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Trends and differences in sexual practices and sexually transmitted infections in men who have sex with men only (MSMO) and men who have sex with men and women (MSMW) in Melbourne, Australia

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3 **Trends and differences in sexual practices and sexually transmitted infections in men**
4 **who have sex with men only (MSMO) and men who have sex with men and women**
5 **(MSMW) in Melbourne, Australia**
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57 Transmitted Diseases, HIV, Syphilis
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ABSTRACT

Objectives

There has been an increase in syphilis and gonorrhoea in urban heterosexual populations in Australia since 2015. Men who have sex with men and women (MSMW) may act as a bridging population for sexually transmitted infections (STI) transmission from men who have sex with men (MSM) to the heterosexual population. We aimed to compare the sexual practices and the trends in HIV/STI positivity between MSM only (MSMO) and MSMW.

Methods

We conducted a repeated cross-sectional study using data from MSM attending the Melbourne Sexual Health Centre, Australia, between 2011 and 2018. We examined the annual trends of sexual practices and HIV/STI positivity and assessed its association with sexual practice using logistic regression in MSMO and MSMW.

Results

Compared to MSMW ($N=2,030$), MSMO ($N=13,282$) were more likely to practice anal sex and to have condomless receptive anal sex with casual male partners, and less likely to have a current regular relationship. Over the 8-year period, there was an increase in condomless receptive anal sex with casual male partners for both groups (MSMO: from 45.9% to 64.3%, $P_{\text{trend}}=0.011$; MSMW: from 41.3% to 58.1%, $P_{\text{trend}}=0.037$) and condomless sex with female partners in MSMW (from 65.4% to 71.1%, $P_{\text{trend}}=0.022$). Syphilis positivity increased in MSMO, (from 5.6% to 8.1%, $P_{\text{trend}}=0.025$) and in MSMW (from 0.9% to 6.0%, $P_{\text{trend}}=0.040$) but HIV, chlamydia and gonorrhoea remained stable.

Conclusion

MSMW had low condom use with both male and female partners which may potentially act as a transmission bridge of HIV/STI from MSM to heterosexuals.

ARTICLE SUMMARY

Strengths and limitations of this study

- We compared sexual practices and HIV/sexually transmitted infections positivity in a high number of men who have sex with men only (N=13,282) and men who have sex with men and women (N=2,030) over an 8-year period
- We provide a comprehensive description of sexual practices distinguishing between condom use with regular or casual sexual partners, and in receptive or insertive anal sex
- The study was conducted in one urban major sexual health clinic and it is possible that our findings may not be generalizable to other settings.
- We were unable to analyse the statistical significance of the temporal trends for gonorrhoea and chlamydia due to a change in the diagnostic test in 2015

INTRODUCTION

Despite considerable public health efforts and biomedical advances,¹ the rate of sexually transmitted infections (STIs) is increasing at an alarming rate particularly among gay, bisexual and other men who have sex with men (MSM) worldwide.² In Australia, there was a 80% increase in the rate of gonorrhoea (from 65.5 to 118.0 per 100,000), a 14% increase in the rate of chlamydia (from 364.5 to 416.8 per 100,000) and more than a two-fold increase in the rate of syphilis (from 7.8 to 18.3 per 100,000) between 2013 and 2017.³ In males, most of the early rises in gonorrhoea and syphilis were accounted for by rises in MSM. However, in the last few years there has been a dramatic increase in both infections in the Australian heterosexual population to levels not seen since the 1980's. In stark contrast to the rise in gonorrhoea and syphilis, there has been an 11% decline in the HIV notification rate from 4.5 per 100,000 in 2013 to 4.0 in 2017 among MSM in Australia, with most of the reduction occurring between 2016 and 2017 after the introduction of pre-exposure prophylaxis (PrEP) in late 2016.³⁻⁵

The cause for the recent rise in gonorrhoea and syphilis in heterosexuals remains unclear,⁶⁻⁹ but a few epidemiological and genomics studies have proposed that bisexual MSM (or men who have sex with men and women) may act as a potential bridging population for STI transmission from MSM to the broader heterosexual population and hence contribute to the rise in STI in heterosexuals.^{1,10,11} In this study, we aimed to compare the demographic characteristics and sexual practices, and describe the trends in HIV/STI positivity in men who have sex with men only (MSMO) and men who have sex with men and women (MSMW) attending a large sexual health clinic in Melbourne between 2011 and 2018.

