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High Prevalence of Chlamydia and Gonorrhea and the Need for Sexually Transmitted Infection Testing Among Men Who Have Sex With Men and Transgender Women in Papua New Guinea

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Abstract

Background: Papua New Guinea has among the highest prevalence of sexually transmitted infections in the world but no estimates of *Chlamydia trachomatis*, *Neisseria gonorrhoeae*, or hepatitis B virus (HBV) are available among men who have sex with men (MSM) or transgender women (TGW).

Methods: We conducted respondent-driven sampling surveys among MSM and TGW in Port Moresby, Lae, and Mt Hagen (2016–2017) to characterize the prevalence of these infections. Eligibility criteria were as follows: aged ≥12 years, born male, could speak English or Tok Pisin, and had oral or anal sex with another person born male in the past 6 months. Participants were surveyed face-to-face and offered testing for anorectal and genital chlamydia and gonorrhea, syphilis, HIV, and HBV. All results are respondent-driven sampling weighted.

Results: We enrolled 400 participants in Port Moresby, 352 in Lae, and 111 in Mt Hagen. Chlamydia prevalence rates in the 3 cities regardless of anatomical site were 19.9%, 19.2%, and 24.3%, respectively. Gonorrhea prevalence rates regardless of anatomical site were 10.3%, 9.4%, and 9.6%, respectively. Hepatitis B virus prevalence rates were 11.7%, 13.8%, and 13.6%, respectively. In multivariable analysis, syphilis was associated with having either chlamydia or gonorrhea in Port Moresby (adjusted odds ratio, 4.0; 95% confidence interval, 2.0–7.9) and Lae (adjusted odds ratio, 2.4; 95% confidence interval, 1.2–5.0).

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Conclusions: There is a large unmet need among MSM and TGW in Papua New Guinea for chlamydia and gonorrhea detection and treatment. The high prevalence of HBV reinforces the importance of ensuring introduction and scale-up of HBV treatment and immunization. Urgent efforts are needed to introduce laboratory-based diagnosis for chlamydia and gonorrhea to ensure these populations have access to much needed treatment services.

The World Health Organization estimates that there are 376.4 million new cases per year of 4 curable sexually transmitted infections (STIs)—*Chlamydia trachomatis* (CT), *Neisseria gonorrhoeae* (NG), *Treponema palladium*, and *Trichomonas vaginalis*—among people aged 15 to 49 years.[1] Although curable STIs may result in pain and discomfort in the short term, in the longer term, they can result in infertility, blindness, and psychosis.[1] They also affect individuals in ways beyond the biological by causing shame, stigma, anxiety, and the disruption of relationships.[2,3] Asymptomatic disease is especially common among men and may account for up to 90% of chlamydia cases.[4]

Curable STIs also contribute to HIV acquisition and transmission. Nonulcerative STIs, such as gonorrhea and chlamydia, increase the risk of acquisition by disrupting the mucosal membrane and local inflammatory responses that recruit HIV target cells and cellular chemicals that upregulate HIV replication.[5] Gonorrhea further contributes to HIV transmission by increasing viral shedding,[6] and genital ulcers may increase the presence and activation of cells susceptible to HIV, increasing the likelihood of infection.[7]

Men who have sex with men (MSM) and transgender women (TGW) are at high risk of acquiring and transmitting STIs, including HIV.[8] Despite this risk, the data on STI and HIV prevalence among these populations in the Pacific are limited. The data that are available are limited to the general population, pregnant women, and female sex workers.[9]

There is a paucity of HIV and STI data on MSM and TGW in Papua New Guinea (PNG), where the HIV epidemic is concentrated among key populations. Until 2016, estimates of STI prevalence among MSM and TGW in PNG were limited to HIV and syphilis in men and TGW who sell and exchange sex. Among men who sell sex, HIV prevalence was estimated to be 8.8% and syphilis prevalence 6.5%. Among TGW who sell sex, HIV prevalence was much higher and estimated to be 23.7%, with syphilis prevalence at 25%.[10] We recently reported HIV and syphilis prevalence rates of 8.5% and 10.1% among MSM and TGW in Port Moresby and 6.9% and 21.1% in Lae, as well as HIV and syphilis prevalence rates of 1.8% and 8.3%, respectively, among survey participants in Mt Hagen.[11] We also found that upwards of three-quarters of MSM and TGW had vaginal or anal sex with a woman in the last 6 months.[11]

A systematic review and mathematical modeling of heterosexual anal intercourse in PNG suggested it could play an important role in the country's HIV and STI epidemics.[12] Pooled chlamydia prevalence estimates among men in PNG vary between 20% and 30%, dependent on whether data were obtained from community- or clinic-based settings, with pooled gonorrhea prevalence estimates from clinic based settings around 10%.[13] Estimates for gonorrhea and chlamydia specifically among MSM and TGW, as well as an analysis of factors contributing to gonorrhea and chlamydia prevalence, have not been reported.

