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Men Who Have Sex with Men in Cambodia: Population Size, HIV Risky Behaviors, and HIV Prevalence

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Abstract Background: Men who have sex with men (MSM) constitute a significant proportion of HIV key populations in Cambodia. We conducted this study to estimate the national population size, assess HIV-related risk behaviors, and determine HIV prevalence among MSM in Cambodia. **Methods:** This research was conducted in 2014 in 12 study sites in Cambodia. MSM size estimation was performed using capture-recapture method with data collected in two time points within an 18-day interval. To assess HIV risk behaviors, a total of 838 MSM were randomly selected for face-to-face interviews during the capture round. A separate survey using a time location sampling approach was conducted to estimate HIV prevalence. **Results:** The estimated size of MSM in Cambodia was 31,000. Of the total, 52.0% were in urban areas; 89.0% were sexually active; and 65.0% were reachable MSM. Phnom Penh had the largest MSM population. More than two-thirds (69.4%) of MSM reported always using condoms in the last month. The majority (71.6%) of them reported receiving HIV information, while 66.6% and 49.3% reported having been tested for HIV and sexual transmitted infections (STI), respectively in the past six months. Eight percent reported having at least one STI symptom in the past 12 months; of whom, 93.6% reported receiving treatment for the most recent symptoms. HIV prevalence among MSM in this study was 2.3%. The highest HIV prevalence was found in Siem Reap (5.9%) and Phnom Penh (3.0%). The prevalence was higher among MSM aged 25 years or older (4.6%) and those with lower formal education level (4.5%). MSM who reported sex work being their main job had the highest HIV prevalence (17.2%) compared to those in other occupation categories who had a prevalence ranging from 1.0% to 4.7%. **Conclusions:** With a population size of approximately 31,000, MSM in Cambodia remain at high HIV risk due to their engagement in multiple risky sexual behaviors. Continued efforts to prevent, manage, and treat HIV in this population are essential to eliminate new HIV infections by 2020. Considerations of sub-groups are imperative to better inform resource allocation to refine the efficacy of intervention programs for this population.

Keywords: men who have sex with men (MSM), size estimation, HIV prevalence, risk behaviors, Cambodia

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1. Introduction

Globally, men who have sex with men (MSM) are recognized as a population with high risk of HIV infection. According to a 2012 review, HIV prevalence among MSM ranged from as low as 3.0% in the Middle East to as high as 25.4% in the Caribbean countries [1]. In all the countries included in the review, the prevalence is substantially higher than that among the general population reported in UNAIDS's 2009 projection [1]. HIV infection is also widespread among MSM throughout Asia, with the highest prevalence rate of up to 35.0% [2]. In 2006, Asian MSM had 18.7 times the odds of being

HIV infected compared with the general adult population [3]. Government and donor investments in HIV prevention programs for MSM are insufficient, particularly when compared with the proportion of MSM transmission to the overall HIV epidemic [2].

Similar to other settings, MSM share a significant role in driving the HIV epidemic in Cambodia. A study in 2010 reported that MSM had the prevalence rates of HIV and sexually transmitted infections (STI) at 2.2% and 51.5%, respectively [4]. The HIV prevalence among MSM was almost three times higher than that among the general population aged 15-49 years old in the same year [4,5]. Also, risky sexual behaviors among this population remain rampant. According to our recent study, only

38.1% of MSM reported always using condoms in the past month when having sex with male sex workers [6,7].

With success in bringing down the HIV prevalence in the general adult population from the peak of about 2.0% in 1998 to 0.6% in 2014, Cambodia is hoping to achieve its new goals through the Cambodia 3.0 strategy aiming to eliminate new HIV infections in Cambodia by 2020 through advancement in HIV prevention and treatment [8]. To support this new strategy, a new standard operating procedure known as the Boosted Continuum of Prevention to Care and Treatment (Boosted CoPCT) was introduced in 2013 [8]. The Boosted CoPCT, however, needs data on national population size as well as behavioral and biological surveillance of MSM for program planning, implementation, monitoring, and evaluation in order to reduce the HIV prevalence among this population. This study thus was conducted to estimate the national population size, assess HIV-related risk behaviors, and determine HIV prevalence among MSM in Cambodia.

2. Materials and Methods

2.1. Study Population

According to UNAIDS, MSM are defined as “males who have sex with males, regardless of whether or not they have sex with women or have a personal or social gay or bisexual identity” [9]. A man will be included in the study if he met the following criteria: (a) 15 years of age or older; (b) biological male; (c) having sex with at least one male partner in the past 12 months; (d) speaking Khmer; and (e) being able and willing to provide an informed consent to participate in the study.

