




# Testing Together Behaviors in Secondary Distribution of HIV/Syphilis Self-testing Program Among Men Who have Sex with Men in China

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## Abstract

HIV self-testing (HIVST) is recommended as a promising way to increase HIV testing uptake among MSM. MSM sometimes used HIVST kits together with their sexual partners or friends. However, limited data was reported on MSM's testing together behaviors with sexual partners and non-sexual contacts. Data were collected among MSM in China from June 2018 to June 2019. Eligible participants (referred to as “index participants”) finished a baseline survey and applied for HIVST kits. They were encouraged to distribute the kits to other people (referred to as “alters”). Index participants finished a 3-month follow-up survey on the distribution and usage of the kits. Alters finished an online survey on the usage of HIVST kits after they returned the photographed testing results. Results were reported based on index participants and alters, respectively. Based on follow-up data, 138 index participants successfully motivated others for HIVST, most of them (77.5%) tested together with at least one alter. Around half of alters (52.3%) reported testing together with index participants. Index participants distributed more HIVST kits to friends than sexual partners. MSM who had ever tested for HIV were more likely to test together. Our study demonstrated that the testing together behaviors during HIVST distribution among sexual partners and social network contacts were common. The social network-based approach is essential in promoting testing together and HIV status disclosure among MSM.

**Keywords** HIVST · Secondary distribution · Sexual network · Social network · Testing together

## Introduction

Human immunodeficiency virus (HIV) testing is a key strategy for HIV prevention and care continuum [1] and knowing the HIV serostatus is crucial to guide one's sexual decision-making and link people to care, thus decreasing the further

transmission of HIV. Although HIV testing coverage has significantly increased among men who have sex with men (MSM) in recent years, the HIV testing rate is suboptimal among this population in China. It was reported that the lifetime HIV testing rate for MSM was only 54% in 2015 [2]. Reasons for the suboptimal HIV testing rate among MSM include dual discrimination towards HIV and homosexuality, low trust in health institutes, and inconvenient clinic time or location [3–5]. The stigma serves as a barrier to HIV testing through negative interactions with healthcare providers and discrimination in healthcare settings [6]. Facilitate-based HIV testing often carries the risk of revealing one's HIV status and sexual orientation, which hinders men from HIV testing [5].

HIV self-testing (HIVST) is recommended as a promising way to increase HIV testing uptake [7–9]. In China, HIVST kits are widely available through online pharmacy stores and government-sponsored pilot programs [10]. There has been a high HIVST acceptance rate among MSM, and around 20% of MSM had used HIVST kits [11]. HIVST can empower MSM to get more control of

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HIV testing in terms of convenience and confidentiality [12]. It has been shown that HIVST increased HIV test frequency and engaged first-time testers [13]. There are several strategies to distribute HIVST kits to MSM, including the secondary distribution approach, which offers multiple HIVST kits to people and lets them distribute the kits to people in their networks. A growing body of literature in China, the US, Europe, and Africa demonstrates that the secondary distribution of the HIVST approach improved HIV testing coverage and new HIV case identification [14–17].

During HIVST secondary distribution, the distributor (index) is sometimes tested together with the recipients (alters). Some secondary distribution programs encouraged participants to test with their sexual partners (called as couple testing or partner testing) and showed the strong ability of couple testing in initiating HIVST, including first-time testing [18, 19]. Couple/partner testing can promote the use of HIVST kits because the support and companionship of other people during the self-testing process are facilitators of HIVST [5]. Additionally, these studies indicated that couple testing among sexual partners led to safer sexual behaviors and decreased HIV infection risks [18, 19]. Some secondary distribution programs did not instruct participants to conduct couple testing but used HIVST kits together spontaneously. For example, a Chinese study did not ask MSM to use HIVST kits with their sexual partners, but half of the MSM reported testing with their sexual partners [14]. However, there is limited literature on MSM couple testing during HIVST secondary distribution among Chinese MSM.