The limited laboratory capacity in PNG means that beyond HIV, testing for STIs is severely constrained and largely confined to syphilis. Syndromic management is used to diagnose and treat other STIs, and in the culture of sexual health services in PNG, anorectal and genital screening—although recommended—is rarely conducted.[14] To inform public health policy and services, together with the PNG National Department of Health, we conducted a bio-behavioral survey to assess the prevalence of anorectal and genital gonorrhea and chlamydia, as well as hepatitis B virus (HBV) among MSM and TGW in Port Moresby, Lae, and Mt Hagen.

METHODS

Community Consultation

Community consultation by the study team with MSM and TGW in Port Moresby, Lae, and Mt Hagen indicated that recruiting MSM and TGW together into one survey sample was acceptable to facilitate sampling and increase the sample size to allow for greater precision in estimates.

Study Population, Setting, and Design

We used respondent-driven sampling (RDS) to recruit MSM and TGW in Port Moresby from June to October 2016, in Lae from January to June 2017, and in Mt Hagen from August to December 2017. Respondent-driven sampling is a variant of snowball sampling that can be used to produce sampling weights and approximate a random sample.[15,16] Eligibility criteria were as follows: age >12 years, spoke English or Tok Pisin, born biologically male, had oral or anal sex with a male in the past 6 months, and in possession of a valid study coupon. Transgender women were defined as being born biologically male and no longer identifying as male. A detailed description of recruitment and other survey methods can be found elsewhere.[11]

Data Collection

Candidate participants were screened for eligibility, and those eligible were asked to provide verbal informed consent. Participants were trained to self-collect anorectal swabs and urine for CT/NG testing (GeneXpert; Cepheid, Sunnyvale, CA) using pictoral instructions with English and Tok Pisin text created for Papua New Guinean MSM and TGW.[17] Fifteen milliliters of venous blood was also collected for HIV (Determine HIV-1/2 [Alere, Waltham, MA] and HIV 1/2 Stat-Pak [Chembio, Medford, NY]), syphilis (Chembio DPP Syphilis Assay; Chembio, Medford, NY), and HBV surface antigen (Alere Determine HBsAg; Alere) testing. The monitoring of molecular and rapid test quality was undertaken using 2 methods. Known in-house quality controls were imported from Australia for use with the dual chlamydia/gonorrhea test. Quality control was run on a monthly basis. Blinded external quality assurance panels for syphilis and HBV were supplied by the Royal College of Pathologists Australasia and conducted biannually. After specimen collection, participants engaged in an interviewer-administered computer-assisted personal interview (Open Data Kit, Washington, DC).

All test results were returned to participants at the end of the first study visit. Participants testing positive for CT, NG, or syphilis were counseled about preventing reinfection and partner testing as appropriate and were provided with same-day treatment by study staff following PNG National STI Guidelines.[18] Those testing positive for HBV antigen were counseled about how to stay healthy and monitor their health. They were also referred for care, as treatment was not available in the public system during the study.

Study staff were trained to identify and refer all sexually exploited persons younger than 18 years to partner organizations experienced in providing counseling, health, social, and other protective services to these populations.

While waiting for test results, participants were trained in how to recruit peers and received 45 PNG kina for their first visit (approximately US$14). They could receive another 10 PNG kina (approximately US$3) per successful recruit plus 5 PNG kina (approximately US$1.50) for transportation at their second visit. All participants were also provided with information on HIV and other STIs, condoms, and lubricants.

Data Measures

The questionnaire used as its foundation the World Health Organization, Centers for Disease Control and Prevention (CDC), Joint United Nations Programme on HIV and AIDS, and FHI 360 Biobehavioral Survey Guidelines for Populations at Risk for HIV.[19] Interview domains included demographics, sexual history and identity, stigma, social cohesion, violence, foreskin cutting assessed through a dichotomous question about whether the foreskin had been cut rather than the nature of the cutting, and uptake of health services. The 2-item Patient Health Questionnaire was used to screen for depression.[20]

Data Analysis

Our analysis characterizes MSM and TGW; their prevalence of anorectal and genital CT and NG, and HBV; and correlates of having either CT or NG infection in each of the 3 survey cities. Odds ratios and 95% confidence intervals (CIs) were calculated for bivariate comparisons, and a P value <0.1 was the threshold for inclusion in multivariable analysis. No model was produced for Mt Hagen because the actual sample size was too small and convergence was not reached for HIV.[21]

Data were weighted and analyzed using Respondent-Driven Sampling Analyst (RDS-A) version 0.62 (Los Angeles, CA) and SAS version 9.3 (Carey, NC). We used Giles' Successive Sampling Estimator in RDS-A. All data presented are RDS-adjusted population estimates unless otherwise indicated. Weights were imported from RDS-A, and survey logistic procedures were used in SAS to identify correlates of HIV infection.

Ethical Approval

This survey was approved by the PNG National Department of Health's Medical Research Advisory Committee, the Research Advisory Committee of the National AIDS Council Secretariat, the PNG Institute of Medical Research's Institutional Review Board, and the Human Research Ethics Committee at UNSW Sydney, Australia. The protocol was reviewed

according to the US CDC's human research protection procedures and was determined to be research, but the CDC was not engaged in data collection and had no direct contact with study participants. A letter of support was provided by Kapul Champion, the peer-led civil society for sexually diverse men and transgender people.

