



Original article

Hookup App Use, Sexual Behavior, and Sexual Health Among Adolescent Men Who Have Sex With Men in the United States


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ABSTRACT

Purpose: Geosocial networking applications (e.g., “hookup apps”) are widely used among adult men who have sex with men (MSM). Little is known about adolescent MSM’s (AMSM) use of these apps. Exploratory research is needed as AMSM’s app use poses various ethical, legal, and sexual health concerns. This article examined AMSM’s app use patterns and its associations with their sexual health and behavior.

Methods: Two hundred sexually experienced AMSM in the United States (M age = 16.6, 49% racial/ethnic minority) completed online survey questions assessing their use of apps specific to MSM and not specific to MSM to meet partners for dating and sex, as well as their sexual behavior and HIV risk.

Results: Overall, 52.5% of participants (n = 105) reported using MSM-specific apps to meet partners for sex. Of these, most participants reported having oral (75.7%, n = 78) and anal sex (62.1%, n = 64) with those partners. Of those who reported having anal sex, 78.1% (n = 50) had sex with those partners more than once, and only 25.0% (n = 16) always used condoms with those partners. Relative to those who used only non-MSM-specific apps, MSM-specific app users reported more sex partners and condomless anal sex partners, greater perceived risk of HIV, more engagement in sexual health services, and greater odds of HIV testing.

Conclusions: Use of MSM-specific apps was not uncommon among this sample of AMSM. Patterns of risk behavior and HIV testing were similar to samples of adult MSM app users. Further research should investigate AMSM’s app-related sexual and HIV/sexually transmitted infection prevention decision-making to guide sexual health education efforts for AMSM.

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IMPLICATIONS AND CONTRIBUTIONS

This study examined and demonstrated normative use of MSM-specific geosocial networking applications among adolescent men who have sex with men, which has ethical, legal, and sexual health considerations. Education on how to navigate such online environments and HIV/sexually transmitted infection prevention and testing are critical.

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Geosocial networking applications are widely used by adult men who have sex with men (MSM) in the United States to meet partners for sex and dating [1–3]. Online social networks, including mobile technologies, provide a means for MSM to explore sexual desires, meet sexual needs, and connect to the gay community [4–6] and have been linked with positive psychosocial outcomes, such as low levels of internalized homophobia and high levels of gay identity affirmation [7]. However, use of these technologies (referred to as “hookup apps” here) is also associated with sexual risk taking and adverse sexual health outcomes [8], such as higher numbers of sex partners [9] and greater incidence of sexually transmitted infections (STIs) [10], not necessarily compared with general samples of MSM. Moreover, some studies indicate MSM are less likely to use condoms with partners met via hookup apps [11], although evidence for this is equivocal [12,13]. MSM who use hookup apps report relatively high rates of lifetime and past-year HIV testing as well, suggesting either that engaging in risk behavior may prompt men to seek sexual health services or that testing negative for HIV/STIs may make men feel invulnerable and lead to greater risk behavior [8,14].

Media reports suggest that adolescent MSM (AMSM) under 18 may also use hookup apps to seek partners [15], and AMSM may gravitate toward them for similar reasons as adults: hookup apps provide a convenient and discreet way to explore their developing sexual identities and overcome common obstacles to meeting same-sex partners, such as proximity, sexual identity disclosure, and ascertaining a prospective partner’s sexual orientation [16,17]. However, the explicitly sexual context of hookup apps and the fact that adolescents are still developing their ability to delay gratification, control impulses, and self-regulate in the face of emotional and rewarding stimuli [18] may also result in greater sexual risk taking among AMSM using hookup apps. Indeed, studies of adolescent sexual behavior and Internet use indicate that relative to heterosexual youth, gay adolescents are more likely to report online partner seeking [19,20] and unprotected sex with a partner met online [19], and these behavior patterns may generalize to MSM-specific hookup apps. Finally, hookup app use poses legal risks if AMSM are under the legal age of consent in their state and have adult partners.

