that their substance use had increased was similar in both survey rounds (round one 22.1%, round two 21.4%).

Just over 70% of the sample reported that they believed it was possible to contract COVID-19 through sex, a small, insignificant increase from round one (66.9%) (Table 2).

Patterns of belief in the possibility of contracting COVID-19 by sex act were similar between rounds one and two. While 95.7% of round two participants believed it was possible to contract COVID-19 through kissing, lower percentages of men believed it was possible to contract COVID-19 through anal sex (receptive anal sex 39.6%: insertive anal sex 36.8%). There were no significant changes in beliefs in the importance of reducing the number of sex partners (1.8 round one, 1.9 round two—on a scale of 1–5 (1 equals not at all important, 5 equals very important)), and, participants in both rounds one and two reported an average of 2.1 on a scale of 1–5 on whether they have reduced their number of sex partners during COVID-19 (1 being totally changing my sexual behavior to 5 being not changing my sexual behavior). However, in round one, men reported a moderate willingness to have sex during COVID-19 (3.5 on a scale from 1 to 5), but this had reduced significantly to 2.1 by round two (p-value 0.043). Men reported a moderate likelihood that they would contract COVID-19 via sex (3.3 on a scale 1–6), with kissing (4.0) and oral-rectal sex (3.4) rated as the most likely sex acts from which they would contract COVID-19, with no changes in these beliefs between rounds one and two.

In round one, participants reported a mean increase of 2.3 sex partners between the 3 months prior to COVID-19 (November 2019–January 2020) and April–May 2020: however, by round two, participants reported an increase of only 1.7 sex partners for the period August–October 2020 relative to the time before COVID-19 (p-value 0.056). While the change in the number of sex partners relative to the time before COVID-19 was not significant, by round two participants did report significant shifts in the number of anal sex and unprotected anal sex (UAI) partners. In the first survey, participants reported an increase in the number of anal sex partners of 2.1 relative to the 3 months pre-COVID-19. However, by round two, the difference in anal sex partners between November 2019–January 2020 (pre-COVID-19) and August–October 2020 had dropped to an increase of only 0.15 (p-value 0.031). There was a significant decline in the number of UAI partners of -0.15 (down from 0.15 in round one: p-value 0.021) between November 2019–January 2020 (pre-COVID-19) and August–October 2020.

Approximately 14% of the sample reported receiving a COVID-19 test in the past 3 months, up from 7.9% in round one (p-value 0.043) (Table 3). There was an insignificant increase in the percentage of participants who had received a HIV test in the past 6 months (round one 37.6%, round two 43.6%). There was a significant decrease in the percentage of participants who reported that COVID-19 had prevented them from getting an HIV test (round two 18.9%, round one 37.2%: p-value 0.035) and an STI test (round two 17.9%, round one 29.3%: p-value 0.032). However, there were no

changes in the reported likelihood of getting an HIV test (round one 3.5, round two 2.6) and an STI test (round one 3.5, round two 3.5).

Participants reported significant shifts in the perceived prevalence of COVID-19 between rounds one and two. While there were no significant changes in the perceptions of COVID-19 prevalence in the U.S population, participants reported higher perceived prevalence in round two relative to round one for their state population (p-value 0.035), county population (p-value 0.041), their friends (p-value 0.026) and their sex partners (p-value 0.023). The majority of participants felt there would be an end to the COVID-19 pandemic: while only 5.0% felt it would end in the next 6 months, 42.5% reported it would end in 6–12 months. However, 13.9% reported that they felt the pandemic would never end. Three-quarters of participants (75.7%) reported that they were very likely to take the COVID-10 vaccine, with only 3.2% reporting being somewhat unlikely and 1.8% very unlikely.

Table 4 shows the results of the regression modeling of self-reported changes in sexual behavior. Men with higher levels of education reported a decline in sex partners (some college beta -2.868 , standard error (SE) 1.250, p value 0.017: college graduate/graduate school beta -1.054 , standard error (SE) 0.059, p value 0.013), and men who reported their sexual identity as bisexual or other had significantly greater increases in numbers of sex partners (beta 4.749, SE 1.296, p value 0.003), anal sex partners (beta 0.483, SE 0.089, p value 0.023) and UAI partners (beta 2.478, SE 0.680, p value 0.032). Men who self-reported living with HIV were significantly less likely to report increases in the number of sex partners (beta -0.288 , SE 0.053, p value 0.000) and anal sex partners (beta -3.299 , SE 1.233, p value 0.001).