RESULTS

We enrolled 863 MSM and TGW in 3 cities: Port Moresby (n = 400), Lae (n = 352), and Mt Hagen (n = 111). Transgender women accounted for 5% to 10% of MSM/TGW in all cities (Table 1). Most MSM and TGW were aged 20 to 29 years in all 3 cities, with median age highest in Port Moresby and lowest in Mt Hagen. Lae had the highest proportion of people with no formal education (18.3%), and Mt Hagen had the highest proportion with at least a high school education (54.7%). Having a cut foreskin was more common in Lae (83.4%) and Mt Hagen (73.4%) than in Port Moresby (59.5%). In Port Moresby, 48.0% hid their sexual behavior or gender identity from health care workers, as did 45.0% in Lae and 39.6% in Mt Hagen.

Age at first anal sex with a man or TGW was similar across all 3 cities, with close to half having done so by age 20 years (Table 2). The proportion of MSM and TGW with 0 to 1 male or TGW anal sex partners in the last 6 months was highest in Mt Hagen (54.1%) and lowest in Port Moresby (32.8%). More than half (51.6%) of MSM and TGW in Port Moresby sold sex during this period compared with 38.2% in Lae and 33.0% in Mt Hagen. Upwards of 4 in 5 MSM and TGW had sex with a woman in the same period.

Approximately one-quarter of MSM and TGW had either chlamydia or gonorrhea, and of those with either STI, 37.6% in Port Moresby, 19.2% in Lae, and 27.9% in Mt Hagen had both (Table 3). Chlamydia was the most prevalent STI among MSM and TGW, and prevalence was similar across cities at 19.9% in Port Moresby, 19.2% in Lae, and 24.3% in Mt Hagen. Gonorrhea prevalence rates were 10.3% in Port Moresby, 9.4% in Lae, and 9.6% in Mt Hagen. There was no difference in chlamydia or gonorrhea prevalence by infection site, that is, anorectal or genital area, except in Lae, where genital chlamydia was more prevalent than anorectal. A small minority of MSM and TGW had both anorectal and genital chlamydia (2.4% in Port Moresby, 2.2% in Lae, and 5.6% in Mt Hagen) or both anorectal and genital gonorrhea (0.5%, 3.0%, and 4.0%, respectively). Hepatitis B prevalence rates were 11.7% in Port Moresby, 13.8% in Lae, and 13.6% in Mt Hagen. Overall, 27.0% of MSM and TGW in Port Moresby, 32.3% in Lae, and 27.6% in Mt Hagen had chlamydia, gonorrhea, or syphilis.

In multivariable analysis (Table 4), among MSM and TGW in Port Moresby, being infected with either genital or anorectal chlamydia or gonorrhea was positively associated with age greater than 12 to 19 years ($P < 0.0001$), having primary versus no formal education (adjusted odds ratio [aOR], 0.7; 95% CI, 0.5–0.9), and having syphilis (aOR, 4.0; 95% CI, 2.0–7.9). In contrast, in Lae, infection with genital or anorectal chlamydia or gonorrhea was associated with having 2 to 4 male or TGW anal sex partners in the last 6 months compared with 1 or none (aOR, 1.9; 95% CI, 1.3–2.7) and syphilis coinfection (aOR, 2.4; 95% CI, 1.2–5.0). It is possible that it may also be associated with HIV (aOR, 1.9; 95% CI, 0.9–4.0).

In both cities, it is plausible that having a cut foreskin was protective against these STI (aOR, 0.6 [95% CI, 0.4–1.0] in Port Moresby; aOR, 0.7 [95% CI, 0.5–1.1] in Lae).

DISCUSSION

This is the first survey to describe the prevalence of chlamydia, gonorrhea, and HBV among MSM and TGW in PNG. Our finding that more than 1 in 5 MSM and TGW in the 3 most populous cities of PNG had CT or NG and more than 1 in 10 had HBV reveal a large unmet need for STI testing and treatment among these populations. Our findings of chlamydia, gonorrhea, and HBV prevalence are among the highest in the world and well above the global estimate of 2.7% prevalence of chlamydia, 0.7% prevalence of gonorrhea among adult men, and 3.6% prevalence of HBV among adults.[1,22] Given the high prevalence of gonorrhea in PNG and the unavailability of testing for the disease, there may be a role for drug resistance testing to ensure treatment efforts are still effective.

The prevalence of chlamydia was especially high in our survey, and in Lae, the prevalence of genital chlamydia infection was higher than that of anorectal. These findings are of particular importance because more than 4 in 5 MSM and TGW in all 3 cities also had sex with a woman in the last 6 months. Chlamydia in women can lead to pelvic inflammatory disease, which can cause chronic pelvic pain, ectopic pregnancy, and tubal factor infertility.[23] The high HBV prevalence among MSM and TGW can also affect their children, as children born to mothers with HBV are at particular risk of developing chronic HBV infection.[22] hepatitis B virus vaccination for the prevention of vertical transmission has achieved only limited success in PNG after its introduction in 2005, with effective coverage achieved at around 30% of newborns.[24]

Altthough it is plausible that CT or NG may be associated with HIV in Lae, we found no association in Port Moresby. However, in both cities, the odds of CT or NG were higher among those with syphilis than those without.

