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Sex Transm Infect. 2016 November ; 92(7): 508–514. doi:10.1136/sextrans-2015-052469.**Gay Mobile Apps and the Evolving Virtual Risk Environment: A Cross-Sectional Online Survey among Men who have Sex with Men in China****Weiming Tang**^{1,2,3,*}, **John Best**^{1,2,4,*}, **Ye Zhang**^{1,2,3}, **Fengying Liu**^{2,3}, **Lai Sze Tso**^{1,3,*}, **Shujie Huang**^{2,3}, **Bin Yang**^{2,3}, **Chongyi Wei**⁵, and **Joseph D. Tucker**^{1,3}¹University of North Carolina Project-China, No. 2 Lujing Road, Guangzhou, China, 510095²Guangdong Provincial Centres for Skin Diseases and STI Control, No. 2 Lujing Road, Guangzhou, China, 510095³SESH Global, No. 2 Lujing Road, Guangzhou, China, 510095⁴School of Medicine, University of California, San Francisco, 550 16th Street San Francisco CA, USA 94158⁵Department of Epidemiology and Biostatistics & Global Health Sciences, University of California, San Francisco, 550 16th Street San Francisco CA, USA 94158**Abstract**

Objectives—The expansion of gay sex-seeking application (gay app) use among men who have sex with men (MSM) may create new virtual risk environments that are associated with STI transmission. The goals of this study were to compare sexual behaviors between gay app users and non-users, and to describe sexual behaviors among gay app users in China.

Methods—In October 2014, we recruited MSM from three Chinese gay websites. Data on socio-demographics, sexual behaviors and gay app use were collected. Logistic regressions were used to compare gay app users to non-app users and to identify factors associated with condomless sex among gay app users.

Results—Of the 1,424 participants, most were less than 30 years old (77.5%), single (83.8%), and self-identified as gay (72.9%). Overall, 824 (57.9%) used gay apps for partner-seeking in the last six months. Among gay app users, 36.4% met their last partner within 24 hours of first message exchange through gay apps, and 59.0% negotiated condom use before in-person meeting. Compared to non-users, gay app users reported engaging in more condomless sex in the last six

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Contributors: WT and JB participated in all stages and wrote the manuscript, YZ and FL helped collect the data; LT, SH, BY, CW and JT helped design the study and reviewed the manuscript.

months (aOR=1.52, 95% CI 1.19–1.94) and more group sex (aOR=1.49, 95% CI 1.02–2.18). Negotiating about condom use before in-person meeting was positively associated with condom use with partners met through gay apps (aOR=1.83, 95% CI 1.29–2.60).

Conclusion—Gay apps are linked to risky sexual behaviors and may foster a virtual risk environment for STI transmission among Chinese MSM. App-based interventions could target young gay men and facilitate condom negotiation.

Keywords

Gay men; Sexual Behavior; HIV; China

Introduction

Key populations, which include men who have sex with men (MSM), transgender individuals, persons who inject drugs, sex workers and people in prisons and other closed (institutional) settings, account for more than half of all new HIV infections in many low and middle-income countries (LMICs).¹ Many MSM in LMIC contexts face harsh local sanctions and cultural stigma and, for a number of reasons, turn to MSM specific smartphone-based sex-seeking applications (gay apps) to find new sex partners.² Gay app use around the world has rapidly expanded over the past five years.³

Gay app use and its associated patterns may influence sexual risk behaviors. Gay apps' geospatial technology facilitates rapid sex partner identification regardless of time or location. Gay app use has been associated with an increased number of sex partners⁴ and condomless sex in the United States.^{4–6} However, other data suggests that sex-seeking gay apps and other gay specific apps may increase social support⁷, facilitate HIV service delivery and decrease risk behaviors.^{8–10}

Although a number of studies have examined gay app use and sexual behaviors in high-income settings, there is limited data from low and middle-income settings.² China presents a unique opportunity to examine the influence of gay app use because the adoption of gay app use has been relatively widespread² and swift.¹¹ Virtually nonexistent five years ago, approximately 40% of gay men reported using gay apps to find sex partners in 2013 and the largest locally developed gay app reported approximately seven million new users last year alone.¹¹

Despite the importance of gay apps, we have very limited knowledge on specific patterns of gay app use and their relationship with high-risk sexual behaviors. Therefore, we conducted a cross-sectional survey among Chinese MSM to: 1) compare sexual risk behaviors between gay app users and non-users; 2) describe specific patterns of gay app use among users; and 3) identify factors associated with condomless anal sex among gay app users.