Other underexamined aspects regarding HIVST kits distribution are the distribution behaviors and testing together behaviors beyond sexual partners. World Health Organization (WHO) newly recommended that social network-based approaches be considered an HIV testing approach for key populations, which offer HIV testing to social contacts of key populations in addition to sexual partners [20]. HIVST distribution via social networks can be a supplement to sexual networks [21]. MSM showed the willingness to test with social network contacts in the secondary distribution process. A study among American MSM reported that 45% of them indicated positive attitudes towards testing with friends [22]. In order to distinguish from couple testing, the term “testing together behavior” is used in this study to describe the behaviors that MSM use HIVST kits together with other people, including sexual partners and social network contacts. However, limited studies have investigated testing behaviors among social networks in real-life settings. Additionally, violence related to the HIVST could be a potential risk when MSM distribute HIVST kits to other people and test together [23]. A low rate of violent events was reported in HIVST studies in Africa [18, 24], while the investigation on this issue is limited among Chinese MSM.

In this study, MSM were provided HIVST kits and can distribute them to anyone they know who might need HIV testing. MSM were not instructed or asked to test with other people. The study aimed to understand the rates of spontaneous testing together behaviors among both sexual networks and social networks during HIVST secondary distribution, to evaluate factors associated with testing together behaviors, and to identify negative feelings and events that occurred during testing together.

## Methods

### Study Design and Participants

This study was conducted in Zhuhai City, Guangdong Province, China from June 2018 to June 2019. MSM were recruited from around China between June 2018 and March 2019 through banner ads on a WeChat platform (a multi-functional social app). There were 5891 followers of the Zhuhai Xutong WeChat platform, and 1711 people read the ads on the platform. MSM also used this platform for self-test kits application and testing results returning.

Participants were eligible if they were biologically male, 16 years old or above, had ever had sex with men, were willing to complete a follow-up survey, and consented to participate in the study. Potential participants were asked to finish a screening survey for eligibility. Eligible participants (referred to as “index participants”) were invited to finish a baseline survey and could apply up to five dual HIV/syphilis self-test kits per 3 months till March 2019. SD BIOLINE HIV/syphilis Duo test kits (Standard Diagnostics Inc.) were used in this study. Then, self-test kits were mailed to index participants after they paid the deposit for the kits online (15 USD/kit). Index participants were encouraged to distribute the self-test kits to others (referred to as “alters”). The deposit was refunded to index participants after receiving the photographed test results from alters or index participants. Participants with positive results of HIV or syphilis were contacted and recommended to receive confirmatory tests and treatment in clinics.

### Measures

Index participants were asked to finish a baseline survey and a 3-month follow-up survey. Alters were invited to finish an online survey after they returned the photographed testing results. A small incentive of 3 USD was provided to all participants who returned the test results and finished a survey.

For both index participants and alters, information on socio-demographic characteristics was asked, including age, residence status, marital status, ethnicity, educational level, annual income, sexual orientation, and gender identity. We

also collected information on sexual behaviors including disclosure of sexual orientation, number of male partners in the past 6 months, condom use in the last sex, sex with females in the past 6 months, and role in the sex. We also asked all participants if they had ever tested for HIV.

In the 3-month follow-up survey, index participants were asked about the information on the usage and distribution of the self-test kits. They were asked to provide information on alters to whom they gave self-test kits, including the gender of the alters and their relationships to the alter. Index participants were asked if they used the HIVST kits together with each alter. Since index participants may distribute kits to more than one alter, index participants were considered to have performed testing together behaviors as long as they tested with at least one alter. Alters were also asked if they used the HIVST kits at the same time as the index. Due to confidentiality concerns, index participants and alters were not required to match the testing together behavior. Index participants and alters were asked if there were negative feelings or events when they distributed or received the self-tested kits (such as shame, untrust, and physical violence).

## Ethical Statement

The institutional review board of Zhuhai Municipal Center of Chronic Disease Control, Guangzhou, China approved this study [2018(4)]. All participants signed the electronic consent form before starting the survey.