The high burden of STIs and that less than half of MSM and TGW living with HIV were aware of their HIV status reveals opportunities for improved sexual health services through increased screening, testing, and treatment of STI and HIV to avoid missed opportunities.[14,25] Syndromic screening for genital and anorectal STI has poor sensitivity but, in the absence of STI testing, may contribute toward the identification of MSM and TGW in need of other health services, including HIV testing, condoms, and lubricants.[26–28] In the absence of gonorrhea and chlamydia testing in PNG, our findings of both anorectal and genital chlamydia and gonorrhea prevalence highlight the importance of strengthening health care provider competency to screen for STI, particularly anorectal STI.

Partner notification services are needed to prevent continued spread and reinfection. A systematic review has shown that expedited partner therapy where a patient delivers medicine or a prescription to their sexual partner was more successful than patient simple referral without provider assistance to reduce reinfection.[29] Findings from a recent assessment of HIV self-testing acceptability by service providers and key population members in PNG found limited support for self-testing but wide support for peer-mediated

self-testing.[30] The assessment also found a desire for this approach to also incorporate HBV and syphilis testing. Because this program is developed, consideration should be made to include screening for STI symptoms, with peer-mediated referral, and treatment and peer-mediated partner notification as appropriate.

Our findings are limited by the cross-sectional nature of our study as well as our sample sizes. The small number of TGW in particular limits the generalizability of our findings to this population. Self-reported data may be subject to response bias given the face-to-face nature of interviews. There are many ways in which men modify their penises in PNG including through cutting of the foreskin.[31] We did not assess the nature of penile foreskin modification, that is, how much of the foreskin was cut off. Differences in the presence of some, none, or complete foreskins may affect our finding of a plausible association between having a cut foreskin and CT or NG infection. Nonetheless, our findings that it is plausible that having a cut foreskin is associated with decreased risk of chlamydia or gonorrhea infection mirror those of another survey in PNG that found that dorsal longitudinal foreskin cut was associated with reduced risk of HIV, syphilis, and genital herpes.[32] An estimated 58.2% of men in Momase region, where Lae is located, have a dorsal longitudinal cut. In the Southern region, where Port Moresby is located, 42.1% of men have it, as do 44.6% of men in the Highlands region where Mt Hagen is located, giving us more confidence in our results.[33]

The high prevalence of STI among MSM and TGW in the 3 main cities of PNG is a serious public health threat. Taking HIV and STI services to MSM and TGW outside the health facility and into the community has the potential to facilitate major gains against these diseases and lead to greater service delivery efficiencies. Such efficiencies are extremely important everywhere but especially in resource-limited settings such as PNG, where external support for STI and HIV services is decreasing.

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TABLE 1.

Characteristics of Men Who Have Sex With Men (MSM) and Transgender Women (TGW) in Port Moresby, Lae, and Mt Hagen