To date, no empirical studies have examined hookup app usage patterns among AMSM. Reasons for this lack of research may include the fact that studies on MSM app use often recruit participants from the apps, whose terms of service require users to be older than 18, as well as actual and perceived barriers among researchers to conducting research on sexual behavior in sexual minority adolescents [21]. However, this is a critical gap in our knowledge. AMSM are disproportionately affected by HIV, accounting for 77% of diagnoses among teenagers [22], and their HIV incidence rate is increasing [23]. Research is needed to shed light on a unique sexual context that may be linked with elevated rates of HIV risk behavior among a group at disproportionately high risk of HIV. This study sought to describe patterns of hookup app use among AMSM and examine relationships between their hookup app use and HIV risk and preventive behaviors.

Methods

As part of a larger study [24–26], AMSM aged 14–17 were recruited from December 2016 to February 2017 through paid Facebook advertisements to complete an online survey on ethical issues in adolescent HIV prevention research. The advertisements

targeted adolescents who indicated they were romantically interested in the same or both genders on their profile and/or listed interests relevant to sexual minority youth (e.g., pop culture figures, sexual-minority-related organizations). Clicking on the advertisement directed the individual to a brief eligibility survey. Eligible individuals were assigned male at birth; identified as gay, bisexual, pansexual, queer, or questioning/unsure; reported having had anal sex with a male partner; lived in the United States; could read English at an eighth grade level; and self-reported an HIV-negative status or had not previously been tested for HIV. Eligible individuals reviewed an online consent form and were automatically routed to the survey upon confirming consent. Participants who completed the survey and whose data passed the study’s validation protocol [27] received a \$30 electronic gift card. Procedures were approved by the universities’ institutional review boards with a waiver of parental permission, and the National Institutes of Health issued a Certificate of Confidentiality.

Measures

Sociodemographic characteristics. Participants completed items assessing age, race and ethnicity, birth-assigned sex, gender identity, sexual orientation, and sexual orientation disclosure (i.e., “outness”) to parents. For analysis, race/ethnicity was dichotomized to non-Hispanic white versus racial/ethnic minority, sexual orientation was dichotomized to gay versus non-gay-identified, and disclosure to parents was dichotomized to being not out versus being out to at least one parent.

Sexual history and HIV/STI risk. One item asked participants to select whether they had sex with “only guys”, “mostly guys but some girls”, “guys and girls equally”, “mostly girls but some guys”, or “only girls”; those endorsing the last option were ineligible, and the rest were dichotomized to behaviorally homosexual versus behaviorally bisexual for analysis. Additional items obtained more details about participants’ sexual behavior and sexual risk specific to sex with male partners. Items included number of lifetime anal sex partners, number of lifetime condomless anal sex (CAS) partners, and frequency of substance and alcohol use before sex in the past 12 months. Finally, items assessing perceived risk of HIV [28] asked about participants’ perceived likelihood of becoming infected with HIV (1 = *extremely unlikely*, 5 = *extremely likely*) and how frequently participants worried about getting infected with HIV (1 = *none of the time*, 5 = *all of the time*).

Sexual healthcare engagement and testing. Six items assessed participants’ healthcare experiences relevant to their sexual health [29]. Items began with “In the past I have spoken to a doctor, nurse, or other healthcare provider about...” and asked about sexual orientation, sex with male partners, HIV testing, pre-exposure prophylaxis (PrEP) to prevent HIV infection, condoms and other HIV/STI prevention methods, and HIV/STI prevention specific to male–male sex. Response options were on a five-point scale (1 = *never*, 5 = *always*), and for analysis, a sexual healthcare engagement score was calculated based on the mean of all six items, with higher scores indicating greater levels of engagement. Two other items assessed whether participants had ever been tested for HIV in their lifetime and whether they had been tested for STIs in the past year.