2.2. Study Sites

The study was conducted in urban areas of 12 sites (the capital city and 11 provinces) in Cambodia: Banteay Meanchey, Battambang, Kampong Cham, Kampong

Chhnang, Kampong Speu, Kandal, Koh Kong, Phnom Penh, Preah Sihanouk, Prey Veng, Siem Reap, and SvayRieng. These study sites were selected because they had been in the list of areas with high HIV burden.

2.3. Sample Sizes and Sampling Procedures

This paper comprised three studies: (1) national MSM size estimation; (2) HIV-related risk behavioral survey; and (3) HIV prevalence among MSM in Cambodia.

To prepare for the size estimation, we updated lists of MSM venues in the study sites prior to the data collection, using a two-phase method. In the first phase, we collected a list of existing venues/hotspots from local non-governmental organizations (NGOs) in each study site. We then met with the NGOs and Municipal/Provincial Health Departments to review and update the lists. These stakeholders were also asked about specific times and days that MSM preferred to congregate in these spots. During the first phase, 108 new venues/hotspots were identified and added to the 505 existing venues in the original lists. In the second phase, we identified members of MSM communities who had extensive networks within this population and were potentially not in the current HIV program coverage areas. These persons included MSM who knew other MSM living outside of their area. We then worked with them to investigate additional new venues/hotspots. To identify MSM who had a large network, we visited public spots such as parks, riverbanks, and streets and asked 15 MSM about the number of MSM and places where MSM met. Out of the 15, two MSM who knew more than the others were selected for interviews. The purpose of this process was to identify venues/hotspots that were not included in the existing lists. Eight key informants (MSM with a broad network) were interviewed in each study site, with 96 interviews in total. The names of additional locales were added to the updated lists. In phase two, 28 more venues/hotspots were identified (see Table 1). An MSM venue map was developed out of this exercise.

Table 1. Estimated numbers of MSM and venues/hotspots by study site from Phase 1 to Phase 2

Study Sites	Number of venues	Phase 1	Phase 2	Total	Estimated number of MSM
BanteayMeanchey	82	70	0	152	1,326
Battambang	83	2	0	85	2,244
Kampong Cham	27	0	0	27	300
Kampong Chhnang	28	2	0	30	282
Kampong Speu	2	16	3	21	529
Kandal	19	0	0	19	344
Koh Kong	27	14	2	43	272
Phnom Penh	108	0	13	121	4,356
Prey Veng	69	4	0	73	571
Siem Reap	43	0	0	43	801
Preah Sihanouk	17	0	0	17	120
SvayRieng	0	0	10	10	56
Total	505	108	28	641	10,698

Abbreviation: MSM, men who have sex with men.

For the size estimation, all venues/hotspots were visited during a capture round and re-visited during a recapture round. For the behavioral assessment, EpiInfo software (Odense, Denmark) was used to calculate the required sample size. Inconsistent condom use was considered the main outcome variable for this calculation. Based the 2010 study, the percentage of MSM who did not use condoms during their last sexual encounter was

approximately 35.0%, and the number of MSM was estimated to be around 21,300 in 2008 [10,11]. By selecting the confidence limit at 4% and choosing the design effect equal to two, the minimum required sample size was 800 individuals, taking into account a 95.0% confidence interval (CI) and a 10.0% refusal rate. A two-stage cluster sampling was used to recruit the participants. Venues/hotspots were considered primary sampling units,

and individuals were considered secondary sampling units. From the existing geographical information system mapping for key populations in five provinces, there were about nine MSM per venue/hotspot. Therefore, 133 venues/hotspots were randomly selected from the entire list of 641 venues/hotspots to draw a representative sample.

To estimate the HIV prevalence, a biological survey was conducted using a time-location sampling approach. The same map developed for the size estimation was used as a sampling frame to randomly select a sample size of 1,646 MSM from seven study sites including Banteay Meanchey, Battambang, Kampong Cham, Kandal, Phnom Penh, Preah Sihanouk, and Siem Reap. Approximately 200 MSM per study site were selected, except Phnom Penh where 400 MSM were included in the sample.

2.4. Data Collection Training and Procedures

Prior to the data collection, a three-day training course was conducted with all research team members. The training covered several topics such as the study objectives, the use of the tools, interview techniques, ethical considerations, communication skills, and how to administer the questionnaires. Data collection team leaders were responsible for the overall monitoring of the data collection and quality. They were also responsible for identifying, documenting, and reporting protocol violation and social harms to the principal investigators. Moreover, they checked completed questionnaires upon receipt from team members.