	Port Moresby			Lae			Mt Hagen		
	Valid (n = 400)	**Population Proportion (Weighted), % (95% CI)**	**Chlamydia/ Gonorrhea Prevalence (Weighted), %**	**Valid (n = 352)**	**Population Proportion (Weighted), % (95% CI)**	**Chlamydia/ Gonorrhea Prevalence (Weighted), %**	**Valid (n = 111)**	**Population Proportion (Weighted), % (95% CI)**	**Chlamydia/ Gonorrhea Prevalence (Weighted), %**
Gender identity	400			352			111		
Male	354	89.3 (84.2–94.5)	19.9 (10.2–29.5)	325	93.8 (89.9–97.7)	21.4 (15.6–27.2)	104	94.3 (90.1–98.5)	25.8 (17.0–35.6)
TG	46	10.7 (5.5–15.8)	42.4 (26.0–56.7)	26	6.2 (2.3–10.1)	53.9 (26.4–81.4)	7	5.7 (1.5–9.9)	38.7 (0.0–85.6)
Age, y	400			345			111		
Sample median (IQR)		27 (23–33)			25 (22–30)			21 (19–25)	
12–19	36	11.4 (7.0–15.7)	6.8 (5.8–7.8)	45	14.2 (9.5–18.9)	18.3 (10.7–25.8)	32	24.3 (14.5–34.1)	37.2 (8.7–65.6)
20–24	107	26.3 (21.0–31.7)	34.0 (5.2–62.8)	107	32.1 (26.0–38.1)	29.1 (12.6–45.6)	51	48.1 (36.5–59.7)	27.6 (18.7–36.5)
25–29	113	26.4 (21.0–31.7)	23.7 (9.4–37.9)	90	26.0 (20.5–31.4)	18.3 (6.7–30.0)	11	11.6 (4.9–18.3)	31.6 (16.4–46.8)
30–34	63	17.0 (12.2–21.8)	13.1 (5.5–20.8)	54	13.6 (9.6–17.7)	20.7 (10.2–31.1)	8	8.3 (1.8–14.9)	9.0 (0.5–17.5)
≥35	81	18.9 (14.0–23.8)	21.3 (16.7–25.9)	49	14.2 (9.0–19.4)	26.0 (17.3–34.6)	9	7.7 (1.4–14.0)	0.0 (0.0–0.0)
Education	400			352			111		
No formal education	36	8.7 (5.4–12.0)	34.1 (19.4–48.7)	62	18.3 (13.1–23.4)	23.8 (12.5–35.0)	8	6.5 (2.1–10.9)	56.4 (4.0–100.0)
Primary	203	48.8 (42.7–55.0)	19.5 (15.8–23.1)	140	40.9 (34.6–47.1)	25.1 (17.7–32.4)	37	38.8 (28.3–49.3)	11.4 (3.8–18.9)
High school or higher	161	42.5 (36.3–48.7)	22.9 (1.3–44.6)	150	41.0 (34.2–47.3)	22.8 (9.1–36.4)	66	54.7 (43.8–65.5)	34.1 (19.4–48.7)
Marital status	400			352			111		
Never married	246	62.4 (56.1–68.8)	26.0 (8.2–43.7)	240	70.9 (65.2–76.6)	25.1 (16.8–33.4)	88	77.9 (68.0–87.9)	29.4 (23.0–35.7)
Married	77	18.2 (13.3–23.1)	17.7 (15.8–19.6)	53	13.8 (9.6–17.9)	20.8 (13.3–28.3)	14	13.6 (4.9–22.4)	10.8 (0.0–38.7)
Divorced, separated, or widowed	77	19.4 (14.6–24.1)	14.6 (11.2–17.9)	59	15.3 (11.0–19.6)	20.8 (10.7–30.7)	9	8.4 (1.6–15.3)	26.1 (0.0–64.2)
Main source of income	380			340			102		
Formal sector	94	23.6 (18.3–28.8)	30.5 (11.5–49.5)	94	26.5 (21.0–32.0)	35.4 (26.1–44.8)	14	15.7 (7.1–24.3)	25.6 (0.0–60.4)
Informal sector	153	39.3 (33.1–45.5)	19.5 (2.4–36.6)	149	45.7 (39.5–52.0)	17.7 (11.7–23.6)	40	43.0 (32.5–53.5)	26.3 (9.4–43.2)
Unemployed	133	37.1 (31.0–43.3)	18.7 (13–24.4)	97	27.8 (22.3–33.3)	22.7 (12.0–33.4)	48	41.4 (30.9–51.7)	29.6 (7.7–51.4)
Average monthly income	266			255			63		

	Port Moresby			Lae			Mt Hagen		
	Valid (n = 400)	Population Proportion (Weighted), % (95% CI)	Chlamydia/ Gonorrhea Prevalence (Weighted), %	Valid (n = 352)	Population Proportion (Weighted), % (95% CI)	Chlamydia/ Gonorrhea Prevalence (Weighted), %	Valid (n = 111)	Population Proportion (Weighted), % (95% CI)	Chlamydia/ Gonorrhea Prevalence (Weighted), %
<200 kina (~USD 63)	34	11.8 (7.3–16.1)	17.1 (1.5–32.6)	17	7.6 (3.8–11.5)	19.0 (13.9–24.0)	10	14.1 (4.7–23.4)	34.7 (15.7–53.7)
200–499 kina	94	34.1 (26.9–41.3)	20.4 (5.8–35.1)	121	48.1 (40.0–56.3)	19.5 (14.2–24.7)	23	38.8 (20.9–56.9)	24.2 (10.2–38.3)
500–999 kina	94	39.1 (32.0–46.5)	25.4 (16.7–34.2)	80	29.8 (23.0–36.6)	38.4 (30.2–46.7)	15	21.2 (9.4–33.0)	16.7 (0.0–42.5)
≥1000 kina	44	15.0 (9.9–20.0)	35.0 (0.0–78.0)	37	14.5 (9.1–19.8)	13.8 (2.4–25.2)	15	25.8 (12.5–39.2)	27.1 (6.9–47.4)
Have cut foreskin	400			352			111		
Yes	240	59.5 (53.2–65.8)	18.6 (11.7–25.5)	291	83.4 (78.6–88.2)	22.4 (16.0–28.9)	85	73.4 (65.0–81.8)	27.4 (17.0–37.8)
No	160	40.5 (34.2–46.8)	27.6 (9.5–45.8)	61	16.6 (11.8–21.4)	31.2 (22.6–39.7)	26	26.6 (18.3–35.0)	24.2 (6.8–41.6)
Screened positive for depression	400			352			111		
Yes	37	8.0 (4.9–11.1)	25.9 (23.4–28.5)	18	5.7 (2.9—8.4)	1.1 (0.0–2.5)	5	3.8 (2.8–5.1) *	20.0 (5.7–34.3)
No	363	92.0 (88.9–95.1)	21.9 (8.3–35.6)	334	94.3 (91.6–97.1)	22.8 (9.9–35.6)	106	96.2 (94.9–97.3) *	32.7 (9.3–56.1)
Disclosed sexual behaviors to family or friends (non-MSM)	400			352			111		
Yes	160	38.1 (32.0–44.0)	23.1 (7.3–38.8)	140	35.7 (29.6–41.8)	26.2 (10.9–41.5)	44	35.2 (25.9–44.5)	28.2 (6.4–50.0)
No	240	61.9 (55.7–68.0)	21.7 (10.6–32.8)	212	64.0 (58.1–70.4)	22.6 (20.1–25.0)	67	64.8 (55.5–74.1)	25.7 (16.5–34.9)
Hide sexual behavior or gender identity from health care worker	359			209			60		
Yes	173	48.0 (41.8–54.2)	25.3 (10.5–40.2)	89	45.0 (36.1–54.2)	25.4 (1.7–49)	20	39.6 (26.8–52.6)	37.1 (10.2–64.1)
No	186	52.0 (45.8–58.2)	21.2 (7.5–34.9)	120	55.0 (45.8–63.9)	30.5 (22.8–38.2)	40	60.5 (47.4–73.2)	26.9 (5.9–47.9)
Ever experienced physical or sexual violence	382		347			106			
Yes	251	20.5 (7.6–33.4)	270	78.3 (75.0–81.6)	22.7 (13.6–31.8)	66	63.6 (54.0–73.1)	22.2 (9.5–35)	
No	131	26.4 (11.0–41.8)	77	21.7 (18.4–25.0)	26.8 (18.6–35.1)	40	36.4 (26.9–46.0)	33.9 (20.6–47.2)	
Experienced violence in last 12 mo	179			128			27		
Yes	154	87.5 (80.7–94.4)	19.1 (9.1–29.0)	91	67.9 (57.2–78.3)	25.5 (4.4–46.7)	22	79.2 (65.7–92.4)	19.2 (3.9–34.5)