Hookup app use. Ten investigator-created items assessed respondents’ use of social media Web sites and mobile apps to meet

men for dating, romantic relationships, and sex. First, participants were asked to select what Web sites/apps they had ever used for these purposes from the following options: four popular hookup apps for MSM at the time of the study (Grindr, SCRUFF, Jack'd, Adam4Adam); “a social media site or app that is NOT specifically for gay/bisexual guys (e.g., Facebook, Instagram, Twitter, Snapchat, Reddit)”; “a dating site or app that is NOT specifically for gay/bisexual guys (e.g., Tinder, OkCupid, Match.com)”; “not listed”; “I have never used a website/mobile app to meet other guys for dating, romantic relationships, or sex”; and “I do not want to answer.” Those who selected “not listed” were asked to list other Web sites or apps they had used. For analysis, participants were grouped based on whether they endorsed using any MSM hookup apps (MSM app users), using exclusively sites or apps other than MSM hookup apps (other app users), and using no apps (nonusers). Two items assessed whether participants used these Web sites or apps to avoid being outed to other people they knew and because they did not know many gay or bisexual men where they lived (1 = *strongly disagree*, 5 = *strongly agree*).

Participants who did not report using an MSM-specific app did not receive any other questions about app use and continued to other parts of the survey. MSM app users were routed to additional items asking for more detail on how they had used the MSM-specific mobile apps (e.g., meeting friends, chatting, having cybersex, meeting guys for sex, finding a boyfriend) and whether they had ever met a man from the apps in person. Those who endorsed meeting a man from an MSM-specific app in person were asked what types of sexual acts, if any, they had engaged in with those men. Finally, those who reported having had anal sex with a partner met from an app were asked about the frequency of sex and condom use with those partners.

Data analysis

We assessed differences in demographics, HIV/STI risk factors, and HIV/STI health-care engagement by app-use group at the bivariate level using one-way analysis of variance, Pearson chi-square or Fisher's exact tests, and independent samples t-tests. Among MSM app users, we similarly assessed group differences between those who had anal sex with a partner met from an app and those who had not. We then conducted a series of multivariable regression models examining the associations between MSM app use and HIV/STI risk factors and health-care engagement measures, controlling for age, race/ethnicity, sexual orientation, outness, and sex of sexual partners. The type of regression was matched to the dependent variable structure: negative binomial for counts, linear for continuous, and logistic for binary outcomes. Finally, we conducted the same multivariable analyses with having had anal sex with a partner met from an MSM-specific app as the independent variable.

Results

Participant characteristics are presented in Table 1. Participants ranged in age from 14 to 17 years old (M age = 16.6) and were ethnically diverse, with 49.0% identifying as a racial/ethnic minority. Most participants were identified as male (99.0%) and gay (82.5%), were out to at least one parent (67.5%), and had only male sex partners (80.5%). Thirty-five percent of participants reported ever having an HIV test, and 25.0% reported having an STI test in the past year. Of participants who provided a state of residence (n = 180), participants lived in 42 states reflecting

Table 1
Descriptive statistics (N = 200)^a

	n	%
Age (M = 16.64, SD = .86)		
14	8	4.0
15	27	13.5
16	82	41.0
17	83	41.5
Race/Ethnicity		
White	102	51.0
Black or African American	9	4.5
Hispanic/Latino	68	34.0
Asian	10	5.0
Multiracial	8	4.0
Other	1	.5
Sexual orientation		
Gay	165	82.5
Bisexual	26	13.0
Pansexual	6	3.0
Queer	2	1.0
Questioning/unsure	1	.5
Gender identity		
Man	198	99.0
Transgender woman	2	1.0
Outness to parents/guardians		
Not out to parents	64	32.0
Out to one parent, but not all	26	13.0
Out to all parents	109	54.5
Sex of sexual partners		
Only guys	161	80.5
Mostly guys but some girls	28	14.0
Guys and girls equally	5	2.5
Mostly girls but some guys	6	3.0
Types of apps used		
Grindr	102	51.0
Scruff	11	5.5
Jack'd	10	5.0
Adam4Adam	3	1.5
Social media app/site, non-MSM-specific	102	54.0
Dating app/site, non-MSM-specific	64	32.0
Other apps not listed	40	20.0
No apps	32	16.0
MSM app use		
Used MSM-specific apps	105	52.5
Used only non-MSM-specific apps	61	30.5
Used no apps	32	16.0
Used app to avoid being outed (n = 168)		
Strongly disagree	63	37.5
Disagree	26	15.5
Neither disagree nor agree	25	14.9
Agree	36	21.4
Strongly agree	16	9.5
Used app to meet gay/bisexual guys (n = 168)		
Strongly disagree	12	7.1
Disagree	6	3.6
Neither disagree nor agree	11	6.5
Agree	61	36.3
Strongly agree	78	46.4
MSM-app-use purpose (n = 103)		
Meeting new gay/bisexual friends	63	61.2
Chatting with gay/bisexual friends	68	66.0
Having cybersex with guys	44	42.7
Meeting guys in person for sex	71	68.9
Finding a boyfriend	51	49.5
Other reasons not listed	6	5.8
Ever met a person from app (n = 103)		
Yes, a guy for sex	69	67.0
Yes, a guy I casually dated	35	34.0
Yes, a boyfriend	26	25.2
Yes, a new gay/bisexual friend	35	34.0
I have never met anyone from these apps in person	18	17.5