2.4.1. Size Estimation

The capture-recapture method was used to estimate the size of MSM in this study. This method relies on five main assumptions: (1) the population is closed; (2) every member has an equal chance of being recruited in the survey; (3) individuals captured in both rounds need to be matched; (4) the two sample sizes from both rounds are independent; and (5) the sample size of each round is large enough to be meaningful. If the two rounds are independent, the estimated probability of being tagged in both rounds is the product of the probabilities of being tagged in each round [9,11,12].

In the capture round, the data collectors visited every single venue/hotspot identified in the mapping lists and “tagged” all MSM at each venue/hotspot. They contacted MSM present at each survey site, introduced the survey and asked whether the potential participant agreed to be screened for eligibility. If the potential participants were eligible, those who chose to participate were asked to provide a verbal consent using a written standard consent form. For every contact, the data collectors collected brief information on socio-demographic characteristics and risky sexual behaviors using a short questionnaire. After completing the questionnaire, they provided a can of soft drink to the participants to help with recalling during the recapture round. This memorable token was used to prevent double counting and also to help identify individuals counted in both rounds. A question about if the participants had received a can of soft drink after completing an interview was included in the questionnaire for tagging.

Eighteen days after the capture round, the data collectors revisited every survey site to recapture all MSM

present there. The same screening criteria were applied. Also, the same questionnaire was used, except three different questions that were added in the recapture round. In this round, the data collectors provided a handkerchief as a memorable token to the participants and asked if they were captured in the first round. To identify who had been interviewed in the first round, all participants were asked if they had received a can of soft drink after completing an interview in the past two/three weeks. To assess duplicates in the second round, the participants were asked if they had received the second memorable token, a handkerchief.

During both rounds, each venue/hotspot was visited at least two times based on the proposed times of MSM gathering at the venues/hotspots. The proposed times of recruitment were based on the experiences of NGO staff working in the areas or through the key informant interviews (KIIs) with MSM during the venue/hotspot mapping.

2.4.2. HIV-related Risk Behavior Survey

The behavioral survey was conducted simultaneously with the size estimation. Additional behavioral questions were added to the questionnaire administered during the capture round to randomly select MSM to participate in the survey. A total of 838 MSM were interviewed. The survey collected information on socio-demographic characteristics, condom and lubricant accessibility, sexual behaviors with different types of partners, access to HIV programs, and access to health services.

2.4.3. HIV Prevalence Survey

After the behavioral survey, the participants were asked for an informed consent to participate in the prevalence survey. Then, they were interviewed with a short questionnaire about their demographic characteristics and gender identity. A 5-10 ml of whole blood sample was acquired from them for HIV testing. As mentioned above, 1,646 MSM participated in the prevalence survey.

To perform HIV testing, a serial two-test algorithm – Determine HIV ½ and Stat-Pak – was used. A dried blood spot card was prepared for the samples selected for quality control, which were brought to NCHADS’s central laboratory. All positive samples and 10.0% of all non-reactive specimens were tested for the quality control. Two enzyme immunoassays (EIA) were used for this quality control: Vironostika HIV Uniform and Murex HIV-1.2.0 [14].

2.5. Data Analyses

The MSM size estimation analysis was done in four steps. First, a Lincoln-Peterson formula was used to calculate the estimated number of MSM in the 12 study sites. The formula was $N = C1 * C2 / R$ where N was the estimated population size, C1 was the number of unique contacts in Round 1, C2 was the number of unique contacts in Round 2, and R was the number of MSM contacts in both rounds. Second, we assumed that MSM identified at the venues/hotspots were visible-reachable MSM. To take into account the number of hidden MSM, the information from the 96 KIIs was used. Every key informant was asked, “Of the MSM that you know, how many do not disclose their MSM status?” Some of them reported a percentage and others reported an exact number

(e.g. 5 out of 15). From these data, we calculated the mean of the percentages, which was about 35.0%. The number of hidden MSM was based on this percentage.