Men who reported that their substance use had increased during lockdown were significantly more likely to report increases in number of sex partners (beta 1.234, SE 0.786, p value 0.023), anal sex partners (beta 5.697, SE 2.706, p value 0.029) and unprotected sex partners (beta 0.294, SE 0.038, p value 0.011), but there was no significant associations with reporting decreases in substance use. Increases in binge drinking were associated with increases in the number of sex partners (beta 1.527, SE 0.691, p value 0.037) and anal sex partners (beta 0.874, SE 0.124, p value 0.034). Participants who reported experiencing homelessness during COVID-19 were less likely to report increases in number of sex partners (beta -0.908 , SE 0.321, p value 0.021) and number of unprotected anal sex partners (beta -0.470 , SE 0.080, p value 0.039) and men who reported experiencing food insecurity during COVID-19 were less likely to report increases in their number of sex partners (beta -1.775 , SE 0.145, p value 0.037).

Table 4 Regression models for self-reported changes in number of sexual partner, number of anal sex partner and number of unprotected anal sex partners in an online sample of gay, bisexual and other men who have sex with men (GBMSM) (n=279)

Characteristic	Change in number of sex partners	Change in number of anal sex partners	Change in number of unprotected anal sex partners
	Beta (SE) p-value	Beta (SE) p-value	Beta (SE) p-value
Age (18–24)			
25–34	0.115 (0.844) 0.415	– 0.214 (2.637) 0.124	– 0.259 (0.450) 0.214
35–44	0.752 (0.941) 0.247	– 2.231 (2.993) 0.487	– 0.232 (0.500) 0.414
> 45	1.720 (1.119) 0.092	– 2.401 (2.350) 0.484	– 0.444 (0.509) 0.745
Education (high school)			
Some college	0.735 (0.750) 0.127	– 2.868 (1.250) 0.017	– 0.018 (0.401) 0.274
College graduate or graduate school	0.295 (0.834) 0.414	– 1.054 (0.059) 0.013	– 0.277 (0.441) 0.278
Employed (Yes)			
No	0.038 (0.798) 0.089	– 0.049 (2.451) 0.179	0.209 (0.418) 0.332
Race (Black/African American)			
White	– 0.791 (1.393) 0.217	1.561 (2.831) 0.358	0.290 (0.731) 0.278
Other	– 0.793 (1.524) 0.398	– 0.321 (2.864) 0.298	0.291 (0.799) 0.541
Sexual identity (Gay/homosexual)			
Bisexual/other	<i>4.749 (1.296) 0.003</i>	<i>0.483 (0.089) 0.023</i>	<i>2.478 (0.680) 0.032</i>
HIV sero-status (HIV-negative)			
HIV-positive	– 0.288 (0.053) 0.000	– 3.299 (1.233) 0.001	– 0.137 (0.552) 0.412
Relationship status (single)			
Has partner (i.e. boyfriend)	0.533 (0.606) 0.841	– 2.086 (1.862) 0.478	0.158 (0.318) 0.452
Married to male partner	0.133 (0.846) 0.651	0.949 (2.600) 0.845	0.019 (0.441) 0.521
Change in substance use during lockdown (stayed the same)			
Increased	<i>1.234 (0.186) 0.023</i>	<i>5.697 (2.706) 0.029</i>	<i>0.294 (0.038) 0.011</i>
Decreased	– 0.956 (0.733) 0.078	– 1.645 (2.555) 0.298	– 0.287 (0.362) 0.089
Change in binge drinking during lockdown (stayed the same)			
Increased	<i>1.527 (0.691) 0.037</i>	<i>0.874 (0.124) 0.034</i>	0.227 (0.362) 0.125
Decreased	0.484 (0.735) 0.495	0.793 (2.261) 0.546	0.284 (0.386) 0.099
Have skipped meals due to COVID-19 (no)			
Yes	– 1.775 (0.145) 0.037	– 1.695 (3.212) 0.641	0.188 (0.584) 0.278
Have experienced homelessness during COVID-19 (no)			
Yes	– 0.908 (0.321) 0.021	0.662 (1.435) 0.453	– 0.470 (0.080) 0.039
Perceived prevalence of COVID-19 among US population	0.054 (0.032) 0.189	0.145 (0.098) 0.741	– 0.038 (0.016) 0.017
Perceived prevalence of COVID-19 among state population	– 0.055 (0.037) 0.517	– 0.233 (0.111) 0.019	– 0.050 (0.012) 0.047
Perceived prevalence of COVID-19 among county population	– 0.062 (0.030) 0.024	0.069 (0.095) 0.821	0.020 (0.016) 0.451
Perceived prevalence of COVID-19 among friends	– 0.050 (0.023) 0.021	– 0.606 (0.070) 0.027	0.012 (0.011) 0.458
Perceived prevalence of COVID-19 among sex partners	– 0.044 (0.019) 0.002	– 0.189 (0.075) 0.033	– 0.050 (0.011) 0.022
When will the COVID-19 pandemic end			
Within the next 6 months	1.355 (1.388) 0.078	3.536 (4.120) 0.147	<i>1.515 (0.703) 0.014</i>
Within the next 6 months to 1 year	<i>0.129 (0.056) 0.048</i>	1.558 (4.226) 0.184	<i>1.962 (0.782) 0.005</i>
In 1 to 5 years	<i>0.413 (0.061) 0.017</i>	2.667 (4.804) 0.217	<i>2.412 (0.820) 0.034</i>
How likely are you to take the COVID-19 vaccine (Very likely)			
Somewhat likely	0.964 (0.760) 0.217	4.034 (2.335) 0.741	0.504 (0.398) 0.351
Somewhat unlikely/very unlikely	<i>1.219 (0.315) 0.035</i>	<i>0.470 (0.075) 0.032</i>	<i>0.397 (0.069) 0.021</i>