	Port Moresby			Lae			Mt Hagen		
	Valid (n = 400)	**Population Proportion (Weighted), % (95% CI)**	**Chlamydia/ Gonorrhea Prevalence (Weighted), %**	**Valid (n = 352)**	**Population Proportion (Weighted), % (95% CI)**	**Chlamydia/ Gonorrhea Prevalence (Weighted), %**	**Valid (n = 111)**	**Population Proportion (Weighted), % (95% CI)**	**Chlamydia/ Gonorrhea Prevalence (Weighted), %**
No	25	12.5 (5.6–19.3)	18.7 (0.0–52.4)	37	32.1 (21.7–42.8)	19.6 (0.0–41)	5	20.9 (7.6–34.3)	28.3 (0.0–95.7)
Can rely on other MSM and TGW to accompany them to doctor or hospital	373			334			103		
Yes	144	35.9 (30.0–41.8)	20.9 (2.9–39.0)	204	58.4 (52.3–64.5)	22.9 (12.2–33.7)	62	61.2 (51.0–71.3)	31.3 (13.9–48.7)
No	229	64.1 (58.2–70.0)	23.4 (14.1–32.7)	130	41.6 (35.5–47.7)	25.4 (20.5030.2)	41	38.8 (28.7–49.0)	24.1 (12.2–35.9)

*Confidence intervals calculated using Wilson binomial proportion bounds.

TABLE 2.

Sexual Behaviors of Men Who Have Sex With Men and Transgender Women in Port Moresby, Lae, and Mt Hagen, Papua New Guinea