METHODS

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3 We conducted a repeated cross-sectional analysis of retrospective data of MSM attending the
4 Melbourne Sexual Health Centre (MSHC), Australia, between 2011 and 2018. MSHC is a
5 public clinic that offers a range of free clinical services regarding sexual health. MSHC is the
6 largest sexual health clinic in Victoria and provides more than 50,000 clinical consultations a
7 year, approximately 40% of clients are MSM.⁴ Upon arrival, all clients are invited to
8 complete a questionnaire via computer-assisted self-interviewing (CASI), which collects
9 client's demographic characteristics (e.g. age, country of birth, Aboriginal and Torres Strait
10 Islander status), sexual practices (i.e. gender of partners, type of partners [regular or casual],
11 number of partners, condom use and anal sex practice [receptive anal intercourse (RAI) and
12 insertive anal intercourse (IAI)], sex work and injecting drug use behaviour. Data on sexual
13 practices and injecting drug use were measured in the past 12 months, and sex work status
14 was defined as clients who had ever worked in the sex industry during lifetime. Clients are
15 allowed to decline to answer any questions they may wish to.
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35 Clients who were male, aged 18 years and above, reported having sex with another man in
36 the past 12 months, and attended MSHC for the first time between 2011 and 2018 were
37 included in this analysis. Only data from the client's first visit to MSHC was included in the
38 analysis. We categorised MSM into two main categories based on their self-reported sexual
39 practices: (1) men who have sex with men only (MSMO), and (2) men who have sex with
40 men and women (MSMW). It is reasonably hypothesised that the characteristics of MSMW
41 who predominately have male partners are similar to MSMO; while MSMW who
42 predominately have female partners are similar to men who have sex with women only.
43
44 Therefore, we further categorised MSMW into two groups: (1) MSM who reported more
45 female partners than male partners in the past 12 months (MSMW-W); and (2) MSM who
46 reported more male partners than female partners in the past 12 months (MSMW-M) and
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3 compared the characteristics between the two groups. Men with an equal number of male and
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5 female partners in the past 12 months (N=343) were excluded in the comparisons among
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7 MSMW subgroups but they were included in the overall MSMW category.
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12 We also extracted the HIV/STI testing results on the day. STI testing results included
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14 syphilis, gonorrhoea (stratified by anatomical site: anorectal, urethral and oropharyngeal) and
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16 chlamydia (stratified by anatomical site: anorectal and urethral). There was a major change in
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18 gonorrhoea and chlamydia testing at our clinic.¹² Prior to 2015, gonorrhoea was diagnosed by
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20 using culture and chlamydia was diagnosed by nucleic acid amplification test (NAAT) using
21
22 the BD ProbeTec Strand Displacement Amplification Assay (Becton, Dickinson and Co.,
23
24 Sparks, MD, USA). From March 2015 onwards, testing for both gonorrhoea and chlamydia
25
26 was performed using the Aptima Combo 2 Transcription-Mediated Amplification Assay
27
28 (AC2) (Hologic Gen-Probe, San Diego, CA, USA). HIV and serologic syphilis diagnostics
29
30 did not change during the study period. Before July 2015, screening for urethral gonorrhoea
31
32 was only performed in MSM with urethral symptoms as per the Australian guidelines.¹³
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34 However, since July 2015, all MSM were screened for urethral gonorrhoea and chlamydia
35
36 regardless of the presence of symptoms as per our clinic policy.¹⁴ Therefore, the positivity for
37
38 urethral gonorrhoea was calculated as the number of men tested positive divided by the
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40 number of men who were tested or urethral chlamydia to avoid the bias of testing urethral
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42 gonorrhoea among symptomatic MSM, and this approach was also used elsewhere.¹⁵ In
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44 addition, routine screening for oropharyngeal chlamydia among all MSM at MSHC were
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46 introduced in April 2017; however, routine screening for oropharyngeal gonorrhoea were
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48 conducted among all MSM and it did not change over the study period.
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3 Chi-squared test was used to compare the demographic characteristics and sexual practices
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5 between risk groups. We examined the annual trends of sexual practices and HIV/STI
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7 positivity for MSMO and MSMW using chi-squared trend test. Annual trends for condomless
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9 IAI and RAI with casual male partners were examined separately. We reported any
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11 condomless sex (i.e. IAI and/or RAI) with regular male partners for the trend analysis due to
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13 small number of participants reported having regular male partners in our cohort. For
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15 chlamydia and gonorrhoea positivity, we calculated the annual trends for 2011-2014 and
16
17 2015-2018 separately due to the change of the diagnostic assays. Finally, we assessed the
18
19 association between sexual practices and STI/HIV positivity using univariable and
20
21 multivariable logistic regression and reporting the crude odds ratio (OR) and adjusted odds
22
23 ratio (aOR), and their respective 95% confidence intervals (CI). We fitted a model including
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25 the year of the visit and all potential confounding factors (i.e., variables with $P < 0.20$ in the
26
27 univariable analyses) in the multivariable analysis. The 0.05 level was used for statistical
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29 significance in all the analysis. All statistical analyses were conducted using SPSS V.25. This
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31 study was approved by the Alfred Hospital Ethics Committee, Melbourne, Australia (83/18).
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37 No additional data available.
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42 ***Patient and Public Involvement***