Figures in italics are significant at the 5% level

Men who reported perceptions of higher prevalence of COVID-19 among the U.S population had significant decreases in their number of UAI partners (beta -0.038 , SE 0.016 , p value 0.039), which men reporting higher prevalence of COVID-19 at the state level had significant decreases in the anal sex (beta -0.233 , SE 0.111 , p value 0.019) and UAI partners (beta -0.050 , SE 0.012 , p value 0.047). Higher perceived prevalence of COVID-19 at the county level was associated with significant declines in the number of sex partners (beta -0.062 , SE 0.030 , p value 0.024). Men who reported a higher prevalence of COVID-19 among their friends reported significant declines their number of sex partners (beta -0.050 , SE 0.023 , p value 0.021) and anal sex partners (beta -0.606 , SE 0.070 , p value 0.027). Additionally, men who perceived the prevalence of COVID-19 to be higher in their sex partners were less likely to report increases in their number of sex partners (beta -0.044 , SE 0.019 , p value 0.002), anal sex partners (beta -0.189 , SE 0.075 , p value 0.033) and UAI partners (beta -0.050 , SE 0.011 , p value 0.022).

Perceptions of a longer time until the end of the COVID-19 pandemic, or the belief that the pandemic will never end, were associated with increases in the number of sex partners (1–5 years beta 0.129 , SE 0.056 , p value 0.048 ; never beta 0.413 , SE 0.061 , p value 0.017) and UAI partners (6 months–1 year beta 1.515 , SE 0.703 , p value 0.014 ; 1–5 years beta 1.962 , SE 0.782 , p value 0.005 ; never beta 2.412 , SE 0.820 , p value 0.034). Men who reported being somewhat or very unlikely to take the COVID-19 vaccine reported increases in their sex partners (beta 1.219 , SE 0.315 , p value 0.035), anal sex partners (beta 0.470 , SE 0.075 , p value 0.032) and UAI partners (beta 0.397 , SE 0.069 , p value 0.021).

Discussion

The results illustrate a number of important behavioral changes reported by GBMSM between two rounds of surveys that both took place during the COVID-19 pandemic. Across both surveys significant numbers of participants reported experiencing increases in indicators of structural vulnerability, including loss of employment, food insecurity and difficulties with housing due to COVID-19. While a significant proportion of participants reported that their alcohol or substance use had declined, there was a smaller, but still significant, proportion of GBMSM who reported increases in binge drinking and substance use in both survey rounds. This is in contrast to Starks et al. who reported that marijuana use and illicit substance use declined significantly during COVID-19 among sexual minority men [5]. These increases in substance and alcohol use detected in our surveys may be driven by the COVID-19 related stressors,

manifesting as negative coping behaviors. Given the known associations between substance and sexual risk taking [20–22], there is a clear need for programmatic interventions that can provide men with the coping skills and access to services to manage their substance use and sexual risks, and with closures of many services, these likely need to be provided through telehealth platforms.

Many of the beliefs around COVID-19 and sexual behavior remained constant across the two surveys, for example GBMSM continued to rate anal sex as the least risky act for contracting COVID-19. While there was no change in reported importance of the need to reduce the number of sexual partners during COVID-19, there were several significant changes in behavior. The first survey took place in April–May, 2020, only two months into the U.S pandemic: round two took place 9–11 months into the pandemic, by which time the number of COVID-19 cases had risen dramatically in the U.S and more states had initiated lockdowns. By round two of the survey, people had had more time to live in the context of the pandemic, to absorb the seriousness of the pandemic, and perhaps may have had more opportunities to be personally affected by the pandemic. This is reflected in the significant increases in the perceived prevalence of COVID-19 at all levels measured (U.S, state, county, friends and sex partners) between the two surveys. The results indicate that time spent in the pandemic, and perhaps greater exposure to the seriousness of the pandemic, has initiated reductions in sexual risk taking among GBMSM.