## Data Analysis

Descriptive statistics were used to describe index participants' and alters' socio-demographic information, sexual behaviors, HIV testing history, and testing together behaviors. Multivariable logistic regression was used to examine factors associated with testing together behaviors of index participants and alters, and possible confounders, including age, marital status, and ethnicity, were adjusted. The results were reported as odds ratios (OR) or adjusted OR (aOR) with corresponding 95% confidence intervals (95% CI). Analyses were conducted using Stata 16 (StataCorp LLC, College Station, TX, USA).

## Results

### Participants Characteristics

In total, 851 MSM applied for the dual HIV/syphilis self-test kits. Among those applicants, 371 met the eligibility criteria and successfully applied for the self-test kits. The applicants applied for 1150 kits in total. At the end of the study, 1141 photographed testing results were received by researchers.

After verification, 1099 results were valid. The majority of the testing results (73.7%) were from index participants, and 26.3% were from alters. Among 371 index participants, 351 finished the 3-month follow-up survey, and 268 alters finished the survey after returning the test results. Among 268 alters, 264 who were identified as MSM were included in our final analysis.

Table 1 presents the socio-demographic characteristics of the index participants and alters. The average age of index participants was 28.7 years old and that of alters was 29.4. Most of the index participants (84.1%) and alters (72.8%) were never married. Regarding the education level, more than half of the index (53.4%) and alters (53.7%) had finished university. The majority of the index participants were employed (80.1%), and 24.2% had an annual income of less than \$5000. Alters showed similar education and income distribution with index participants, with 81.1% of them employed and 22.1% having an annual income of less than \$5000.

Most of the index participants and alters self-identified as male (96.5%) and gay (69.8%). The percentage of index participants (70.1%) who disclosed their sexual orientation to others was higher than alters (59.2%). In the past 6 months, 56.1% of the index participants had more than two male sex partners. However, only 35.7% of alters had more than two male sex partners. Only a small proportion of index participants (8.4%) and alters (13.2%) had sex with females in the past 6 months. About 79.3% of the index participants and 59.9% of the alters had tested for HIV before.

### Self-testing Together Behaviors

Table 2 shows the self-testing together behaviors of index participants and alters. According to the follow-up survey, 138 index participants reported distributing HIVST kits to at least one alter, resulting in a total of 237 self-test kits. Near half of these kits (108/237, 45.6%) were distributed to index participants' gay friends, 27.0% were given to stable sexual partners, 16.9% to casual sexual partners, and 10.6% to families and others. The majority of the distributors (107/138, 77.5%) tested with at least one alter, performing a total of 145 times testing together behaviors. The testing together behaviors were conducted mainly between sexual partners, and more were reported among stable sexual partners (61/145, 42.1%) than casual sexual partners (25/145, 17.2%). Almost all index participants who gave kits to stable sexual partners (61/64, 95.3%) used the kits with alters concurrently. More than 30% of the reported testing together behaviors are among friends.

Based on 264 alters' responses, more than half of the alters (138/264, 52.3%) reported testing with index participants simultaneously. Regarding the course of HIVST kits, the main source of self-test kits is alter's gay friends: 49.2%

**Table 1** Characteristics of the index participants (n = 371) and alters (n = 264) in China, 2018–2019

Variables	Index		Alter	
	N = 371	%	N = 264	%
Age in years (Mean/SD)	28.7/6.9		29.3/7.0	
Marital status				
Never married	312	84.10	191	72.35
Married or was married	59	15.90	73	27.65
Residence				
Rural	164	44.20	89	33.71
Urban	207	55.80	175	66.29
Ethnicity				
Han	367	98.92	256	96.97
Other minorities	4	1.08	8	3.03
Highest education				
High school/below	74	19.95	62	23.48
Some college	99	26.68	60	22.73
University	198	53.37	142	53.79
Employment				
Student	62	16.71	37	14.02
Employed	292	80.05	227	81.06
Unemployed	12	3.23	13	1.92
Annual income levels (in USD)				
< 2500	48	12.94	32	12.12
2500–5000	42	11.32	26	9.85
5001–8500	99	26.68	75	28.41
8501–15,000	103	27.76	81	30.68
> 15,000	79	21.29	50	18.94
Gender identity				
Male	358	96.50	254	96.21
Female/transgender/other/unsure	13	3.50	10	3.79
Sexual orientation				
Gay	259	69.81	178	67.42
Bisexual	91	24.53	56	21.21
Heterosexual/Unsure	21	5.66	30	11.36
Disclosed same-sex behavior with another man to others				
Yes	260	70.08	158	59.85
No	111	29.92	106	40.15
Anal sex with a male partner in the past 6 months				
Zero	59	15.90	84	31.82
One	104	28.03	85	32.20
More than one	208	56.06	95	35.98
Used a condom during last sexual intercourse with a male partner <sup>a</sup>				
Yes	262	49.60	146	80.66
No	52	50.27	35	19.34
Role in the sex <sup>a</sup>				
Receptive	93	29.62	77	42.54
Insertive	131	41.72	56	30.94
Both	90	28.66	48	26.52
Sex with a female partner in the past 6 months				
Yes	31	8.36	35	13.26
No	340	91.64	229	86.74
Ever tested for HIV before				