Materials and Methods

We conducted an online survey in September-October 2014 among Chinese MSM. We hosted the survey on three large popular gay web portals in Northern China (<http://www.danlan.org>), Southern China (<http://www.yntz.net>), and Eastern China (<http://www.danlan.org>).

www.jstz.org). These web portals provide MSM-specific news, social networking opportunities, and advertisements. These three web portals were selected because of their geographically diverse users and high web traffic. Together they reach an estimated 90,000 unique daily users according to internal analytics.

Survey development and recruitment

We interviewed MSM and other key stakeholders to inform development of our online survey. In addition, our draft survey was reviewed by local MSM who had previously participated in online surveys, local community-based organization (CBO) leaders and staff, social media experts, and physicians and public health experts.¹²¹³ Prior to final survey launch, we piloted the survey with 144 individuals on one of the web portals (data not included in final analysis). We followed a checklist for reporting results of Internet e-surveys (CHERRIES) throughout the process to improve quality and reporting of our web survey.¹⁴ Participants were recruited via banner links on each web portal homepage as well as an announcement sent to registered users. After clicking the banner, participants were directed to the informed consent and eligibility screening questions. Eligibility criteria included being assigned male sex at birth, 16 years of age or older, engaged in anal or oral sex with a man in the previous year, willing to provide their cell phone number and completed the informed consent process. At the end of our survey was an additional section investigating the efficacy of HIV testing promotion messages. Participants eligible for the additional section (never tested for HIV) received a small (10 USD) phone card reimbursement but were not aware of eligibility criteria before the study. The phone number was used to both screen for duplicates as well as provide reimbursement to eligible participants.

Measures—Socio-demographic information collected in the survey included age, occupation, living situation, marital status, education, and income. Participants were asked about their sexual orientation as well as the gender of their current sexual partners, number of sexual partners in the last six months, and history of receptive or insertive condomless anal intercourse with male partners and condomless sex with female partners. They were also asked about participation in group sex and commercial sex.

Participants were asked whether they used gay apps to find sex partners in the last six months. If participants reported any use of gay apps to find sex partners in the last six months, they were categorized as gay app users, while others were categorized as non-users. Those who used gay apps were asked about behaviors with sex partners they met through the applications, including number of partners, condom use, time from initial conversation to in-person meeting, and location of meeting. They were also asked whether they negotiated condom use and discussed HIV status with their sex partner before meeting via gay apps. If participants did not negotiate condom use via gay apps, they were asked whether condom negotiation occurred in-person. In our study, gay app partners were defined as male partners that were found via gay apps.

Statistical Analysis

Descriptive analysis was performed to describe socio-demographics, risk behaviors, and patterns of gay app use. Univariate and multivariate logistic regression were used to compare

gay app users and non-users, while demographic characteristics, including age, residence, education, marital status, and income were adjusted for in the multivariate logistic regression models. Logistic regressions (univariate and multivariate) were also used to compare gay app users who did not use a condom during last anal intercourse with partners found through gay app and those who did, adjusting for age, residence, education, marital status and income in the multivariate logistic regression models.

Ethical Statement

Ethics review committees in China (Guangdong Provincial Center for Skin Diseases and STI Control), and the United States (University of North Carolina at Chapel Hill (14–1685) and the University of California, San Francisco (14–14877)) approved the study prior to launch.

Results

Study participants

In the two months of survey availability, the links to the survey were clicked a total of 5,339 non-unique times. Of these clicks, 2,192 withdrew before screening for eligibility (1,536 withdrew prior to reading the consent form, and 656 did not sign the consent form). In addition, 1,328 of those who clicked did not meet the eligibility criteria and 395 were excluded due to duplicates (same phone number). Overall, a total of 1,424 eligible MSM from 290 cities within 32 provinces finished the online survey.