(continued on next page)

Table 1
Continued

	n	%
Sexual acts among MSM app users (n = 103)		
Hand job	68	66.0
Oral sex	78	75.7
Anal sex	64	62.1
Other type of sexual contact	14	13.5
Anal sex among MSM app users (n = 103)		
Had anal sex with a partner met off an app	64	62.1
Did not have anal sex with a partner met off an app	39	37.9
Anal sex frequency among MSM app users (n = 64)		
One time	14	21.9
2–5 times	29	45.3
6–10 times	8	12.5
More than 10 times	13	20.3
Anal sex and condom use among MSM app users (n = 64)		
Always used condoms with anal sex partner from app	16	25.0
Did not always use condoms with anal sex partner from app	48	75.0
HIV/STI testing		
HIV test (lifetime)	70	35.0
STI test (past year)	50	25.0
	M	SD
HIV/STI risk factors		
Number of male sex partners	3.36	4.57
Number of male CAS partners	1.83	2.97
Substance use before sex	1.56	.92
Perceived risk of HIV	2.49	.90
HIV/STI healthcare engagement		
Engagement in sexual health services	1.68	.86

CAS = condomless anal sex; MSM = men who have sex with men; SD, standard deviation; STI = sexually transmitted infection.

^a Missingness in individual sections due to skip logic and/or participants' selecting "I do not want to answer."

all four geographic regions of the country [30] (South 32.2%, West 32.2%, Northeast 18.9%, Midwest 16.7%). Of the 176 participants who provided a valid ZIP code, 91% were in urban areas and 9% were in rural areas. Outcomes did not differ by geographic location or urbanicity.

App engagement and sexual behavior

App use and sexual behaviors are also presented in Table 1. Over half of participants endorsed using Grindr (51.0%); the other three

MSM-specific apps were endorsed at substantially lower rates (1.5%–5.5%). Over half of participants endorsed using general social media to meet other male partners (54.0%), and approximately one third endorsed general dating apps (32.0%). Most MSM app users reported also using other apps not specific to MSM to meet men (67.6%). Of the 40 participants (20.0%) who reported using apps or sites that were not listed, the most frequently mentioned venues included sites both specific to (Distinc.tt, n = 8; Hornet, n = 6) and not specific to (MeetMe, n = 6; Craigslist, n = 5) individuals seeking same-sex partners. Overall, 52.5% (n = 105) of participants reported using any type of MSM-specific app for the purposes of meeting partners, 30.5% (n = 61) solely used apps not specific to MSM, and 16% (n = 32) did not use any apps for this purpose.

Of the 168 AMSM who reported ever using any apps or Web sites to meet male partners, the vast majority (82.7%) agreed or strongly agreed that they had used these technologies because of lack of access to same-sex partners, and nearly one third (31.0%) agreed or strongly agreed that they had used these technologies to avoid being outed.

Of the 103 AMSM who reported using one of the four listed MSM-specific apps, the most frequently endorsed reason for using the apps was to meet men in person for sex (68.9%); however, a large percentage of users also endorsed other reasons, including chatting with friends (66.0%), meeting new friends (61.2%), and finding a boyfriend (49.5%). Curiosity was mentioned by three participants in the subsequent free-response item. MSM app users also reported having a variety of relationships with men met from the apps, including hookups (67.0%), casual dating partners (34.0%), friends (34.0%), and boyfriends (25.2%). Regardless of relationship type, a majority of MSM app users reported engaging in oral sex (75.7%), hand jobs (66.0%), and anal sex (62.1%) with partners met from the apps. Finally, of the 64 who reported having had anal sex, most had anal sex with the partners more than once (78.1%), and only 25% reported they always used condoms with partners they met through the apps.