**Table 1** (continued)

Variables	Index		Alter	
	N = 371	%	N = 264	%
Yes	294	79.25	158	59.85
No	77	20.75	106	40.15

<sup>a</sup>Only participants who had sex with a male partner in the past 6 months answered the question

**Table 2** Testing together behaviors among index participants (n = 371) and alters (n = 264) in the study, 2018–2019

	Index (n = 371)		Alter (n = 264)	
	Total	Testing together	Total	Testing together
	N %	N %	N %	N %
The number of testers	138	107/138 77.54	264	138/264 52.27
The number of distributions of test kits	237	145/237 53.11	264	138/264 52.27
First-time tester among distributors or recipients	21	14/21 66.7	106	48/106 45.3
Relationship of the index and alter				
Stable sexual partner	64/237 27.00	61/145 42.07	83/264 31.44	61/138 44.20
Casual sexual partner	40/237 16.88	25/145 17.24	31/264 11.74	17/138 12.32
Gay Friends	108/237 45.57	44/145 30.34	130/264 49.24	53/138 38.41
Family	6/237 2.53	3/145 2.07	13/264 4.92	5/138 3.62
Other	19/237 8.02	12/145 8.28	7/264 2.65	2/138 1.45
Negative experiences when the index delivering a kit to the alter				
The alter did not understand at the time why the index gave him a self-test kit	16	15	17	13
The alter felt that giving him a kit was to shame him	6	6	13	11
The alter felt that the index does not trust him	14	14	24	15
Because of the test kit, the index and alter had some verbal conflict, such as arguing, verbal abuse, etc	1	1	12	10
Because of the test kit, the index and alter had some physical conflict, such as forceful pushing or hitting, etc	0	0	12	10
The index used forceful methods to make the alter accept the test, including threats, treating him coldly, or using force	1	1	13	10
Because of the test, the relationship between the index and alter has become distant	3	2	12	10
At least experienced one negative event above	25	23	31	22

of alters got self-test kits from their gay friends. For the rest alters, 31.4% got the self-test kits from stable sexual partners, 11.7% from casual sexual partners, and 7.6% from families and others. More than 40% of the alters (61/138, 44.20%) had testing together behaviors with their stable sexual partners, and more than one-third (53/138, 38.41%) with their friends.

Half of 106 alters who had never been tested for HIV received the HIVST kit from their gay friends and conducted their first HIVST. Furthermore, 48 (45.3%) tested with index

participants at the same time. Among 48 alters who tested with their index participants, 23 (47.9%) used self-test kits with their friends and 16 (33.3%) with their stable sexual partners.

A small number of index participants (25/371, 6.7%) and alters (23/264, 8.7%) reported some negative feelings or events when they distributed or received the self-test kit. Descriptions of those negative feelings and events can be found in Table 2. Negative feelings, such as misunderstanding, shame, and mistrust were most frequently reported.