Demographics and behaviors

Of the 1424 participants, 14.5% (206) were less than 20 years old, 63.1% (898) were between 20 and 29 years old, and the majority (88.9%) resided in an urban area. In addition, 68.0% (969) had a college degree, while another 6.0% (86) had a graduate degree or higher. Over four-fifths (83.8%) of participants were never married, two-fifths (41.3%) were students, and about three quarters (74.0%) had an annual income over \$3000USD (Table 1).

Among survey participants, 48.5% (691) reported that they currently have a main partner and 29.1% (414) had ever engaged in vaginal or anal sex with women. Among those who ever engaged in sex with women, 44.0% (182/414) had reported condomless sex with women in the last six months. 29.6% (421) of participants reported engaging in condomless anal sex with their last male partner in the last six months. When engaging in anal intercourse, 36.8% (524) of participants preferred insertive, 43.6% (621) preferred receptive, and the rest 19.6% (279) had no preference.

Patterns of gay app users

In the last six months, 824 (57.9%) participants used a gay app to seek sex partners. Among gay app users, 337 (40.9%) also found partners using other online media. Of the gay app users, 334 (40.5%) started to use gay apps within the last year, and 398 (48.3%) have been using gay apps for one to three years (Table 2).

About one-third (32.3%) of gay apps users met four or more sex partners via gay apps in the last six months. Approximately one quarter (23.7%) reported six or more receptive anal sex

acts with partners met through a gay app in the last six months, and about one quarter (25.5%) had six or more insertive anal sex acts with partners met through gay app in the last six months.

For the last gay app partner, 36.4% reported meeting in person within 24 hours of initiating contact on a gay app, and 38.5% met within 2–7 days. About half of them had sex in a hotel.

Before meeting in person, 59.0% of participants reported negotiating condom use with their last gay app partners. Among those who did not discuss condom use via gay app, 32.3% talked about condom use in person. About one quarter (25.4%) gay app users did not use condom during last anal sex with the last partner met through gay app. Only one-third of gay app users discussed HIV status with their last gay app partner before meeting in person.

Factors associated with gay app use

Participants who had never engaged in sex with women were more likely to be gay app users (crude OR=1.85, 95% CI 1.47–2.32). Compared to non-users, gay app users were more likely to have condomless anal intercourse in the last six months, with crude OR of 1.31 (95% CI 1.04–1.66) (Table 3).

After adjusting for age, residence, education, marital status and income we found gay orientation, never having engaged in sex with women, and reported condomless anal intercourse in the last six months were still positively associated with gay app use, with adjusted ORs of 1.30 (95% CI 1.01–1.66), 1.49 (95% CI 1.12–1.96), and 1.52 (95% CI 1.19–1.94), respectively. In addition, gay app users were more likely report engaging in group sex, with adjusted OR of 1.49 (95% CI 1.02–2.18) (Table 3).

After adjusting for age, residence, education, marital status and income, we found users who had condomless anal intercourse with last gay app partner were more likely to report more than 20 receptive anal sex acts with gay app partners in the last six months (aOR 2.49, 95% CI 1.27–4.87) than users who used condom consistently with last gay app partner. Negotiating condom use before meeting in person was associated with reporting condom use during last anal sex with gay app partner (aOR= 1.83, 95% CI 1.29–2.60). However, no correlation was identified between in-person condom negotiation and subsequent condom use (aOR= 0.84, 95% CI 0.58–1.21). In addition, having sex at home or at venues were also associated with a higher likelihood of reported condomless anal intercourse during last anal sex with the last gay app partner, compared to having sex at hotels, with adjusted ORs of 1.65 (95% CI 1.15–2.38) and 1.92 (95% CI 0.99–2.60), respectively (Table 4).

We found a differential pattern of behavior based upon time to meeting partner on the gay application. Individuals who met their partners in less than one week after initiating conversations on the application were more likely to report multiple partners in the last six months (78.3%) when compared to individuals who took greater than one week (78.3 vs. 56.5%, $p<0.05$, Table 5). We also found 28.4% gay app users who met their partners in-person within one week after online meeting asked the serostatus of their last gay app partners, versus 47.8% ($P<0.05$) for those meeting partners longer than one week after online meeting (Table 5).