Group differences in app engagement and sexual behavior

Group differences among all participants by their level of app engagement (i.e., MSM app users vs. other app users vs. nonusers) are presented in Table 2. Regarding demographic characteristics, MSM app users were slightly older, and a larger percentage

Table 2
Group differences by type of apps used

	MSM app users (n = 105)	Other app users (n = 61)	Nonusers (n = 32)	Pearson chi-square or F	p
	n (%) or M (SD)	n (%) or M (SD)	n (%) or M (SD)		
Demographics					
Age	16.82 (.76)	16.44 (.89)	16.44 (1.01)	F = 5.03	.007
Racial or ethnic minority	n = 51 (49.0%)	n = 30 (49.2%)	n = 15 (48.4%)	$\chi^2 = .005$	.997
Nongay sexual orientation	n = 14 (13.3%)	n = 17 (27.9%)	n = 4 (12.5%)	$\chi^2 = 6.31$	.051
Out to at least one parent	n = 73 (70.2%)	n = 42 (68.9%)	n = 19 (59.4%)	$\chi^2 = 1.34$	.511
Behaviorally bisexual	n = 14 (13.3%)	n = 18 (29.5%)	n = 7 (21.9%)	$\chi^2 = 6.497$	.039
HIV/STI risk factors					
Number of male sex partners	4.51 (5.83)	2.13 (1.89)	2.00 (1.92)	F = 7.35	.001
Number of male CAS partners	2.40 (3.65)	1.21 (1.59)	.97 (1.72)	F = 4.55	.012
Substance use before sex	1.58 (.82)	1.63 (.93)	1.28 (.44)	F = 2.13	.122
Perceived risk of HIV	2.70 (.91)	2.25 (.79)	2.22 (.93)	F = 6.89	.001
HIV/STI healthcare engagement					
Engagement in sexual health services	1.78 (.91)	1.51 (.63)	1.75 (1.02)	F = 2.01	.136
HIV test (lifetime)	n = 41 (40.2%)	n = 13 (23.6%)	n = 15 (46.9%)	$\chi^2 = 6.01$	.049
STI test (past year)	n = 25 (23.8%)	n = 13 (21.3%)	n = 11 (34.4%)	$\chi^2 = 2.03$	.363

CAS = condomless anal sex; MSM = men who have sex with men; STI = sexually transmitted infection.

Table 3
Group differences among MSM app users by anal sex with a partner met from the app

	Yes anal sex (n = 64) n (%) or M (SD)	No anal sex (n = 41) n (%) or M (SD)	Pearson chi-square or t	p
Demographics				
Age	16.95 (.72)	16.61 (.77)	t = -2.31	.023
Nonwhite race/ethnicity	n = 31 (48.4%)	n = 20 (50.0%)	$\chi^2 = .02$	.877
Nongay sexual orientation	n = 6 (14.6%)	n = 8 (12.5%)	$\chi^2 = .10$	.754
Out to at least one parent	n = 45 (70.3%)	n = 28 (70.0%)	$\chi^2 = .00$	.973
Behaviorally bisexual	n = 10 (15.6%)	n = 4 (9.8%)	$\chi^2 = .745$	.388
HIV/STI risk factors				
Number of male sex partners	6.13 (6.96)	2.00 (1.23)	t = -4.63	.000
Number of male CAS partners	3.31 (4.37)	.95 (.93)	t = -4.18	.000
Substance use before sex	1.65 (.88)	1.46 (.69)	t = -1.20	.235
Perceived risk of HIV	2.77 (.90)	2.60 (.92)	t = -.93	.356
HIV/STI healthcare engagement				
Engagement in sexual health services	1.84 (.93)	1.67 (.88)	t = -.93	.357
HIV test (lifetime)	n = 30 (49.2%)	n = 11 (26.8%)	$\chi^2 = 5.10$	.024
STI test (past year)	n = 22 (34.4%)	n = 3 (7.3%)	$\chi^2 = 10.09$	.001