Third, we calculated an estimated total number of MSM in the 12 study sites, of which 35.0% were hidden MSM, 54.0% were visible-reachable and sexually active, and 11.0% were visible-reachable but sexually inactive (those who had sex with at least one man in lifetime, but not in the past 12 months). This 11.0% was calculated from the screening for participation eligibility. Finally, we relied on assumptions that (1) Being MSM is biological; thus, MSM can be anywhere within the general male population and (2) MSM are likely to relocate to urban cities where they can meet their peers and sexual partners. In our case, we calculated a ratio of MSM to the general male population in the same age ranges and survey sites. Overall, the ratio of MSM to the general male population was about 18 MSM per 1,000 males in urban areas and five MSM per 1,000 males in rural areas. The ratio was used to extrapolate an estimated number of MSM in other sites, which were not covered in the study. By doing so, we were able to estimate the total number of MSM nationwide.

In the behavioral survey, participants selected during the capture round were analyzed to assess HIV risky behaviors using descriptive analyses. In the prevalence survey, the HIV prevalence was determined by dividing all HIV positive cases with the sample size. Data were disaggregated by self-identified gender, age group, level of education, and study site.

Epi Data version 3.1 (Odense, Denmark) was used for double data entry, and STATA version 12.0 (College Station, TX) was used to analyze the demographic characteristics, HIV risky behaviors, and HIV prevalence. Excel spreadsheet was used to calculate summary data for the size estimation.

2.6. Ethical Considerations

Participation in this study was voluntary, and anticipated risk for the participants was minimal. A verbal informed consent was obtained from each participant in the size estimation and behavioral surveys and a written informed consent in the prevalence survey. Privacy and confidentiality of the participants were strictly protected by conducting the interviews in private places, coding the participants, and safeguarding the database with passwords. The study protocol was approved by the National Ethics Committee for Health Research (NECHR) in Cambodia and FHI 360's Protection of Human Subjects Committee (PHSC).

3. Results

3.1. Socio-demographic Characteristics

Socio-demographic characteristics of MSM in the size estimation survey are shown in Table 2. In total, 5,557 MSM were interviewed in both rounds, with a mean age of 24.8 years (SD=6.6), ranging from 15 to 49 years. The mean years of formal education completed were 9.6 (SD=3.6). The majority (92.7%) were never married; 5.0% were married; and 1.9% were divorced or separated. The most common occupations reported were business

owners (18.8%), students (16.8%), and laborers (15.0%). A high proportion of the participants (85.8%) reported living in the current city for more than two years, with a mean duration of 7.4 years (SD= 4.3).

Table 2. Socio-demographic characteristics of visible-reachable MSM interviewed in capture and recapture rounds (n= 5,557)

Socio-demographic characteristics	Number (%)
Age groups	
15-19	1044 (18.7)
20-24	2176 (39.0)
25-29	1370 (24.6)
30-34	573 (10.3)
35-39	181 (3.2)
40-44	88 (1.6)
45-49	128 (2.3)
Mean age (years, \pm SD)	24.8 (6.6)
Education (years)	
Never attended school	84 (1.5)
1-6	899 (16.2)
7-9	1700 (30.6)
10-12	1952 (35.2)
12 or higher	915 (16.5)
Mean years of formal education completed (\pm SD)	9.6 (3.6)
Occupation	
Unemployed	513 (9.2)
Students	933 (16.8)
Office workers	781 (14.0)
Entertainment workers	586 (10.5)
Self-employed	1042 (18.8)
Salon & hairdressers	779 (14.0)
Labor workers	835 (15.0)
Sex workers	40 (0.7)
Other	260 (4.7)
Marital Status	
Never married	5163 (92.7)
Married	281 (5.0)
Divorced, separated, or widowed	105 (1.9)
Length of stay in the current city	
< 1 year	416 (7.5)
1-2 years	374 (6.7)
> 2 years	4777 (85.8)
Mean length of stay in current city (in months, \pm SD)	89.3 (51.9)

Abbreviations: MSM, men who have sex with men; SD, standard deviation.

3.2. Size Estimation

3.2.1. Estimation of Visible-reachable MSM Population in the 12 Study Sites

The estimation of visible-reachable MSM population in the 12 study sites is shown in Table 3. The first column is the number of MSM counted during the capture round (Round 1). The second column is the number of MSM counted during the recapture round (Round 2). The third column is the number of MSM retagged – captured in both rounds. The fourth column shows the estimated number of MSM using the Lincoln-Peterson formula.

All MSM captured in both rounds were identified in hotspots/venues; therefore, these MSM were considered as visible-reachable MSM. The estimated size of MSM population in the 12 provinces was approximately 7,800 with a 95.0% confidence interval (CI) ranged from 7,300 to 8,400 MSM. Of the selected sites, the majority of MSM were in urban administrative districts categorized by the

2008 census. The rural administrative districts were only in Kampong Chhnang and Prey Veng provinces (Table 3).