Sexual behaviours based on the means of meeting partners were also compared (Appendix A). Rates of reported condom use with last sexual partner met via gay application were similar to those of last partner met via websites. There were higher reported rates of condomless sex with last partners met via in-person venues (Appendix A).

Discussion

The increasing use of gay apps among Chinese MSM reduces many barriers for MSM to meet new sex partners. Most of the literature about gay app use among MSM has come from high-income contexts.²¹⁵ Our study extends the existing literature by recruiting participants from many big cities throughout China, not requiring in-person disclosure of sexual orientation to participate, and gathering detailed gay app data. Our findings indicate that gay app users have more high-risk behaviours than non-users, which may correlate with increased disease transmission among gay app users.

We found that gay app users were more likely to report condomless sex. This was consistent with some literature¹⁶, but contrasted our earlier research in China.² A potential reason for this contrast is that the population of gay app users is evolving and higher numbers of men with high-risk behaviors have become users. For example, in 2013, only about 40% MSM reported that they were gay app users, while this proportion increased to 58% in 2014. China's most popular gay app has grown to 15 million users in only two years.¹¹ Another potential reason is the behaviors of the users may also change over time. Perhaps users exercised a greater degree of caution when first using the application and participate in higher risk behaviors as app use becomes normalized within the community. We did not collect information on sexual behaviors before and after the use of gay apps. Future studies should investigate temporal behavior changes among app users.

Our study suggests that men who reported negotiating condom use through gay apps were more likely to use a condom. This finding is consistent with literature that reports enhanced communication about condom use is associated with condom use.¹⁷¹⁸ We did not find any relationship between in-person condom negotiation and subsequent condom use, suggesting the importance of condom negotiation on gay apps. The low rate of negotiation about condom use may further increase the chance of condomless anal sex and in turn increase the transmission of HIV and other STIs. Coordinating efforts with gay app companies to encourage regular discussion about condom use or other harm reduction behaviors before in-person meetings might be useful. Several gay app companies have taken a more public health-focused approach (hornet), but have not been as effective in drawing and retaining gay app users over time as conventional gay apps in China.

Our results indicated that the time from online meeting to in-person meeting was often only a few hours. The short duration between online meeting and in-person meeting may limit communication between gay app users in regards to discussing HIV sero-status and condom use. Shorter duration between meeting online and in person was associated with less discussion about HIV status. The short duration between online meeting and in-person meeting may also facilitate increased number of partners for gay app users. We found evidence for this trend in our study, finding that a higher proportion of gay app users who

met their last gay app partners in-person within one week of initiating conversation (vs. >1 week) have two or more gay app partners in last six months. Combined with the higher condomless anal intercourse rate, these features may foster a virtual environment for gay app users, and in turn facilitate HIV transmission.

Our study has several limitations. First, we only recruited online gay men who tend to be younger and more highly educated¹⁹ compared to non-online gay men in China. However, national data²⁰ suggest that young gay men have a disproportionate burden of syphilis and HIV. Second, all the behaviors measured in our study were based on self-report. This may result in a social desirability reporting bias, especially given stigma surrounding HIV and MSM behaviours. However, our survey did not collect personal information except participants' cell phone numbers for reimbursement. Third, a large number of MSM who clicked the survey link withdrew before being screened for eligibility, which may have resulted in selection bias. Fourth, the failure to distinguish between partner types – and particularly to distinguish between whether they were in a monogamous ongoing relationship or not is also an important limitation of our study. A recent study of Hong Kong app users found relationship status to be a predictor of condom use.²¹ In addition, our survey recruited online MSM from across the country and did not include populations who do not use the Internet or MSM web portals. However, there is widespread Internet use across China and previous studies have not found a difference in reported condom use between online and non-online MSM.²² Finally, this is a cross-sectional survey and cannot identify causality. Regardless, our study identifies app users as a population of increased sexual risk for future health campaigns.