CAS = condomless anal sex; MSM = men who have sex with men; STI = sexually transmitted infection.

had exclusively male sex partners relative to other app users and nonusers. Regarding HIV/STI risk factors, MSM app users reported a greater number of both male sex partners and male CAS partners, as well as greater perceived risk of HIV. Nonusers reported the greatest proportion of lifetime HIV testing (46.9%), although MSM app users reported similarly high levels of HIV testing (40.2%). Nonusers were not statistically similar to either MSM app or other app users and were excluded from further analyses.

Group differences among MSM app users by whether or not they had sex with a partner met from the apps are presented in Table 3. MSM app users who had anal sex with a partner met from the apps were slightly older, reported a greater number of male sex partners and male CAS partners, and were more likely to report having an HIV test in their lifetime and an STI test in the past year relative to those who did not have anal sex with a partner met from the apps.

Associations with HIV/STI risk factors and engagement in healthcare services

Results from the multivariable regression models of HIV/STI risk factors and engagement in sexual healthcare services on MSM app use are presented in Table 4. After accounting for demographic variables, MSM app use was associated with having twice

as many male sex partners and twice as many male CAS partners. MSM app use was also associated with greater perceived risk of HIV, more engagement in sexual health services, and 2.86 times the odds of ever having received an HIV test.

In the parallel regression models among MSM app users (Table 5), having had anal sex with a partner met through an MSM app was associated with almost three times the number of male sex partners and 3.43 times the number of male CAS partners compared to MSM app users who had not had anal sex with a partner met through an app, controlling for demographics. Anal sex with a partner met from an MSM-specific app was also significantly associated with 2.60 times the odds of lifetime HIV testing and 9.69 times the odds of past-year STI testing.

Discussion

To our knowledge, our study is the first to describe the use of MSM-specific hookup apps among a large sample of AMSM. Our findings indicate that although individuals under age 18 are not permitted to use hookup apps according to the apps' terms of service, MSM app use among AMSM is prevalent and may be as normative as among adult MSM. For example, over half of our sample reported using MSM-specific hookup apps, and the percentage of adult MSM app users reported in other studies has ranged from 54% [9] to 63% [31].

Table 4

Adjusted odds ratios, incident rate ratios, regression coefficients, and 95% confidence intervals for the association between MSM app use and HIV/STI risk factors and healthcare engagement among AMSM (N = 166)

Correlate	Number of male sex partners ^a	Number of male CAS partners ^a	Substance use before sex ^b	Perceived risk of HIV ^b	Engagement in sexual health services ^b	HIV test (lifetime) ^c	STI test (past year) ^c
MSM app use	2.07*** [1.50, 2.86]	2.06** [1.36, 3.14]	.03 [-0.25, .31]	.40** [.11, .69]	.36* [.09, .67]	2.86* [1.26, 6.47]	1.30 [.58, 2.92]
Age	1.11 [.96, 1.32]	1.14 [.91, 1.42]	.02 [-0.15, .19]	.01 [-0.16, .19]	-.10 [-0.26, .06]	1.15 [.73, 1.79]	1.12 [.69, 1.82]
Nonwhite race/ethnicity	1.37* [1.034, 1.82]	1.33 [.92, 1.91]	-.17 [-0.44, .09]	.10 [-0.18, .37]	-.13 [-0.39, .12]	1.15 [.56, 2.33]	1.43 [.67, 3.03]
Nongay sexual orientation	.74 [.48, 1.15]	.94 [.55, 1.61]	-.10 [-0.50, .29]	.01 [-0.40, .42]	.21 [-0.17, .59]	1.29 [.43, 3.88]	1.32 [.43, 4.06]
Out to at least one parent	1.07 [.77, 1.49]	1.15 [.75, 1.78]	.09 [-0.22, .41]	.01 [-0.31, .34]	.41** [.11, .78]	2.49* [1.00, 6.16]	3.12* [1.11, 8.77]
Behaviorally bisexual	1.37 [.92, 2.06]	1.28 [.77, 2.11]	.71*** [.33, 1.09]	-.22 [-0.62, .17]	.08 [-0.29, .45]	3.17* [1.13, 8.88]	1.93 [.69, 5.43]

AMSMM = adolescent men who have sex with men; CAS = condomless anal sex; STI = sexually transmitted infection.