	Port Moresby			Lae			Mt Hagen		
	Valid (n = 400)	Population Proportion (Weighted), % (95% CI)	Chlamydia/ Gonorrhea Prevalence (Weighted), %	Valid (n = 352)	Population Proportion (Weighted), % (95% CI)	Chlamydia/ Gonorrhea Prevalence (Weighted), %	Valid (n = 111)	Population Proportion (Weighted), % (95% CI)	Chlamydia/ Gonorrhea Prevalence (Weighted), %
Age first had anal sex with a man or TGW, y	376			332			103		
10–14	33	7.1 (4.2–10.0)	40.1 (18.2–61.9)	28	7.5 (3.8–11.1)	35.8 (25.1–46.5)	2	3.0 (2.1–4.3) *	0.0 (0.0–0.0)
15–19	143	37.7 (31.5–43.9)	19.3 (1.0–37.6)	123	41.0 (34.2–47.8)	21.3 (13.5–29.0)	54	47.8 (36.3–59.4)	39.3 (26.6–51.9)
20–24	108	30.2 (24.5–36.0)	24.5 (5.1–43.8)	103	29.3 (23.5–35.2)	27.3 (18.0–36.7)	56	32.9 (21.3–44.6)	22.0 (14.2–29.8)
≥25	92	24.9 (19.1–30.7)	17.5 (15.0–19.9)	78	22.2 (16.7–27.8)	23.0 (13.0–33.1)	16	16.2 (7.5–25.0)	9.6 (2.9–16.2)
No. male or TGW anal sex partners in the last 6 mo	378			339			103		
0–1 partner	111	32.8 (28.6–37.1)	15.0 (6.0–24.1)	107	37.7 (26.6–48.7)	19.3 (14.3–24.4)	53	54.1 (43.6–64.6)	28.2 (20.6–35.8)
2–4 partners	170	45.1 (37.9–52.3)	20.6 (8.0–33.2)	168	48.2 (42.1–54.3)	30.4 (24.8–36.0)	39	34.0 (22.2–45.8)	26.2 (7.7–44.7)
≥5 partners	97	22.1 (11.1–33.1)	35.2 (15.5–54.9)	64	14.1 (6.9–21.4)	21.1 (3.3–39.0)	11	11.9 (4.3–19.6)	26.5 (9.3–43.6)
Used Internet or mobile apps to meet partners, last 6 mo	399			351			111		
Yes	85	23.2 (16.8–29.6)	34.9 (5.1–64.7)	98	24.0 (18.6–29.3)	24.1 (13.4–34.7)	45	42.6 (33.2–52.0)	40.4 (19.9–60.9)
No	314	76.8 (70.4–83.2)	18.4 (14.1–22.7)	253	76.0 (70.7–81.4)	23.5 (17.8–29.2)	66	57.4 (48.0–66.8)	16.3 (7.2–25.5)
Had vaginal/anal sex with a woman in the last 6 mo	361			327			106		
Yes	294	80.7 (75.5–85.9)	19.9 (11.4–28.3)	302	92.1 (88.8–95.4)	22.0 (17.9–26.1)	95	87.7 (80.5–94.9)	27.9 (18.7–37.2)
No	67	19.3 (14.1–24.5)	21.9 (4.2–39.6)	25	7.9 (4.6–11.2)	23.5 (0.0–47.8)	11	12.3 (5.1–19.5)	12.8 (0.0–30.1)
Exchanged sex for money in the last 6 mo	378			339			103		
Yes	195	51.6 (45.3–58.0)	21.2 (7.3–35.1)	143	38.2 (31.6–44.7)	23.8 (12.6–35.1)	37	33.0 (23.4–42.6)	29.0 (13.5–44.6)
No	183	48.4 (42.0–54.7)	23.1 (8.5–37.8)	196	61.8 (55.3–68.4)	25.5 (20.4–30.7)	66	67.0 (57.4–76.6)	26.4 (17.7–35.2)

* Confidence interval calculated using Wilson binomial proportion bounds.

TABLE 3.

Prevalence of Sexually Transmitted Infections Among Men Who Have Sex With Men and Transgender Women in Port Moresby, Lae, and Mt Hagen

	Port Moresby		Lae		Mt Hagen	
	Valid (n = 400)	Population Proportion (Weighted), % (95% CI)	Valid (n = 352)	Population Proportion (Weighted), % (95% CI)	Valid (n = 111)	Population Proportion (Weighted), % (95% CI)
Prevalence of chlamydia or gonorrhea	89	22.2 (19.2–27.2)	84	23.9 (18.6–29.2)	24	26.5 (16.5–36.6)
Prevalence of chlamydia and gonorrhea coinfection *	30	37.6 (24.6–50.9)	19	19.2 (9.7–28.4)	5	27.9 (22.8–33.6) †
Prevalence chlamydia	79	19.9 (15.2–24.7)	70	19.2 (14.4–23.9)	22	24.3 (13.9–34.7)
Anorectal	30	7.6 (4.4–10.9)	17	5.8 (2.2–7.4)	4	5.5 (4.2–7.1) †
Genital	42	10.5 (6.9–14.1)	46	12.9 (8.7–17.0)	14	15.0 (6.1–23.9)
Both	7	2.4 (0.1–4.6)	7	2.2 (0.4–4.0)	4	5.6 (0.4–10.8)
Prevalence gonorrhea	40	10.3 (6.4–14.2)	33	9.4 (6.0–12.8)	7	9.6 (2.4–16.9)
Anorectal	25	6.6 (3.5–9.7)	6	1.9 (0.4–3.4)	4	6.2 (4.8–7.9) †
Genital	13	3.2 (1.2–5.2)	17	4.9 (2.6–7.2)	0	0.0
Both	2	0.5 (0.3–0.8)	10	3.0 (1.0–5.1)	3	4.0 (2.9–5.4) †
Prevalence hepatitis B	56	11.7 (8.1–15.3)	50	13.8 (9.6–18.0)	15	13.6 (6.5–20.8)
Prevalence active syphilis	17	4.0 (1.7–6.4)	29	8.3 (4.8–11.7)	3	2.5 (1.7–3.7) †
Prevalence HIV	30	8.5 (4.3–12.6)	23	7.2 (3.8–10.7)	2	1.3 (0.8–2.2) †
Prevalence of STI ‡	100	27.0 (11.6–42.4)	105	32.3 (26.0–38.6)	26	27.6 (19.0–36.2)
Prevalence of STI coinfection §	34	10.4 (0.0–21.1)	25	9.6 (6.1–13.1)	6	10.9 (0.4–21.5)

* Among those with at least anorectal/genital chlamydia or anorectal/genital gonorrhea.

† Confidence intervals calculated using Wilson binomial proportion bounds.