Table 3. Estimation of visible-reachable MSM population in the 12 study sites

Study sites	Capture (C1)	Recapture (C2)	R	Total	95% CI	
	Number	Number		Number	Lower	Upper
BanteayMeanchay	307	514	238	663	634	692
Battambang	440	573	250	1008	947	1070
Kampong Cham	113	123	69	201	182	221
Kampong Chhnang (Urban)	59	115	32	212	170	254
Kampong Chhnang (Rural)	50	96	26	185	143	227
Kampong Speu	87	146	40	318	256	379
Kandal	115	183	74	284	255	314
Koh Kong	39	59	31	74	66	82
Phnom Penh	1291	1624	569	3685	3502	3867
Prey Veng (Rural)	41	173	32	222	189	254
Siem Reap	366	430	212	742	696	789
Preah Sihanouk	65	118	52	148	134	161
SvayRieng	53	44	32	73	65	81
Total	3026	4198	1657	7815	7238	8391

Abbreviation: CI, confidence interval; MSM, men who have sex with men.

3.2.2. Estimation of Visible-reachable and Hidden MSM in the 12 Study Sites

MSM estimated by the capture-recapture method are considered visible-reachable MSM and did not represent the whole MSM population. In this section, we attempted to include hidden and sexually inactive MSM.

As shown in Table 4, the total number of MSM was calculated by the sum of: (1) MSM who reported having sex with at least one man in the past 12 months (54.0%), (2) MSM who reported having had sex in their lifetime but not in the past 12 months (11.0%)—referred to as sexually inactive MSM, and (3) hidden MSM (35.0%). By including all three aforementioned groups, the total number of MSM in the age group of 15-49 years in the 12 selected city and provinces was estimated to be 13,719.

Table 4. Calculating MSM proportion among the general male population

Study sites	MSM aged 15-45			
	Sexually active (54%)	Sexually inactive(11%)	Hidden MSM (35%)	Total MSM
Phnom Penh	3685	751	2388	6823
Battambang	1008	205	654	1868
Siem Reap	742	151	481	1375
BanteayMeanchey	663	135	430	1228
Kampong Chhnang (Urban)	212	43	137	393
Kampong Chhnang (Rural)	185	38	120	343
Kampong Speu	318	65	206	588
Kandal	284	58	184	527
Prey Veng(Rural)	222	45	144	410
Kampong Cham	201	41	131	373
Preah Sihanouk	148	30	96	273
Koh Kong	74	15	48	137
SvayRieng	73	15	47	135
Total	7815	1509	4802	13719

Abbreviation: MSM, men who have sex with men.

Table 5. Calculation of MSM ratio in the general male population in the study sites

Study sites	Male population aged 15-49 [†]	Total MSM aged 15-49	Ratio MSM per 1000 male population
		<i>Urban</i>	
Phnom Penh	329073	6823	21
Battambang	101083	1868	18
Siem Reap	75947	1375	18
BanteayMeanchey	51301	1228	24
Kampong Chhnang	11166	393	35
Kampong Speu	57084	588	10
Kandal	69469	527	8
Kampong Cham	42654	373	9
Preah Sihanouk	22226	273	12
Koh Kong	7906	137	17
SvayRieng	13304	135	10
Total	781214	13719	18
		<i>Rural</i>	
Prey Veng	104537	410	4
Kampong Chhnang	55864	343	6
Total	160401	753	5

Abbreviation: MSM, men who have sex with men.

[†]Male population in 2014 was estimated based on male population on the 2009 National Committee for Sub-National Democratic Development (NCDD), applying annual growth rate of 1.6%, 1.7%, 1.8%, 1.8%, 1.8% in 2010, 2011, 2012, 2013, and 2014, respectively[15].

3.2.3. Ratio of MSM Aged 15-49 to the General Male Population in Age Groups

After the total number of MSM in the study sites was calculated, the ratio of MSM to the general male population in each province was calculated as shown in Table 5. The total number of MSM was divided by the number of males in the same age range (15-49 years old) from selected administrative districts where venues/hotspots of MSM existed. From this calculation, we obtained an overall ratio of MSM to the general male population of 18 MSM per 1,000 males for urban areas and five MSM per 1,000 males in rural areas.