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44 Patients were not directly involved in this study; only data gathered retrospectively and
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46 coming from electronic health records was used.
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50 51 **RESULTS**

52 ***Demographic characteristics***

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54 There were 18,851 MSM attending MSHC for the first time between 2011 and 2018. We
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56 excluded 1,909 MSM (10.1%) who had had sexual contact with another man but declined to
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3 report the number of male sexual partners and 1,630 MSM (8.6%) who reported no male
4 sexual partner in the past 12 months at the current visit but had previously reported male
5 partners at the clinic. The remaining 15,312 participants were included in this data analysis,
6 including 13,282 MSMO (86.7%) and 2,030 MSMW (13.3%). Among 2,030 MSMW, 859
7 (42.3%) were MSMW-W, 828 (40.8%) MSMW-M and 343 (16.9%) had equal number of
8 male and female partners in the past 12 months.
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19 Of the 15,312 MSM, the median age was 27 years (interquartile range, IQR: 23-33) but
20 MSMW were slightly older than MSMO (median age: 29 *versus* 27; $p < 0.001$) (Table 1). The
21 proportion of men born in Australia was higher in MSMW than in MSMO (57.9% *versus*
22 50.5%, $p < 0.001$). The proportion of injecting drug use in the past 12 months was higher in
23 MSMW than MSMO (2.5% *versus* 1.7%, $P = 0.029$; Table 1); and it was similar in MSMW-W
24 and in MSMW-M (3.1% *versus* 2.5%, $P = 0.480$; Table S1).
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35 *Sexual practices*

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37 The proportion of men who reported sex overseas in the past 12 months was significantly
38 higher in MSMW than in MSMO (39.5% *versus* 36.7%; $P = 0.019$); and more MSMW-W
39 (45.7%) reported sex overseas than MSMW-M (37.1%; $P = 0.001$) (Table S1). Less than half
40 (40.5%) of MSMO had a male regular partner. Among MSMW, 8.5% had a regular male
41 partner, 33.4% a regular female partner, and 4.6% had regular male and female partners
42 (Table 1).
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53 The proportion of MSM reporting ≥ 5 sexual partners (regardless gender of the partners) in
54 the past 12 months, was higher among MSMW (80.6% in MSMW-M and 69.7% in MSMW-
55 W) than MSMO (55.8%; $P < 0.001$), and this proportion increased significantly in MSMW
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3 (from 63.1% in 2011 to 70.8% in 2018, $P_{\text{trend}}=0.026$) but only increased marginally in
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5 MSMO (from 50.4% to 56.6%; $P_{\text{trend}}=0.052$) In addition, the proportion of MSMW with ≥ 5
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7 female sexual partners increased significantly from 23.2% in 2011 to 30.3% in 2018 (P_{trend}
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9 $=0.026$) (Table S2-S3).

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15 Anal sex practices with casual male partners varied between MSMO and MSMW. The
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17 proportion of MSMO having RAI only with casual male partners was higher (10.5%) than in
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19 MSMW (7.0%); however, the proportion of MSMO having IAI only with casual male
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21 partners was lower (11.2%) than in MSMW (15.0%) ($P<0.001$). Condomless sex with casual
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23 male partners in the past 12 months was more common in MSMO than in MSMW for RAI
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25 (54.3% *versus* 50.2%; $P=0.006$) but there was no significant difference in IAI. Two-thirds
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27 (67.4%) of MSMW had condomless vaginal or anal sex with female casual partners in the
28
29 past 12 months (Table 1). Among MSMO, there was a 40.1% increase in condomless RAI
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31 ($P_{\text{trend}}=0.011$) and 43.1% increase in IAI ($P_{\text{trend}}=0.012$) with casual male partners in the past
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33 12 months (Figure 1). Similarly, among MSMW, there was a 41.5% increase in condomless
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35 RAI ($P_{\text{trend}}=0.037$) and an 8.7% increase in condomless vaginal or anal sex with female
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37 casual partners ($P_{\text{trend}}=0.022$). The proportion of condomless IAI with casual male partners
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39 did not change during the study period ($P_{\text{trend}}=0.354$) (Figure 1, Table S2-S3). MSMW-M
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41 showed a lower use of condom with casual male partners but a higher use with casual female
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43 partners compared to MSMW-W (Table S1).
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52 Regarding regular male partners, both condomless RAI and condomless IAI were more
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54 commonly reported in MSMO (RAI: 71.9%; IAI: 71.5%) than in MSMW (RAI: 62.8%; IAI:
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56 63.4%; $P=0.003$; $P=0.007$) (Table 1) and condomless anal sex regardless of IAS or RAS,
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3 increased from 69.1% to 78.5% in MSMO ($P_{\text{trend}}=0.020$) but not in MSMW ($P_{\text{trend}}=0.467$)
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5 (Figure 1, Table S2-S3).
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10 ***HIV/STI positivity***