A greater percentage of participants in round two reported receiving a COVID-19 test, reflecting the greater availability of testing by round two, but also that by round two there had been more time to be tested. More than three-quarters of the sample reported they would be very likely to take a COVID-19 vaccine, reflecting high levels of willingness recorded in the general U.S. population [23]. Interestingly, there were significant reductions in the percentage of participants who felt that COVID-19 had prevented them from receiving STI or HIV tests, although the reported likelihood of testing for either did not change. These changes may reflect the re-opening of services in some locations, or may also reflect the greater availability of testing options as services began to transition to telehealth modalities [24].

Many of the factors associated with changes in sexual behavior were similar to those shown in analysis of the round one data [17]. It is possible that lockdown situations gave men more time to participate in both sexual activity and substance use, and that sex and substance use became distractions from disrupted routines or the stress of living in a pandemic. As in round one, men reported perceptions that rates of COVID-19 were higher at the US national and state levels than among their friends or sex partners, suggesting a sense of othering—that COVID-19 exists elsewhere and happens to other people. Men in round two also reported

higher perceived prevalence of COVID-19, again a reflection of the timing of the survey longer into the pandemic. However, participants who reported higher perceived prevalence of COVID-19 at any level had significant reductions in their sexual risk taking. It is possible that men are making decisions on sexual behavior based on their perceptions of the risk of contracting COVID-19, and men who perceive COVID-19 to be more prevalent, may therefore be less willing to have sex due to a perceived higher risk of infection. However, a significant proportion of GBMSM did not believe it was possible to contract COVID-19 through sex, and anal sex was consistently ranked as the lowest risk for COVID-19, illustrating the need to continue to educate GBMSM on the risks of COVID-19 from close physical contact that includes sex.

Round two added questions on perceptions of when the pandemic would end and vaccine willingness. Men who thought the end of the pandemic was further away or would never occur, were consistently more likely to have more sex partners, more anal sex partners and more UAI. Men who said they were unlikely to take the vaccine were also having more sex. These results point to the presence of some GBMSM who are perhaps fatalistic about the ending the pandemic, and are continuing their sexual behavior under the belief that the pandemic may not end. Rather than reduce their sexual behavior to avoid COVID-19 infection, these men continue to engage in sexual behavior, and, in particular, high-risk sexual behavior. The survey did not collect information on beliefs around the accuracy of the pandemic, so it is not possible to establish whether these men are pandemic-deniers. But the results do reinforce the need for HIV prevention and COVID-19 prevention programs to find ways to reach out to GBMSM to continue to educate on the potential for HIV and COVID-19 transmission.

There are several limitations to the current study. The data were collected online, and therefore represent only those with access to the internet and may over-represent those who were seeking sex via apps. The survey did not collect information on viral suppression status for men living with HIV, restricting the ability to include viral suppression in the definition of unprotected anal sex. The retention rate for round two was only 50%, and while the only recorded difference between round one and round two participants was in employment status, it may be that those who did not engage with round two of the survey may have differing beliefs about or experiences of the COVID-19 pandemic. The survey was conducted in November 2020 to January 2021, just as vaccines were emerging and being rolled-out, and so men may have been in the early stages of forming their opinions of the vaccines. The survey did not collect vaccination status, and it is possible that some participants may have received vaccines from December 2020 onwards. Also, vaccines became available in December 2020, and so

those taking the survey in later December and January 2021 may have responded differently to questions on the likelihood of vaccinations. It would be important to repeat this survey later in 2021, to understand whether vaccine attitudes and sexual behavior continue to change. The sample is predominantly White and highly educated. With a more racially and economically diverse sample we may expect to observe greater variation in the negative experiences of COVID-19, given the demonstrated higher rates of loss of employment and structural vulnerabilities experienced by communities of color during the pandemic.

The results illustrate some significant declines in sexual behavior among GBMSM as the COVID-19 pandemic progressed, however there exists a smaller subset of men who continue to engage in high risk behavior—high risk for both HIV/STIs and COVID-19—perhaps driven by beliefs that the pandemic will not end. As vaccine programs continue to roll out across the U.S, as lockdowns ease and as we return to some normalcy, it will be important to continue to provide GBMSM with culturally appropriate and accessible HIV prevention services, and think critically about ways to re-engage men in HIV prevention. In the meantime, as the pandemic continues, there remains a clear need to continue to provide comprehensive HIV prevention and care services, and telehealth and other eHealth platforms provide a safe, flexible mechanism for providing services [25, 26]. HIV and COVID-19 prevention strategies currently operate independently, and there is clearly the potential—and need—for COVID-19 and HIV prevention programs to integrate, to promote messaging around the dual risks associated with sexual risk taking during the COVID-19 pandemic.

Declarations

Conflict of interest The authors declare that they have no conflict of interest.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Ethical approval for this study was obtained from the University of Michigan Institutional Review Board (IRB Number HUM00180117).

Informed consent Informed consent was obtained from all participants via an electronic consent form.

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