3.2.4. Estimation of Visible-Reachable and Hidden MSM in all 24 City and Provinces

Table 6 shows the final national size estimation of MSM population in Cambodia. This number included urban, rural, visible-reachable, hidden, sexually active, and sexually inactive MSM across the country. In total, the population size of MSM in Cambodia was estimated to be approximately 31,000. Of these, about 16,000 MSM were estimated to be in urban areas and 15,000 in rural areas. The largest number of MSM, about 6,800, was found in Phnom Penh. Five provinces had a population size of MSM between 2,000 and 3,000 – Banteay Meanchey, Battambang, Kampong Cham, Kandal, and Siem Reap. In addition, six other provinces had a population size of MSM between 1,000 and less than 1,500 – Kampong Chhnang, Kampong Speu, Kampong Thom, Kampot, Prey Veng, and Takeo.

Table 6. The extrapolated number of MSM from the general male population aged 15-49 years

Study sites	Urban			Rural			Total		
	Total male population	Ratio/1000 males	MSM	Total male population	Ratio/1000 males	MSM	Total male population	Ratio/1000 males	MSM
Phnom Penh	329073	21	6823	N/A	N/A	N/A	329073	21	6823
Battambang	80784	23	1868	192696	5	963	273480	10	2831
BanteayMeanchey	75947	18	1375	150086	5	750	226033	9	2125
Siem Reap	51301	24	1228	185992	5	930	237293	9	2158
Kampong Chhnang	11166	35	393	123013	5	615	134179	8	1010
Kampong Speu	57084	10	588	156563	5	783	213647	6	1371
Kandal	69469	8	527	300133	5	1501	369602	5	2028
Prey Veng	7199	18	130	217091	5	1085	224290	5	1215
Kampong Cham	42654	9	373	471508	5	2358	514162	5	2731
Preah Sihanouk	22226	12	273	34332	5	172	56558	8	445
SvayRieng	13304	10	135	152362	5	762	165666	5	897
Koh Kong	7906	17	137	28285	5	141	36191	8	278
UddarMeanchey	35308	18	636	22950	5	115	58258	13	750
Pursat	17302	18	311	99045	5	495	116347	7	807
Kampong Thom	15323	18	276	172227	5	861	187550	6	1137
Takeo	13125	18	236	253926	5	1270	267051	6	1506
Mondulkiri	2758	18	50	12653	5	63	15411	7	113
Kampot	10148	18	183	165484	5	827	175632	6	1010
Pailin	8939	18	161	9357	5	47	18296	11	208
Kratie	8698	18	157	78030	5	390	86728	6	547
Stung Treng	8157	18	147	20870	5	104	29027	9	251
Ratanakiri	6503	18	117	31373	5	157	37876	7	274
PreahVihear	4879	18	88	40245	5	201	45124	6	289
Kep	2852	18	51	7248	5	36	10100	9	88
Total	902105	18	16263	2925470	5	14627	3827575	8	30891

Abbreviations: MSM, men who have sex with men; N/A, not available.

3.3. HIV Risk Behaviors and Access to Health Care

As shown in Table 7, 88.6% of the respondents reported having anal sex in the last 12 months (88.6%), and 64.0% reported having anal sex in the last month. The mean number of sexual partners in the last month was 1.7 (SD=4.8). Approximately 60.0% had two or more sexual partners in the last month. Among those who reported having sexual intercourse in the last six months; 70.5% had biological male partners; 2.3% had biological female partners; and 27.2% had both. Of the total, 69.4% reported always using condoms when having sexual intercourse with their partners in the past six months. The three most common places for MSM to meet their partners were streets, parks or riversides (57.0%); clubs or discotheques

(40.4%); and private houses (39.3%). The two most common sources from which they received condoms were friends or outreach workers (69.3%) and pharmacies, drug stores, or private clinics (61.9%).

Table 8 presents the access to HIV education and health services among MSM in this study. The majority of respondents (71.6%) reported receiving HIV information from outreach workers in the last six months. Approximately two-thirds (66.6%) reported getting tested for HIV, and 49.3% reported having been tested for STI (49.3%) in the last six months. A small proportion of the respondents (7.8%) reported having STI symptoms in the last 12 months; of whom, 93.6% received treatment for the most recent symptom. The proportion of the respondents who had visited M-Style website and Facebook page was very low (13.9% and 11.1%, respectively).

