Prevalence and contextual risk factors of sexually transmitted infections in Hong Kong: abridged secondary publication

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KEY MESSAGES

1. The prevalence of composite sexually transmitted infections (STIs) was 1.9%, with 1.2% among men and 2.5% among women, and similarly for chlamydia at 1.4% overall, with 1.2% for men and 1.7% for women.
2. However, the prevalence of chlamydial infection was 5.8% in young sexually active women, 4.8% in the sexually active men, and 4.1% in sexually active women aged 40 to 49 years.
3. Three independent risk factors were identified for both composite STIs and chlamydia: younger age, living alone, and males (or females with male partners) travelled outside Hong Kong in the past 12 months.
4. Mandatory surveillance and reporting of STIs and large population-based screening of chlamydia should be considered.

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Introduction

Sexually transmitted infections (STIs) are preventable through early identification and effective intervention. Population-based prevalence data can be used to understand the disease burden and distribution as well as effective prevention and control measures. Hong Kong has never conducted any population-based STI prevalence study, and STIs (except hepatitis B) are not notifiable. To provide guidance information for future STI control and prevention, territory-wide STI and sexual health survey (TeSSHS) was conducted to determine the prevalence and associated individual and contextual risk factors of three major STIs (genital chlamydia, gonorrhoea, and syphilis) in a representative sample of adults aged 18 to 49 years in Hong Kong.

Methods

TeSSHS was a population-based household study using geospatial random sampling, computer-assisted personal interview questionnaire. In light of the sensitive nature of the questions, certain portions of the survey were self-completed by the participants to maintain privacy and anonymity. All participants were asked to provide a urine sample to test for *Chlamydia trachomatis* and *Neisseria gonorrheae*, with an optional on-site rapid screening test for syphilis.

A stratified geospatial probability sampling of the whole population across Hong Kong's 412 District Council Constituency Areas, each with approximately 17 000 residents. A proportional sample size was determined, with a total of 79 areas randomly selected in proportion to each of the districts. Random points were dropped using the Geospatial Modelling Environment in accordance with 2011 Census boundary maps. These points were then matched to proximally located residential buildings, and a proportional number of households relative to the buildings were selected. Information was collected for each selected building including number of floors and the living quarters per floor to compile an address list for recruitment. Excel was then used to randomly generate household numbers for the final list of households to be approached by the enumerators. Only one eligible subject was interviewed per household to reduce intra-class correlation of family members with similar risk factors. Next birthday method was used when more than one member would like to join the study. The sample size for TeSSHS was based on the chlamydia prevalence estimate (2.3%) from the Chinese Health and Family Life Survey.[1] To detect prevalence with a precision of ±1% with 95% confidence, a total of 863 participants were estimated.

The questionnaire was based on a review on the risk factors of STIs/HIV among the Chinese population[2] and a previously validated questionnaire used in mainland China,[1] with additional questions on travel, condom self-efficacy, and mental health (PHQ-9). Invitation letters were sent to the selected households 1-2 weeks before the visits. Three attempts were made at each address at different

time and days of the week before it was considered 'no contact'. The survey was conducted either at the participants' homes or through appointments at one of the four centres across the city. The participants could select if and how they would like to be informed of the test results.

The overall prevalence of composite and individual STIs was weighted for age, sex ratio, and birthplace according to the 2011 Census. Prevalence estimates for all, sexually experienced, and sexually active (reported sexual intercourse in the past 12 months) were calculated. Multivariable analysis was performed to identify risk factors after univariate analysis, with chlamydia and composite STI rates as outcome variables. Further analysis involving environmental factors, spatial analysis (Global Moran's I), and multilevel modelling using svy module using Stata 14.1 (Stata Corp, College Station [TX], US) was performed to identify contextual factors.