‡ Any of the following: anorectal/genital chlamydia, anorectal/genital gonorrhea, or active syphilis.

§ At least 2 of the following: anorectal/genital chlamydia, anorectal/genital gonorrhea, or active syphilis.

TABLE 4.

Multivariate Analysis for Factors Associated With Gonorrhea or Chlamydia Infection Among MSM and Transgender Women in Port Moresby and Lae, Papua New Guinea

	Port Moresby				Lae			
	OR (95% CI)	***P***	**aOR (95% CI)**	***P***	**OR (95% CI)**	***P***	**aOR (95% CI)**	***P***
Gender identity		0.0002		0.2313		0.0345 *		
Male	Ref		Ref		Ref			
TG	3.0 (1.8–4.8)		1.6 (0.7–3.5)		4.8 (1.1–20.4)			
Age, y		<0.0001		<0.0001		0.1151		
12–19	Ref		Ref		Ref			
20–24	7.1 (1.8–27.0)		13.3 (7.1–24.8)		1.8 (0.5–6.6)			
25–29	4.3 (1.7–10.5)		7.4 (4.4–12.5)		1.0 (0.3–3.4)			
30–34	2.1 (1.0–4.6)		2.9 (1.5–5.4)		1.2 (0.8–2.6)			
≥35	3.7 (2.8–4.9)		6.8 (3.3–14.0)		1.6 (0.9–2.9)			
Education		<0.0001		<0.0001		0.7628		
No formal education	Ref		Ref		Ref			
Primary	0.5 (0.3–0.8)		0.7 (0.5–0.9)		1.1 (0.4–2.6)			
High school or higher	0.6 (0.3–1.1)		1.0 (0.5–2.1)		0.9 (0.2–3.6)			
Monthly income †		0.0037				0.0008		
<200 kina (~USD 63)	Ref				Ref			
200–499 kina	1.3 (0.7–2.4)				1.0 (0.8–1.3)			
500–999 kina	1.7 (0.8–3.7)				2.7 (1.8–4.0)			
≥1000 kina	2.6 (0.8–8.9)				0.7 (0.3–1.5)			
Cut foreskin		0.0361		0.0702		0.0570		0.0928
Yes	0.6 (0.4–1.0)		0.6 (0.4–1.0)		0.6 (0.4–1.0)		0.7 (0.5–1.1)	
No	Ref				Ref			
Disclosed sexual behaviors to family/friends (non-MSM)		0.7334				0.5875		
Yes	1.1 (0.7–1.7)				1.2 (0.6–2.6)			
No	Ref				Ref			
Hide sexual behavior or gender identity from health care worker		0.1587				0.6958		
Yes	1.3 (1.0–1.8)				0.8 (0.2–3.0)			

	Port Moresby				Lae			
	OR (95% CI)	***P***	**aOR (95% CI)**	***P***	**OR (95% CI)**	***P***	**aOR (95% CI)**	***P***
No	Ref				Ref			
Experienced violence in last 12 mo		0.9714				0.4561		
Yes	1.0 (0.2–5.8)				0.7 (0.3–1.9)			
No	Ref				Ref			
Total no. male/TG partners in last 6 mo		<0.0001		0.1111		0.0038		0.0023
0 or 1 partner	Ref		Ref		Ref		Ref	
2–4 partners	1.5 (0.9–2.4)		1.2 (0.7–2.2)		1.8 (1.3–2.5)		1.9 (1.3–2.7)	
≥5 partners	3.1 (2.0–4.6)		1.7 (1.0–3.0)		1.1 (0.5–2.7)		1.1 (0.5–2.4)	
Used Internet/mobile app to meet partners, last 6 mo		0.1055				0.8720		
Yes	2.4 (0.8–6.9)				1.0 (0.7–1.5)			
No	Ref				Ref			
Exchanged sex for money in last 6 mo		0.3383				0.7125		
Yes	0.9 (0.7–1.1)				0.9 (0.5–1.5)			
No	Ref				Ref			
Experienced STI symptoms in last 12 mo		0.0229		0.1337				0.0852
Yes	2.0 (1.1–3.7)		1.9 (0.8–4.1)		1.6 (1.0–2.5)	0.0325	1.6 (0.9–2.6)	
No	Ref				Ref			
Coinfection with HBV		0.7918				0.3007		
Yes	1.1 (0.6–1.8)				0.7 (0.3–1.4)			
No	Ref				Ref			
Coinfection with Syphilis		<0.0001		<0.0001		0.0557		0.0207
Yes	2.7 (1.8–3.9)		4.0 (2.0–7.9)		2.3 (1.0–5.5)		2.4 (1.2–5.0)	
No	Ref				Ref			
Coinfection with HIV		0.0108		0.3196		0.0620		0.0697
Yes	4.7 (1.5–14.8)		2.3 (0.5–11.4)		1.8 (1.0–3.2)		1.9 (0.9–4.0)	
No	Ref				Ref			

[*] Excluded from multivariate model because of high relative SE.

[†] Income variable excluded from multivariate analysis at both sites because of small cell size.