Table 7. Sexual behaviors and condom use among MSM (n= 838)

Variables	n (%)
Had anal sex in last 12 months	742 (88.6)
Had anal sex last month	536 (64.0)
Role at last anal sex in last 12 months	
Never had sex	75 (8.9)
Insertive	346 (41.0)
Receptive	343 (41.0)
Both	74 (8.8)
Number of sexual partner in the last month	
Mean (\pm SD)	1.7 (4.8)
0	139 (16.6)
1	197(23.5)
2-3	254 (30.4)
3 or more	247(29.5)
Type of sexual partners in the last 6 months	
Biological male only	538 (70.5)
Biological female only	17 (2.3)
Both	208 (27.2)
Places to meet partners in the last 12 months	
Clubs or discotheques	308 (40.4)
Saunas, spas, or massage parlors	131 (17.2)
Barbers or beauty salons	27 (3.5)
Streets, parks or river sides	435 (57.0)
Private houses	300 (39.3)
Specific communities	101 (13.2)
M-Style or SMS clubs	19 (2.5)
Always use condom use when having anal sex in the last 6 months	530 (69.4)
Referent places to get condom and lubricant	
Friend(s)	581 (69.3)
Condom peer sale rep	100 (11.9)
Pharmacy/drug store/clinic	519 (61.9)
Condom outlets	29 (3.5)
Star mart	115 (13.7)
Grocery store	187 (22.3)

Abbreviations: MSM; men who have sex with men; SD, standard deviation.

Table 8. Exposure to HIV programs and access to health services among MSM

Variables	Number (%)
Received information on HIV in the last 6 months	600 (71.6)
Visited MStyle website in the last 6 months	116 (13.9)
Used MStyle Facebook page in the last 6 months	93 (11.1)
Had HIV test in the last 6 months	558 (66.6)
Had STI screening in the last 6 months	413 (49.3)
Had STI symptoms in the last 12 months	65 (7.8)
Received STI treatment for most recent symptoms	784 (93.6)

Abbreviations: MSM, men who have sex with men; STI, sexually transmitted infection.

3.4. HIV Prevalence

The overall HIV prevalence among MSM in this study was 2.3%. The prevalence rates differed greatly by age groups and education levels. Those in the age group of 25 years and older had a much higher HIV prevalence rate (4.6%) than those in the age group of 15-24 years (0.6%). The prevalence was 4.5% among those who had completed 0-6 years of education, compared to 2.0% and 1.2% among those who had completed 7-9 years and \geq 10 years of education, respectively. The prevalence was also particularly high in some study sites such as Siem Reap (5.9%), Phnom Penh (3.0%), and Banteay Meanchey (2.5%) compared to Preah Sihanouk (1.7%), Kampong

Cham (0.7%), Battambang (0.5%), and Kandal (0.5%). In addition, although only 1.8% of the sample reported selling sex as their main occupation, the prevalence among this group was much higher (17.2%) compared to MSM in other occupation categories, in which the prevalence rates were less than 5.0%.

4. Discussion

This study is the first national MSM population size estimation after two smaller studies conducted in 2004 and 2008 [10,16]. We estimated that there were approximately 31,000 MSM aged 15 to 49 in Cambodia in 2014. We found that the overall HIV prevalence among MSM in Cambodia was 2.3%. This prevalence is similar to that in the 2010 study, which found that HIV prevalence among homosexual MSM and bisexual MSM was 2.1% and 2.2%, respectively [4]. However, the prevalence in 2010 was subject to be underestimated because the majority of cases were new, and those who had learned their HIV status were very unlikely to participate in the study. It is worth noting that our study did not collect information whether the HIV cases were new or old. But, it is possible that only a small proportion of HIV positive patients had died and only a small proportion of MSM was newly diagnosed. In contrast, it is also possible that the majority of HIV cases in our study were newly diagnosed, and those who had learned their HIV status did not participate in the study. Nonetheless, the current HIV prevalence among MSM is lower than that in other Asian nations such as Thailand (17.3% in 2005), Vietnam (6.3% in 2012), Laos (5.6% in 2009), China (4.9% in 2013), and Malaysia (3.9% in 2011) [17,18,19,20,21].

The HIV prevalence was particularly high among older MSM, MSM with low level of education, MSM who sold sex, and MSM living in some particular geographical areas including Banteay Meanchey, Phnom Penh, and Siem Reap. The age factor is consistent with a Chinese study that found older age to be associated with increased probability of having HIV among MSM [20]. Our findings also imply that low-educated MSM may have limited knowledge about HIV transmission and prevention. Low level of education was also revealed to be related with HIV infection among Thai and Chinese MSM [17,20]. MSM who sold sex might have a better likelihood of contracting HIV due to their frequent contact with at-risk clients. This factor was also confirmed in Laotian and Chinese studies [19,20].