Gay apps have become a widely accepted part of gay life in China. Our survey data suggest that gay apps foster a virtual environment that is associated with condomless sex and other high-risk behaviours in China. We found specific features and patterns of gay app use that were correlated with higher rates of risky sexual behaviors. Longitudinal prospective studies that targets how gay app use shifts behavioral norms of MSM are needed. In addition, policy makers, researchers and gay app companies should work together to explore the role of gay apps in facilitating HIV and other STI transmission among MSM. Further implementation research on using the gay apps of MSM may be useful for preventing STI and for promoting other STI services such as partner services.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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References

1. Organization WH. Consolidated Guidelines on HIV prevention, diagnosis, treatment and care for key populations. 2014 Jul.
2. Bien CH, Best JM, Muessig KE, et al. Gay Apps for Seeking Sex Partners in China: Implications for MSM Sexual Health. *AIDS and Behavior*. 2015:1–6. [PubMed: 24668254]
3. Kirby T, Thornber-Dunwell M. Phone apps could help promote sexual health in MSM. *The Lancet*. 2014; 384(9952):1415.
4. Holloway IW, Pulsipher CA, Gibbs J, et al. Network Influences on the Sexual Risk Behaviors of Gay, Bisexual and Other Men Who Have Sex with Men Using Geosocial Networking Applications. *AIDS and Behavior*. 2015:1–11. [PubMed: 24668254]
5. Grosskopf NA, LeVasseur MT, Glaser DB. Use of the internet and mobile-based “apps” for sex-seeking among men who have sex with men in New York City. *American journal of men's health*. 2014; 8(6):510–520.
6. Winetrobe H, Rice E, Bauermeister J, et al. Associations of unprotected anal intercourse with Grindr-met partners among Grindr-using young men who have sex with men in Los Angeles. *AIDS care*. 2014; 26(10):1303–1308. [PubMed: 24754563]
7. Hightow-Weidman LB, Muessig KE, Pike EC, et al. HealthMpowerment.org Building Community Though a Mobile-Optimized, Online Health Promotion Intervention. *Health Education & Behavior*. 2015 1090198114562043.
8. Holloway IW, Rice E, Gibbs J, et al. Acceptability of smartphone application-based HIV prevention among young men who have sex with men. *AIDS and Behavior*. 2014; 18(2):285–296. [PubMed: 24292281]
9. Muessig KE, Pike EC, Fowler B, et al. Putting prevention in their pockets: developing mobile phone-based HIV interventions for black men who have sex with men. *AIDS patient care and STDs*. 2013; 27(4):211–222. [PubMed: 23565925]
10. Cornelius JB, Cato M, Lawrence JS, et al. Development and pretesting multimedia HIV-prevention text messages for mobile cell phone delivery. *Journal of the Association of Nurses in AIDS Care*. 2011; 22(5):407–413. [PubMed: 21256053]
11. Watt LPA. Chinese gay dating app grows to 15 million users. *US NEWS*. 2014
12. Chow EP, Tucker JD, Wong FY, et al. Disparities and risks of sexually transmissible infections among men who have sex with men in China: a meta-analysis and data synthesis. *PloS one*. 2014; 9(2):e89959. [PubMed: 24587152]
13. Bien CH, Muessig KE, Lee R, et al. HIV and Syphilis Testing Preferences among Men Who Have Sex with Men in South China: A Qualitative Analysis to Inform Sexual Health Services. 2015
14. Eysenbach G. Improving the quality of Web surveys: the Checklist for Reporting Results of Internet E-Surveys (CHERRIES). *Journal of medical Internet research*. 2004; 6(3):e34. [PubMed: 15471760]
15. Chaudhary SC, Sawlani KK, Arora R, et al. Native aortic valve fungal endocarditis. *BMJ Case Reports*. 2013; (007144)
16. Rice E, Holloway I, Winetrobe H, et al. Sex risk among young men who have sex with men who use Grindr, a smartphone geosocial networking application. *Journal of AIDS & Clinical Research*. 2012
17. Wilson PA, Díaz RM, Yoshikawa H, et al. Drug use, interpersonal attraction, and communication: situational factors as predictors of episodes of unprotected anal intercourse among Latino gay men. *AIDS and Behavior*. 2009; 13(4):691–699. [PubMed: 18985447]
18. Noar SM, Carlyle K, Cole C. Why communication is crucial: Meta-analysis of the relationship between safer sexual communication and condom use. *Journal of health communication*. 2006; 11(4):365–390. [PubMed: 16720536]
19. Han L, Bien CH, Wei C, et al. HIV self-testing among online MSM in China: implications for expanding HIV testing among key populations. *JAIDS Journal of Acquired Immune Deficiency Syndromes*. 2014; 67(2):216–221. [PubMed: 24991972]