TABLE 1. Demographic and socio-economic information of participants (n=881)

	Unweighted observations, No. (%)			Weighted distributions, %		
	Male (n=346)	Female (n=535)	All (n=881)	Male (47.2)	Female (52.8)	All (100)
Age, y						
18-29	146 (42.2)	152 (28.4)	298 (33.8)	35.4	31.4	33.3
30-39	91 (26.3)	158 (29.5)	249 (28.3)	29.6	31.3	30.6
40-49	109 (31.5)	225 (42.1)	334 (37.9)	35.0	37.3	36.1
Education						
≤Junior high school	69 (19.9)	181 (33.8)	250 (28.4)	20.7	28.0	24.5
Senior high school	115 (33.2)	183 (34.2)	298 (33.8)	34.0	36.0	35.1
>Senior high school	162 (46.8)	171 (32.0)	333 (37.8)	45.3	36.0	40.4
Birthplace						
Hong Kong	249 (72.0)	269 (50.3)	518 (58.8)	77.1	67.8	72.2
Mainland China/ Macau/Taiwan	93 (26.9)	263 (49.2)	356 (40.4)	21.7	31.4	26.8
Other	4 (1.2)	3 (0.6)	7 (0.8)	1.2	0.8	1.0
Residency						
Permanent	335 (96.8)	472 (88.2)	807 (91.6)	97.3	91.6	94.3
Non-permanent	11 (3.2)	63 (11.8)	74 (8.4)	2.7	8.4	5.7
Reasons moved to Hong Kong (n=343)						
Work	7 (7.4)	13 (5.2)	20 (5.8)	7.9	4.8	6.1
Family reunion	79 (84.0)	227 (91.2)	306 (89.2)	83.4	91.6	88.3
Study or others	8 (8.5)	9 (3.6)	17 (5.0)	8.7	3.7	5.7
Profession (n=585)						
Manual labour	44 (17.0)	14 (4.3)	58 (9.9)	16.4	2.7	9.9
Sales/service	79 (30.5)	136 (41.7)	215 (36.8)	30.4	37.6	33.8
Self-employed	31 (11.9)	26 (8.0)	57 (9.7)	11.8	6.8	9.5
Clerical worker	44 (17.0)	112 (34.4)	156 (26.7)	17.5	38.9	27.6
Technical worker	42 (16.2)	28 (8.6)	70 (12.0)	16.2	10.6	13.5
Civil servant	19 (7.3)	10 (3.1)	29 (5.0)	7.7	3.5	5.7
Household income, HK$ (n=751)						
0-12 499	47 (15.5)	102 (22.8)	149 (19.8)	14.7	20.9	17.8
12 500-$39 999	190 (62.7)	281 (62.7)	471 (62.7)	62.8	62.5	62.6
40 000-≥100 000	66 (21.8)	65 (14.5)	131 (17.4)	22.6	16.7	19.6
Housing type (n=866)						
Public housing	217 (63.8)	334 (63.5)	551 (63.6)	63.1	59.9	61.4
Home ownership scheme	43 (12.6)	86 (16.3)	129 (14.9)	13.0	18.7	16.0
Private	80 (23.5)	106 (20.2)	186 (21.5)	23.9	21.4	22.6
No. of people living with						
0	20 (5.8)	15 (2.8)	35 (4.0)	6.4	3.4	4.8
1-2	131 (37.9)	182 (34.0)	313 (35.5)	37.5	33.3	35.3
>2	195 (56.4)	338 (63.2)	533 (60.5)	56.1	63.3	59.9

Results

Between November 2014 and March 2016, 893 participants were successfully recruited in TeSSHS, with a response rate of 24.5%. After weighting, 47.2% were males and 52.8% were females, with similar proportions in three age-groups, although those aged 40-49 years were slightly over-represented at 36.1% (Table 1).

All the 16 positive cases for *C trachomatis* were identified from heterosexual participants. Among the three gonorrhoea cases, two were heterosexual and one was homosexual. The overall prevalence of the composite STIs was 1.9%, with 1.2% for men and 2.5% for women, and similarly for chlamydia at 1.4% overall, with 1.2% for men and 1.7% for women (Table 2). However, the prevalence of composite STIs was high among sexually active young participants: 4.8% among males and 8.7% among females. The prevalence of chlamydia was 5.8% in young sexually active women, 4.8% in sexually active men, and 4.1% in sexually active women aged 40 to 49 years. There was a U-shape distribution curve among female participants.