The geographical factor could pinpoint to the metropolitan and migration-inducing features of these study sites. Phnom Penh and Siem Reap are the prime attraction areas for tourists and migrants, who are lured by entertainment venues and job prospects. Banteay Meanchey borders Thailand, which draws a considerable number of Cambodian men from the province to migrate to work there [22]. Approximately 10% of MSM in the 2010 study were recent migrants, which were at risk of HIV infection [4]. Migrants are a population often found to be at greater risk of HIV infection and transmission. Being away from home and families for a long time and earning disposable income might enable migrants to engage in risky behaviors such as substance use and sex purchase. Once back home, they risk transmitting HIV or

STIs to their wives or sweethearts. The Chinese study also iterated that migrant MSM had a higher probability of having HIV infection [20].

Our study also found that MSM in Cambodia remain a high-risk group for HIV infection because of their risky sexual behaviors such as having multiple sexual partners and inconsistent condom use. As already shown, 60.0% of them had two or more sexual partners over the last month, and only about 70.0% used condoms all the time when having anal sex in the last six months. However, compared to the finding of the 2010 study that 65.0% of MSM reported using condoms in the last sex [4], our study might reflect an improvement in condom use among this high-risk population. Further, the rates of HIV (66.6%) and STI (49.3%) testing have also been improved. The association of the large number of sexual partners with HIV infection among MSM was also unveiled in previous studies in Cambodia [4,23], Laos [19], Thailand [17], Malaysia [21], and China [20]. Moreover, the Cambodian, Laotian, and Chinese studies depicted the relationship between inconsistent condom use and HIV infection among MSM [4,19,20,23].

Finally, there was low utilization of HIV prevention programs, such as MStyle website (13.9%) and MStyle Facebook page (11.1%), among the participants. This finding is in line with the 2012 systematic review, which claimed that HIV outreach programs for MSM might potentially face challenges because of structural factors (such as fear for stigma and discrimination) that discouraged their health-seeking behaviors [1].

Several limitations of this study should be noted. The national size estimation was based only on data from 12 city and provinces and was assumed to reflect the nationwide number of MSM. This estimation, however, may not have included: (1) MSM who were in hidden places unknown to the field staff, outreach workers, and data collectors; (2) MSM who lived in rural areas; and (3) MSM who did not have sex with their male partners in the past 12 months. This pitfall might also have affected the sample for the behavioral survey as the data were collected at the same time during the capture round of the size estimation.

In the size estimation, the 18-day time gap between the two rounds was not validated whether it was a sufficient lag time to be able to capture those MSM who might have been out of town for a short period of time during the survey. It was also difficult to justify whether everyone had an equal chance to participate because of the intrinsic nature of human variation. Recall bias was inevitable as the participants were asked to report certain events that had occurred over the last several months.

In the behavioral survey, the self-reported measures may have led to inherent biases for under- and over-reporting. Finally, although the study tools were developed in close consultation with the program teams and experts of the fields and were pretested, the findings of this study might be limited by unknown reliability and validity of the tools.

5. Conclusions

With approximately 31,000 MSM in Cambodia, continued efforts to prevent, manage, and treat HIV in this

key population are essential to achieve the 3.0 goal of eliminating new HIV infections in the country by 2020. Our study found a prevalence rate of 2.3% among MSM, which is remarkably high compared to 0.28% among the general population [24]. The HIV prevalence is particularly higher in some sub-groups of the MSM population, such as older MSM, MSM with low level of education, MSM residing in tourist and migrant areas, and sex workers. We also found high level of inconsistent condom use, low HIV and STI testing, and low utilization of outreach programs such as tailor-made websites and Facebook pages among MSM. These findings suggest that additional or revamped interventions on condom use and provision of HIV-related services are critically important to mitigate HIV risky behaviors among MSM. Ultimately, it should be conceded that our study provides concrete data for Cambodia to estimate the sub-national HIV prevalence using AIDS Epidemic Model, and specific findings to better inform resource allocation to refine the efficacy of intervention programs for MSM.

Statement of Competing Interests

The authors declare that they have no competing interests.

Authors' Contributions

Designed the study: SY, PM, NS, CL, and TS. Developed the protocol and tools: SY, PM, NS, ST, CL, and PC. Performed the statistical analysis: SY, SC, and KP. Led data collection: PM, PC, SC, and ST. Reviewed literature, interpreted the findings, and wrote the manuscript: SY, CN, SC, and JD. Revised and approved the manuscript: all authors.

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