20. Gu WM, Yang Y, Wang QZ, et al. Comparing the performance of traditional non-treponemal tests on syphilis and non-syphilis serum samples. *International Journal of STD & AIDS*. 2013; 24(12): 919–925. [PubMed: 23970626]
21. Yeo TED, Ng YL. Sexual risk behaviors among apps-using young men who have sex with men in Hong Kong. *AIDS care*. 2015:1–5.
22. Zhang D, Bi P, Lv F, et al. Differences between Internet and community samples of MSM: implications for behavioral surveillance among MSM in China. *AIDS care*. 2008; 20(9):1128–1137. [PubMed: 18825519]

Key Messages

- Gay sex-seeking applications (gay apps) are widely used by Chinese Men who have sex with men (MSM) recruited online;
- Compared to non-users, gay app users reported engaging in more condomless sex in the last six months and reported engaging in more group sex;
- Gay apps users who had more receptive sex and did not negotiate condom use before meeting engaged in more condomless sex.

Table 1
Demographics and behaviors of participants from an online survey in China, 2014 (N=1424)

Characteristics	Gay app users (n=824)		Non-users (n=600)		Total (N=1424)	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Age						
<20	132	16.0	74	12.3	206	14.5
20–29	548	66.5	350	58.3	898	63.1
30 and above	144	17.5	176	29.3	320	22.5
Residency						
Urban	752	91.3	514	85.7	1266	88.9
Rural	72	8.7	86	14.3	158	11.1
Education						
High school or below	186	22.6	183	30.5	369	25.9
College / Bachelors	588	71.4	381	63.5	969	68.0
Masters or PhD	50	6.1	36	6.0	86	6.0
Marital Status						
Single, never married	732	88.8	462	77.0	1194	83.8
Engaged / Married	60	7.3	98	16.3	158	11.1
Divorced / Widowed	32	3.9	40	6.7	72	5.1
Student						
Yes	362	43.9	226	37.7	588	41.3
No	462	56.1	374	62.3	836	58.7
Yearly Income (\$, USD)						
3000 and below	222	26.9	148	24.7	370	26.0
3001–6000	233	28.3	187	31.2	420	29.5
6001–9600	215	26.1	161	26.8	376	26.4
9601–15000	100	12.1	71	11.8	171	12.0
>15000	54	6.6	33	5.5	87	6.1
Sexual Orientation						
gay men	626	76.0	412	68.7	1038	72.9
Bisexual	198	24.0	188	31.3	386	27.1

Characteristics	Gay app users (n=824)		Non-users (n=600)		Total (N=1424)		
	Frequency	Percent	Frequency	Percent	Frequency	Percent	
Transgender individuals	Yes	31	3.8	30	5.0	61	4.3
	No	793	96.2	570	95.0	1363	95.7
Currently have a main sexual partner	Yes	409	49.6	282	47.0	691	48.5
	No	415	50.4	318	53.0	733	51.5
Ever engaged in vaginal or anal sex with women	Yes	195	23.7	219	36.5	414	29.1
	No	629	76.3	381	63.5	1010	70.9
Engaged in condomless sex with women in the last six months*	Yes	78	40.0	104	47.5	182	44.0
	No	117	60.0	115	52.5	232	56.0
Engaged in condomless anal sex with last male partner men in the last six months	Yes	263	31.9	158	26.3	421	29.6
	No	561	68.1	442	73.7	1003	70.4
Preferred sexual role during anal sex with man	Insertive	282	34.2	242	40.3	524	36.8
	Receptive	384	46.6	237	39.5	621	43.6
	No preference	158	19.2	121	20.2	279	19.6
Engaged in group sex in the last 12 months	Yes	90	10.9	51	8.5	141	9.9
	No	734	89.1	549	91.5	1283	90.1
Engaged in commercial sex in the last 12 months	Yes	53	6.4	29	4.8	82	5.8
	No	771	93.6	571	95.2	1342	94.2
Self-reported HIV status#	Tested, positive	31	7.4	37	13.1	68	9.7
	Tested, negative	358	85.2	211	74.6	569	81.0
	Tested, no result	31	7.4	35	12.4	66	9.4
Had sex with men in the last six months	Yes	824	100.0	426	71.0	1250	87.8
	No	0	0.0	174	29.0	174	12.2