In univariate analysis, residency status, birthplace, living status, living with the only sexual partner, and males (or females with male partners) had travelled outside Hong Kong within past 12 months were identified as significant factors in contracting either composite STIs or chlamydia. Relevant negative factors included multiple sexual partners, partner change, no condom use, lower education level, and ethnicity. Three independent risk factors ie, younger age, living alone, and male (or female with male partner) travelled outside Hong Kong in the past 12 months were identified in the multivariate model (Table 3). Compared with participants aged 27 to 39 years, those aged 18 to 26 years were 6 to 9 times more likely to contract composite STIs and 7 to 10 times more likely to contract *C trachomatis*. Compared with participants

TABLE 2. Prevalence of composite sexually transmitted infections (STIs) and chlamydia

	% (95% confidence interval)		
	All (n=881)	Sexually experienced (n=733)	Sexually active (n=566)
Prevalence of the composite STIs	1.9 (1.2-2.9)	2.3 (1.4-3.6)	2.7 (1.7-4.3)
Male (n=346)	1.2 (0.5-2.8)	1.5 (0.6-3.6)	1.9 (0.8-4.4)
Age, y			
18-26	1.7 (0.4-6.7)	3.3 (0.8-12.0)	4.8 (1.2-17.6)
27-39	1.3 (0.3-5.1)	1.6 (0.4-6.2)	1.8 (0.4-7.0)
40-49	0.6 (0.1-4.6)	0.7 (0.1-4.8)	0.9 (0.1-6.1)
Female (n=535)	2.5 (1.5-4.1)	2.9 (1.7-4.8)	3.5 (2.0-5.9)
Age, y			
18-26	3.3 (1.2-8.6)	5.3 (2.0-13.5)	8.7 (3.2-21.4)
27-39	0.7 (0.2-2.9)	0.8 (0.2-3.3)	1.0 (0.2-3.9)
40-49	3.8 (1.9-7.5)	4.0 (2.0-7.9)	4.5 (2.1-9.2)
Prevalence of chlamydia	1.4 (0.8-2.5)	1.8 (1.0-3.0)	2.3 (1.3-3.9)
Male (n=346)	1.2 (0.5-2.8)	1.5 (0.6-3.6)	1.9 (0.8-4.4)
Age, y			
18-26	1.7 (0.4-6.7)	3.3 (0.8-12.0)	4.8 (1.2-17.6)
27-39	1.3 (0.3-5.1)	1.6 (0.4-6.2)	1.8 (0.4-7.0)
40-49	0.6 (0.1-4.6)	0.7 (0.1-4.8)	0.9 (0.1-6.1)
Female (n=535)	1.7 (0.9-3.1)	2.0 (1.1-3.7)	2.6 (1.4-4.9)
Age, y			
18-26	2.2 (0.7-6.9)	3.5 (1.1-11.0)	5.8 (1.7-18.2)
27-39	0.3 (0-2.3)	0.4 (0.1-2.6)	0.4 (0.1-3.1)
40-49	2.8 (1.2-6.2)	2.9 (1.3-6.5)	4.1 (1.8-9.0)

living with more than two people, those living alone were 12 times more likely to contract composite STIs. Compared with males or females whose male partners did not travel out of Hong Kong in the past 12 months, those who had travelled were 6 to 8 times more likely to contract composite STIs and 5 to 11 times more likely to contract chlamydia. Compared with those preferred testing in private clinics, those who preferred testing in public facilities were 3 times more likely to contract STIs.

The spatial analysis showed total randomness. The finding in the multilevel modelling was no different from univariate analysis. Key environmental factors were used as univariate variables to test their association with the STI outcomes. The presence of dermatological clinic within 1 km was associated with *C trachomatis* infection (OR=3.47, 95% CI=1.18-10.19).

Discussion

This study identifies high STI prevalence in sexually active young people and middle-aged women. Younger age, living alone, and males (females with male partners) travelled outside Hong Kong in the past 12 months were three independent risk factors for STI. STIs could be silently infecting anyone with a normal sexual life.

The strengths of this study include the use of comprehensive theoretical framework of social epidemiology; systematic review for risk factors of HIV/STIs; geospatial modelling environment for sampling; and objective outcome measures including polymerase chain reaction and syphilis rapid tests. However, owing to the sensitive nature of TeSSHS, participants might have underreported the number of sexual partners. In addition, the sample size calculation was based on the prevalence of composite STI, which might lead to insufficient cases for further spatial and multilevel analyses. The relatively low response rate is understandable and is comparable to those reported in the UK[3] and to the Hong Kong Family Planning Association Report of Youth Sexuality Study, which does not require samples for STI testing, with an overall response rate of 25.9%.