**Table 3** Associated factors for testing together behaviors among index men, 2018–2019 (n = 371)

	Index			aOR	95% CI	p-Value
	OR	95% CI	p-Value			
Age	1.01	0.98–1.05				
Marital status						
Married or was married	1.45	0.81–2.61				
Never married	Ref.					
Ethnicity						
Han	1.22	0.13–11.85				
Other minorities	Ref.					
Highest education						
High school/below	Ref.			Ref.		
Some college	1.69	0.82–3.50		1.85	0.88–3.87	
University	2.09	1.09–4.02	**	2.29	1.17–4.45	**
Residence						
Urban	1.75	1.10–2.79	**	1.75	1.08–2.82	**
Rural	Ref.					
Employment						
Student	Ref.					
Employed	1.34	0.71–2.52				
Unemployed	1.04	0.25–4.36				
Annual income levels (USD)						
< 2500	Ref.					
2500–5000	0.67	0.23–1.93		0.65	0.22–1.90	
5001–8500	1.08	0.48–2.43		1.06	0.44–2.53	
8501–15,000	1.66	0.75–0.65		1.63	0.71–3.75	
> 15,000	2.17	0.97–0.89	*	2.15	0.90–5.13	
Gender identity						
Male	Ref.					
Female/transgender/other/unsure	1.57	0.50–4.91				
Sexual orientation						
Gay	Ref.					
Bisexual	1.07	0.64–1.82				
Heterosexual/unsure	1.27	0.39–3.28				
Disclosed same-sex behavior with another man to others						
Yes	1.06	0.65–1.75				
No	Ref.					
Anal sex with a male partner in the past 6 months						
Zero	Ref.					
One	1.18	0.55–2.52		1.13	0.53–2.43	
More than one	1.72	0.87–3.39		1.65	0.83–3.27	
Condom use last time <sup>a</sup>						
Yes	2.68	1.21–5.96	**	2.72	1.22–6.05	**
No	Ref.			Ref.		
Role in the sex <sup>b</sup>						
Receptive	Ref.			Ref.		
Insertive	1.69	0.93–3.07	*	1.66	0.90–3.05	
Both	1.38	0.72–2.67		1.35	0.69–2.62	
Sex with female						
Yes	1.40	0.65–3.03		1.15	0.48–2.74	
No	Ref.			Ref.		
Ever tested for HIV						
Yes	2.08	1.11–3.91	**	2.03	1.07–3.86	**
No	Ref.			Ref.		

**Table 3** (continued)<sup>a</sup>The multivariate logistic regression analysis controlled age, marital status, and ethnicity<sup>b</sup>The regression was analyzed among those who had sex with male in the past six months\* $p < 0.1$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$ 

Verbal conflict, physical conflict, and coercive behaviors were very rare. Most of the negative feelings or events happened during or after testing together. For example, 12 alters thought their relationships became distant after receiving the HIVST kits, and 10 of them had such feelings after using the self-test kits with the index participants.

### Factors Associated with Testing Together Behaviors

Tables 3 and 4 show the logistic regression results for the testing together behaviors among index participants and alters. After controlling for age, marital status, and ethnicity, index participants who finished university education (aOR = 2.29, 95% CI 1.17–4.45), used condoms in the last sex (aOR = 2.72, 95% CI 1.22–6.05), and had ever tested for HIV (aOR = 2.03, 95% CI 1.07–3.86) were more likely to test with alters at the same time.

Alters who finished university education (aOR = 2.29, 95% CI 1.17–4.45), had ever tested for HIV (aOR = 1.75, 95% CI 1.05–2.93) were more likely to test with index participants. Compared with alters who self-identified as heterosexual or unsure, gay men (aOR = 2.55, 95% CI 1.12–5.82) were more likely to test together. Alters who were stable sex partners of index participants (aOR = 7.33, 95% CI 2.41–22.29) were more likely to test together than in other relationships. Alters who had one sexual partner in the past 6 months (aOR = 3.40, 95% CI 1.77–6.53) and used condom in the last sex (aOR = 2.44, 95% CI 2.11–5.37) were more likely to test with index participants.