^a Incident rate ratios (IRRs).

^b Regression coefficients (B).

^c Odds ratios (ORs).

* $p < .05$; ** $p < .01$; *** $p < .001$.

Table 5

Adjusted odds ratios, incident rate ratios, regression coefficients, and 95% confidence intervals for the association between having anal sex with a partner met from an MSM app and HIV/STI risk factors and healthcare engagement among MSM app users (N = 105)

Correlate	Number of male sex partners ^a	Number of male CAS partners ^a	Substance use before sex ^b	Perceived risk of HIV ^b	Engagement in sexual health services ^b	HIV test (lifetime) ^c	STI test (past year) ^c
Anal sex with partner from MSM app	2.97*** [2.02, 4.38]	3.43*** [2.10, 5.62]	.17 [-.17, .51]	.24 [-.15, .62]	.25 [-.12, .62]	2.60* [1.02, 6.63]	9.69** [2.34, 40.04]
Age	1.10 [.87, 1.38]	1.076 [.81, 1.42]	-.09 [-.31, .13]	.01 [-.25, .26]	-.18 [-.42, .06]	.98 [.54, 1.78]	.56 [.27, 1.17]
Nonwhite race/ethnicity	1.37 [.97, 1.97]	.995 [.66, 1.51]	-.01 [-.33, .32]	.19 [-.19, .56]	-.10 [-.46, .25]	1.32 [.55, 3.15]	1.62 [.59, 4.49]
Nongay sexual orientation	.903 [.52, 1.58]	1.102 [.58, 2.09]	-.16 [-.68, .37]	-.19 [-.79, .41]	.09 [-.48, .66]	.92 [.20, 4.21]	.96 [.19, 4.91]
Out to at least one parent	1.025 [.70, 1.50]	1.04 [.65, 1.66]	.21 [-.16, .57]	.04 [-.38, .46]	.66** [.26, 1.07]	2.84 [.97, 8.32]	4.18* [1.09, 16.00]
Behaviorally bisexual	.97 [.58, 1.63]	1.021 [.56, 1.86]	.71** [.21, 1.21]	-.08 [-.66, .49]	-.10 [-.65, .45]	3.23 [.76, 13.84]	1.28 [.30, 5.55]

CAS = condomless anal sex; MSM = men who have sex with men; STI = sexually transmitted infection.

^a Incident rate ratios (IRRs).

^b Regression coefficients (B).

^c Odds ratios (ORs).

* $p < .05$; ** $p < .01$; *** $p < .001$.

Although participants in our study most frequently reported using MSM-specific apps to meet partners for sex, a majority also endorsed nonsexual purposes. These reasons for use echo findings among adult samples [2,5,13,32]. Many AMSM in our sample also endorsed using general social media and dating sites to meet potential partners. The motivations behind the selection of media may be nuanced: Holloway et al. [4] reported that among MSM aged 18–24, Grindr, Facebook, and dating sites were more likely used for making new friends, connecting with existing friends, and meeting people for sex, respectively. Future research among AMSM should examine whether they also make such distinctions. Regardless, participants in our sample reported using MSM apps largely because they felt they lacked access to other MSM nearby, which has been voiced by other samples of sexual minority youth [16]. Previous work has demonstrated that the Internet serves multiple functions in the exploration and acceptance of sexual orientation identity, including communicating with and meeting other sexual minorities and connecting with the sexual minority community [17,33]. Hookup apps may be another avenue by which AMSM perform normative developmental tasks of adolescence, such as dating and initiating sexual behaviors. AMSM have a smaller pool of potential partners relative to their heterosexual peers due to the smaller size of the sexual minority community, as well as the relative lack of sexual minority male peers who are out in any given school, where youth tend to meet partners [16,34]. As such, MSM-specific apps may be one of the few ways in which AMSM can explore relationships with same-sex partners.