The overall chlamydia prevalence in Hong Kong is similar to that in the UK (1.5% among females and 1.1% among males)[3] and in the US[4] (2.0% among females and 1.4% among males) but lower than that in mainland China[1] (2.6% among females and 2.1% among males). In the UK, the highest prevalence group was females aged 18 to 19 years, with prevalence of 4.7%, compared with 0.3% among females aged 35 to 44 years.[3] However, TeSSHS finds a higher prevalence of chlamydia in sexually active females aged 40 to 49 years, with prevalence of 4.1%. Interestingly, such a U-shape pattern was found in HPV infection in Hong Kong, with the first peak in females aged 26 to 30 years (12.4%) and the second peak in females aged 46 to 50 years (5.8%).[5] It is hypothesised that changes in sexual behaviours or hormones may be the reason.[5] Further research is necessary to assess the mechanism of the U-shape pattern of infection in Hong Kong.

Based on the theoretical framework of an epidemic, the basic reproductive rate (R_0) is calculated as $R_0=\beta cD$, where β indicates the pathogen's infectiveness, c the number of contacts, and D the duration of infectivity. To control chlamydia, D could be reduced through earlier detection and treatment; therefore, mandatory surveillance of STIs should be considered. As up to 85% of the males and 90% females infected with chlamydia are asymptomatic, large population-based screening such as those in the US, the UK, and Australia could be considered. More effective sexual health education targeted at the risk factors and specific age-groups is needed. About 70% of TeSSHS participants would seek testing and treatment in the private sector if STIs are suspected. This suggests that 80% of STI cases in Hong Kong are managed in the private sector. Optimal ways in partner notification and linkage-to-care deserve further exploration.

TABLE 3. Logistic regression of factors associated with composite sexually transmitted infections (STIs) and chlamydial infection

Factors	Adjusted odds ratio (95% confidence interval)					
	Composite STIs			Chlamydial infection		
	All (881)	Sexually experienced (733)	Sexually active (566)	All (881)	Sexually experienced (733)	Sexually active (566)
Male (n=346)						
Female (n=535)	3.46 (1.13-10.6)*	2.78 (0.97-7.94)†	2.56 (0.88-7.41)†	2.27 (0.74-6.96)	1.87 (0.65-5.35)	1.78 (0.62-5.16)
Age-group, y						
27-39 (n=322)						
18-26 (n=225)	5.81 (1.39-24.4)*	7.08 (1.72-29.1)*	9.48 (2.33-38.6)*	6.82 (1.36-34.2)*	8.04 (1.67-38.6)*	9.96 (2.09-47.5)*
40-49 (n=334)	3.08 (0.78-12.2)	2.98 (0.76-11.6)	2.96 (0.71-12.3)	3.32 (0.72-15.2)	3.24 (0.72-14.7)	3.67 (0.80-16.8)†
Born in Hong Kong						
Yes (n=518)						
No (n=363)	2.46 (0.72-8.40)	2.19 (0.67-7.19)	2.8 (0.83-9.48)†	3.79 (0.96-15.0)†	3.32 (0.89-12.4)†	3.21 (0.82-12.6)†
Living with others						
>2 (n=533)						
0 (n=35)	12.1 (2.07-70.2)*	12.2 (2.13-70.2)*	12.1 (2.03-72.1)*	12.1 (1.85-79.1)*	12.3 (1.93-78.8)*	11.9 (1.89-75.1)*
1 or 2 (n=313)	3.87 (1.36-11.1)*	3.87 (1.37-11.0)*	3.27 (1.12-9.53)*	2.12 (0.74-6.09)	2.15 (0.74-6.24)	2.21 (0.71-6.90)
Male (or female with male partner) travelled out of Hong Kong						
No (n=425)						
Yes (n=456)	8.21 (2.38-28.3)*	6.37 (1.99-20.4)*	7.01 (1.73-28.4)*	11.1 (2.65-46.6)*	8.4 (2.10-33.5)*	5.35 (1.25-22.8)*
STI testing facilities						
Private (n=569)						
Public (n=312)	2.97 (1.04-8.45)*	3.18 (1.12-8.99)*	2.74 (1.02-7.36)*	2.5 (0.78-8.04)	2.67 (0.84-8.46)†	2.77 (0.97-7.91)†

* P<0.05
† P>0.05 to <0.1

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Disclosure

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1. Wong WC, Zhao Y, Wong NS, et al. Prevalence and risk factors of chlamydia infection in Hong Kong: a population-based geospatial household survey and testing. PLoS One 2017;12:e0172561.
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