### Discussion

Distributing HIVST kits among sexual and social networks may be a useful strategy to initiate the first-time HIVST among MSM. This study extended the existing literature by expanding the scope of HIVST secondary distribution from sexual networks to social networks, exploring the experiences of the people testing together in their sexual and social networks, and examining the effectiveness of HIVST distribution through a network-based approach. We found that although testing together behaviors was more common among sexual partners, index participants mostly reached untested MSM through social networks.

Our findings reported a moderate rate of testing together behaviors between index participants and alters

compared with other studies where only sexual partners were included as alters [14, 19]. This finding is comparable with a study among Chinese MSM, which reported that half (54.2%) of distributors used the kits together with their sexual partners [14]. Higher rates of testing together behaviors were reported in studies where distributing to sexual partners was encouraged. A higher couple testing rate (82%) was reported among female sex workers who were encouraged to test together with their partners in a study in Africa [19]. Although the rate of testing together behaviors was lower among social contacts than sexual partners in our study, it was higher than that in a similar study among African MSM about network distribution in which only 24% of the participants reported concurrent testing [15].

Findings in our study supported that HIVST distribution through the social network-based approach effectively scaled up HIV testing and reached untested men. Compared to sexual network distribution in this study, more HIVST kits were distributed to gay friends than sexual partners and more untested men were reached by social networks than sexual networks. Friends were the most reported relationship between index participants and alters in our study, which was also anticipated and reported in other studies [15]. Scholars considered social networks as microenvironments where MSM share health information and social support with each other [25]. Distributing self-test kits to and testing with friends, colleagues, families can be helpful to form a supportive environment among MSM. Another potential advantage of distributing HIVST kits through MSM's social networks lies in the high overlap between the social and sexual networks in MSM groups. A study on MSM in Shanghai showed that 22% of MSM indicated that at least one of their current male or female sex partners was a member of their social networks [26]. These findings suggested that the social network, as important as the sexual network, can be an effective way to deliver HIV prevention programs among MSM. Unlike another study among African MSM that 83% of the participants shared kits with their families [15], however, only less than 5% of the MSM in our study did so. The low distribution among family members may relate to the low rate of sexual orientation disclosure to families [27, 28].

We found that there were higher chances for stable sexual partners to test together than people in other relationships. Given that only 20.6% of index participants and 17.9% of alters knew their stable and casual sexual partner's HIV

**Table 4** Associated factors for testing together behaviors among alters, 2018–2019 (n=264)

	Alter			aOR	95% CI	p-Value
	OR	95% CI	p-Value			
Age	0.94	0.91–0.98	***			
Marital status						
Never married	1.73	1.00–2.98	**			
Married or was married	Ref.					
Ethnicity						
Han	Ref.					
Other minorities	1.54	0.36–6.59				
Highest education						
High school/below	Ref.					
Some college	1.48	0.72–3.03		1.55	0.6–3.19	
University	2.08	1.13–3.82	**	2.10	1.12–3.93	**
Residence						
Urban	1.03	0.62–1.73		1.15	0.68–1.93	
Rural	Ref.			Ref.		
Employment						
Student	4.32	1.14–16.37	***	2.90	0.72–11.67	
Employed	1.57	0.50–4.95		1.59	0.49–5.22	
Unemployed	Ref.			Ref.		
Annual income levels (USD)						
< 2500	Ref.					
2500–5000	0.70	0.24–2.00				
5001–8500	0.58	0.25–1.36				
8501–15,000	0.59	0.25–1.35				
> 15,000	0.70	0.28–1.74				
Gender identity						
Male	2.65	0.67–10.47				
Female/transgender/other/unsure	Ref.					
Sexual orientation						
Gay	2.43	1.09–5.40	**	2.55	1.12–5.82	**
Bisexual	1.20	0.48–3.00		1.44	0.56–3.72	
Heterosexual/unsure	Ref.			Ref.		
Disclosed same-sex behavior with another man to others						
Yes	1.50	0.91–2.46				
No	Ref.					
Relationship						
Stable sexual partner	5.15	1.82–14.57	***	7.33	2.41–22.29	***
Casual sexual partner	2.26	0.71–7.19		3.12	0.91–10.69	
Gay friend	1.28	0.48–3.42		1.56	0.55–4.40	
Other	Ref.			Ref.		
Anal sex with a male partner in the past 6 months						
Zero	Ref.					
One	3.33	1.76–6.28	***	3.40	1.77–6.53	***
More than one	1.24	0.69–2.25		1.29	0.70–2.38	
Condom use last time <sup>a</sup>						
Yes	2.41	1.13–5.12	**	2.44	2.11–5.37	**
No	Ref.			Ref.		
Role in the sex <sup>b</sup>						
Receptive	Ref.					