Note:

* for participants who had sex with women only;
Only among testers, n=703

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Table 2

Gay app use information and behaviors of gay app users in China (N=824).

Variables		Frequency	Percent
Found partners through traditional internet site in the last six months	<i>Yes</i>	337	40.9
	<i>No</i>	487	59.1
Found partners in person at venues in the last six months	<i>Yes</i>	72	8.7
	<i>No</i>	752	91.3
Time since started to use gay app	<i>< 6 months</i>	137	16.6
	<i>6 months- 1 year</i>	197	23.9
	<i>1-3 years</i>	398	48.3
	<i>> 3 years</i>	92	11.2
Number of sex partners found through gay app in the last 6 months	<i>1</i>	224	27.2
	<i>2 to 3</i>	334	40.5
	<i>4 to 6</i>	122	14.8
	<i>Above six</i>	144	17.5
Number of receptive anal sex acts with partners met through gay app in the last six months	<i>0 to 5</i>	629	76.3
	<i>6 to 10</i>	107	13.0
	<i>11 to 20</i>	45	5.5
	<i>above 20</i>	43	5.2
Number of insertive anal sex acts with partners met through gay app in the past six months	<i>0 to 5</i>	614	74.5
	<i>6 to 10</i>	128	15.5
	<i>11 to 20</i>	44	5.4
	<i>Above 20</i>	38	4.6
Time duration between meeting the last sex partner through a gay app and meeting in person	<i>< 1 hour</i>	75	9.1
	<i>1-24 hours</i>	225	27.3
	<i>2-7 days</i>	317	38.5
	<i>2-3 weeks</i>	87	10.6
	<i>> 3 weeks</i>	120	14.6
Place had sex with the last partner met through gay app in the last six months	<i>Home</i>	345	41.9
	<i>Hotel</i>	398	48.3
	<i>Venues</i>	81	9.8
Used condom during last anal sex with the last partner met through gay app	<i>Yes</i>	527	74.7
	<i>No</i>	179	25.4
Negotiated about condom use with the last gay app partner before met in person	<i>Yes</i>	486	59.0
	<i>No</i>	338	41.0
Negotiated about condom use in person with the last gay app partner*	<i>Yes</i>	109	32.3
	<i>No</i>	229	67.8

Variables		Frequency	Percent
Asked for HIV status of the last gay app partner before met in person	<i>Yes</i>	274	33.3
	<i>No</i>	550	66.7

Note: Refer to participants who had not negotiated about condom use with the last gay app partner before met in person.

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Table 3

Factors correlated with gay app use among MSM in China, 2014 (N=1424)

Variables	Crude OR	95% CI	Adjusted OR [€]	95% CI
Currently have a main sexual partner	No	Ref	Ref	
	Yes	1.11	0.90,1.37	1.15
Ever engaged in vaginal or anal sex with women	Yes	Ref	Ref	
	No	1.85	1.47,2.32	1.49
Engaged in condomless sex with women in the last six months	No	Ref	Ref	
	Yes	0.74	0.50,1.09	0.82
Engaged in condomless anal sex with last male partner in the last six months	No	Ref	Ref	
	Yes	1.31	1.04,1.66	1.52
Engaged in group sex in the last 12 months	No	Ref	Ref	
	Yes	1.32	0.92,1.89	1.49
Engaged in commercial sex in the last 12 months	No	Ref	Ref	
	Yes	1.35	0.85,2.16	1.38
Self-reported HIV status	Negative or not sure	Ref	Ref	
	Positive	0.60	0.36, 0.97	0.67
Sexual Orientation	Bisexual	Ref	Ref	
	Homosexual	1.44	1.14,1.82	1.30

Note:

[€]:Model adjusted for age, residence, education, marital status and income.