The potential benefits of AMSM's use of hookup apps notwithstanding, MSM app users engaged in more risky sexual behaviors than their counterparts. Similar to adult samples [8,9,11–13], MSM app use was linked with increased perceived risk of HIV and number of total and CAS partners. MSM apps provide a forum to meet sex partners quickly and easily and communicate specific risk-related desires (e.g., CAS) and sexual expectations. Adolescents may be relatively inexperienced at understanding and negotiating such communication, leading to offline outcomes in which sexual risk may be expected. Conversely, AMSM who engage in risky health behaviors may be more inclined to use MSM apps that they know to be highly sexualized [3,35]. These AMSM could gravitate toward this method of

finding partners precisely because of its ease, anonymity, and ability to occlude one's age. Future research should assess how AMSM's level of experience with hookup apps contributes to elevated risk perceptions and behaviors.

Regardless of the reasoning behind the increased risk, the data suggest that AMSM may be aware of their risk-taking behavior and utilize sexual health services accordingly. Similar to findings from adult samples [31], youth who used MSM-specific apps reported greater odds of HIV testing and more use of sexual health services compared with peers who only used other apps. That both risk and health engagement behaviors were similarly increased among AMSM who had had anal sex with a partner met from an MSM app relative to those who had not further corroborates the impression that AMSM's sexual risk taking is not a function of naivety. Increased testing and use of sexual health services could be linked to the fact that sexual health outreach is increasingly common on MSM-specific apps and the fact that user profiles often describe sexual health information such as last HIV testing date and PrEP use.

Last, there are other public health implications from our findings beyond adolescents' sexual risk-taking behavior. As our results suggest that underage MSM app use is not uncommon, strategies that increase the safety of both adolescent and legal adult users are needed. AMSM hookup app users may post personal information and share sexually explicit pictures of themselves, but youth could be prosecuted for sexting pictures of themselves to potential partners. Adult users, who may knowingly or unknowingly interact with AMSM online, may risk greater legal consequences should their interactions escalate to sexual contact offline. Finally, AMSM who meet adult partners online could be at higher risk of sexual victimization and HIV infection associated with age-discrepant sexual relationships [36,37].

Limitations

Our study was not without limitations. First, we used a cross-sectional design with a moderately sized sample of AMSM, which precludes our drawing causal links and hinders our ability to generalize to larger populations. Second, although the age range for inclusion was 14–17 years, most participants were between the ages of 16 and 17, and it is unclear whether younger adolescent

MSM app users' behaviors differ. Third, we recruited participants primarily from Facebook and Instagram, and it is possible these youth may differ from those recruited from MSM apps or the community. Fourth, our measures may have been a limiting factor. For example, we did not assess the nature of participants' relationships with the partners they met through the apps, which may influence inconsistent condom use if the relationships are romantic or known partners [38]. Finally, these items were embedded within a larger survey, and we were limited in the depth of information we were able to obtain about hookup app use among AMSM. Nevertheless, these results provide an initial glance into a phenomenon that warrants future research.

Future Directions

Although our findings paint a preliminary picture of hookup app use and sexual behavior among AMSM, other important questions remain about the perceived risks and benefits of using hookup apps, AMSM's self-presentation in these venues [39], and youth's decision-making around the trustworthiness of others' profiles [40]. In addition, the types of partners met from hookup apps and whether and how AMSM navigate sexual consent discussions with adult partners should be explored. Given the non-normative nature of hookup apps among adolescent and adult MSM, implementing stricter policies is likely to be ineffective in preventing AMSM's access to these apps. Thus, future studies should also examine the potential role of hookup apps as a context for HIV prevention and testing among AMSM [41] and the education needed for AMSM to navigate such apps safely. As with the former, MSM apps could be a forum through which to educate young users about HIV risk behaviors and sexual health responsibilities (e.g., condom use, PrEP uptake and adherence, serostatus assumptions). However, this must be preceded by education about navigating online interactions, dating, and sex to protect themselves from negative encounters that may stem from such venues. As the Internet and connected technologies evolve further, continued attention to how young people adopt new media is critical.

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