**Table 4** (continued)

	Alter			aOR	95% CI	p-Value
	OR	95% CI	p-Value			
Insertive	0.87	0.43–1.75				
Both	0.56	0.27–1.15				
Sex with female						
Yes	Ref.			Ref.		
No	2.72	1.27–5.81	**	2.17	0.92–5.10	
Ever tested for HIV						
Yes	1.60	0.97–2.62	*	1.75	1.05–2.93	**
No	Ref.			Ref.		

<sup>a</sup>The multivariate logistic regression analysis controlled age, marital status, and ethnicity

<sup>b</sup>The regression was analyzed among those who had sex with male in the past six months

\*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

status before sex [29], distributing HIVST kits among sexual partners might increase the percentage of knowing their sexual partners' status. In our study where HIVST kits were available, stable sexual partners were highly likely to test together. Our findings supported that HIVST distribution might be an efficient strategy to increase the testing together frequency and disclosure of HIV status to each other. However, the concern is that fewer testing together behaviors were reported among casual sexual partners than stable sexual partners. The effect of secondary distribution of HIVST on promoting disclosure of HIV status among casual sexual partners was suboptimal. More strategies on promoting testing together behaviors and knowing sexual partners' HIV status among casual sexual partners are needed.

HIV testing history was a predictor for self-testing together behaviors of both index participants and alters. Studies have shown the relationship between HIV testing history and self-testing acceptance [11, 18, 24]. Our study further supported that HIV testing history is related to self-testing together behaviors among MSM. The mechanism under the association needs further exploration. Although untested alters were less likely to test together with index participants, this study found a significant number of untested alters tested with index participants. Nearly half of the untested alters who reported testing together behaviors use the HIVST kit as their first HIV test. Previous studies showed that HIVST with partners, friends or relatives can provide emotional support and encourage people to test [16, 30]. Despite the need for social support during HIVST is not universal, it has implications that self-testing kits could be distributed in pairs and encourage people to test with a trusted person.

There are several limitations in this study. First, we only collected information on index participants' distribution at a 3-month follow-up survey. Some self-test kits were distributed after the survey, and information on the distribution

after the follow-up survey was missing. However, this proportion is less than 1% and may not impact the overall outcomes. Second, most of the sample in this study were younger than 30 years old and well-educated. The representativeness of the sample is compromised. The interpretations of the findings were limited. Third, the recruitment advertisements were only on the WeChat official platform, hence those who had limited access to the Internet and WeChat were not included. Forth, index participants need to come out in front of the research team members, which might be a barrier or concern for MSM to participate. Fifth, in this study, it is unknown who, index participant or alter, suggested or refused to test together, which may impact the findings.

## Conclusion

The HIVST distribution among MSM's social networks can increase HIVST uptake and promote HIVST to people who had never been tested before beyond sexual networks. While testing together behaviors were more likely to happen between sexual partners than people in other relationships, there was still a notable percentage of friends testing together. Thus, HIVST distribution and testing together behaviors beyond sexual partners of MSM are promising strategies for HIV/AIDS prevention in China. Although few negative feelings and events were reported, proper instruction on testing together and referral services should be provided in future secondary distribution programs.

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**Data Availability** Not applicable.

**Code Availability** Not applicable.

## Declarations

**Competing interests** All authors have declared no conflicts of interests.

**Ethical Approval** The institutional review board of Zhuhai Municipal Center of Chronic Disease Control, Guangzhou, China provided approval for this study.

**Consent to Participate** All participants signed the electronic consent form before starting the survey.

**Consent for Publication** Not applicable.

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