Table 4
Factors correlated with condomless anal intercourse with the last gay app partner among MSM and in China, 2014 (N=824)

	Crude OR		95% CI		Adjusted OR [€]		95% CI	
	Ref		Ref		Ref		Ref	
Time started to use gay app								
> 3 years	Ref							
< 6 months	1.02	0.53,1.99	0.85	0.42,1.68				
6–12 months	1.08	0.59,2.00	0.91	0.48,1.72				
1–3 years	0.99	0.57,1.74	0.91	0.51,1.62				
> 3 years	Ref		Ref					
Number of sex partners found through a gay app in the last 6 months								
1	Ref		Ref					
2 to 3	0.86	0.57,1.31	0.84	0.55,1.29				
4 to 6	0.61	0.34,1.08	0.60	0.33,1.09				
Above six	0.90	0.54,1.48	0.95	0.57,1.58				
Number of receptive anal sex acts with partners met through a gay app in the last six months								
0 to 5	Ref		Ref					
6 to 10	1.13	0.68,1.85	1.14	0.69,1.90				
11 to 20	0.98	0.47,2.06	0.97	0.46,2.06				
Above 20	2.14	1.12,4.09	2.49	1.27,4.87				
Number of insertive anal sex acts with partners met through a gay app in the last six months								
0 to 5	Ref		Ref					
6 to 10	0.77	0.47,1.27	0.80	0.48,1.34				
11 to 20	1.76	0.88,3.50	1.70	0.84,3.47				
Above 20	1.56	0.78,3.15	1.86	0.89,3.87				
Time duration between met the last sex partner through a gay app and met in person								
> 3 weeks	Ref		Ref					
< 1 hour	0.70	0.33,1.51	0.73	0.33,1.60				
1–24 hours	0.86	0.50,1.48	0.84	0.48,1.46				
2–7 days	1.03	0.62,1.72	1.04	0.62,1.75				
2–3 weeks	0.88	0.45,1.75	0.88	0.44,1.77				
Place had sex with the last gay app partner								
Hotel	Ref		Ref					
Home	1.65	1.16,2.36	1.65	1.15,2.38				
Venues	2.21	1.16,4.23	1.92	0.99,3.74				

	Crude OR		95% CI		Adjusted OR [€]		95% CI	
Negotiated about condom use with the last gay app partner before met in person	Yes	Ref			Ref			
	No	1.85	1.32,2.61		1.83		1.29,2.60	
Negotiated about condom use with the last gay app partner after meeting in person	Yes	Ref			Ref			
	No	0.87	0.61,1.24		0.84		0.58,1.21	
Asked for HIV status of the last gay app partner before met in person	Yes	Ref			Ref			
	No	1.00	0.51,1.94		0.98		0.50,1.93	
Self-reported HIV status	Negative or not sure	Ref			Ref			
	Positive	2.27	0.78, 6.60		2.22		0.76, 6.52	

[€]Model adjusted for age, residence, education, marital status and income.

Sex patterns with last app partners among Chinese MSM who met last gay app partner within and over one week after met through gay app in last six months, 2014 (N=824)

Table 5

	Duration between first met through gay app and in person				P	
	Frequency	Percentage	Frequency	Percentage		
	One week or less	More than one week				
Number of gay app partners in last six months	<2	134	21.7	90	43.5	<0.001
	2 or more	483	78.3	117	56.5	
Negotiated about condom use with the last gay app partner before met in person	Yes	356	57.7	130	62.8	0.22
	No	261	42.3	77	37.2	
Used condom during last anal sex with the last partner met through gay app	Yes	394	74.8	133	74.3	0.92
	No	133	25.2	46	25.7	
Asked for HIV status of the last gay app partner before met in person	Yes	175	28.4	99	47.8	<0.001
	No	442	71.6	108	52.2	
Place had sex with the last gay app partner	Hotel	252	40.8	93	44.9	0.055
	Home	299	48.5	99	47.8	
	Venues	66	10.7	15	7.3	