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12 Overall, MSMO had a higher HIV, syphilis, gonorrhoea and chlamydia positivity than
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14 MSMW (Table 2). MSMO had higher extra-genital gonorrhoea and chlamydia positivity than
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16 MSMW; however, the positivity for urethral gonorrhoea and urethral chlamydia did not differ
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18 between the two groups. There was no increase in gonorrhoea and chlamydia positivity in the
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20 periods 2011-2014 and 2015-2018 in both groups (Table S6-S7). Among MSMW, MSMW-
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22 M had a higher gonorrhoea and chlamydia positivity but not HIV and syphilis compared to
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24 MSMW-W (Table S4).
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31 There was a 44.6% increase in syphilis positivity from 5.6% in 2011 to 8.1% in 2018 (P_{trend}
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33 $=0.025$) in MSMO and more than a six-fold increase in syphilis positivity from 0.9% in 2011
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35 to 6.0% in 2018 ($P_{\text{trend}}=0.040$) in MSMW. HIV positivity did not change in both groups
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37 between 2011 and 2018 (Table S6-S7).
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42 After adjusting for other potential confounding factors, MSMO had higher odds of testing
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44 positive for gonorrhoea at any anatomical site (aOR 1.32, 95% CI 1.11 to 1.58), chlamydia at
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46 any anatomical site (aOR 1.38; 95% CI 1.15 to 1.65), syphilis (aOR 1.71, 95% CI 1.35 to
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48 2.16) and HIV (aOR 4.41, 95% CI 2.46 to 7.91) compared to MSMW (Table 3).
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51 Additionally, MSMO had higher odds of testing positive for gonorrhoea at any anatomical
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53 site (aOR 1.48; 95% CI 1.09 to 2.01), chlamydia at any anatomical site (aOR 1.46; 95% CI
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55 1.08 to 1.96), syphilis (aOR 2.10, 95% CI 1.37 to 3.23), and HIV (aOR 6.32, 95% CI 2.01 to
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57 19.90) compared with MSMW-W in the adjusted analysis; however, there was no significant
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3 difference in HIV/STI positivity between MSMW-M and MSMW-W in the adjusted analysis
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5 (Table S5).
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10 **DISCUSSION**

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12 In this study of 13,282 MSMO and 2,030 MSMW in Melbourne, Australia, we found that
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14 there were significant changes in sexual practices among bisexual men over the period in
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16 which rates of STIs had been increasing in heterosexual men and women. Specifically, we
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18 found that condomless anal sex with casual male partners and condomless anal sex with
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20 female partners had increased in bisexual men as had the positivity for syphilis. While the
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22 sexual risks and STI positivity was generally lower in bisexual men than for MSMO, their
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24 rising rates are consistent with the hypothesis that there may be more transmission to
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26 heterosexuals than had occurred previously. Clarifying this issue and what factors are causing
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28 the rising rates of STIs is likely to contribute significantly to the design of STI control
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30 programs.
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38 A number of other studies have assessed HIV and sexual practices in bisexual men but their
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40 results are conflicting. A meta-analysis published in 2014 concluded that MSMW had a lower
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42 HIV prevalence (16.9%) compared to MSMO (33.3%) but higher than men who have sex
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44 with women only (MSWO) (3.5%) which was consistent with our findings.¹⁶ Consistent with
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46 our findings, the authors found that MSMW (15.9%) were less likely to engage in
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48 condomless receptive anal sex compared to MSMO (35.0%).¹⁶ However, some other studies
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50 conducted in different settings, such as China, India and the US, have shown the risk of HIV
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52 among MSMW is similar or even at a higher risk compared to MSMO.¹⁷⁻²⁰
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3 Our data suggest that MSMO have a higher positivity for syphilis, chlamydia and gonorrhoea
4 than MSMW; however, the comparison of STI positivity between MSMO and MSMW varies
5 in published studies. For example, Davis and colleagues (2016) conducted a study among
6 Chinese MSM showing no differences between MSMW and MSMO in the lifetime
7 prevalence of syphilis, gonorrhoea, chlamydia and genital warts but a higher prevalence of
8 genital herpes in MSMW (6.6%) compared to MSMO (0.4%)²⁰. In USA, MSMW had a 57%
9 increased odds of having an STI compared to heterosexuals, but no differences were found
10 between MSMO and heterosexuals or MSMO and MSMW.¹⁹ Similarly, an Indian study has
11 shown that there were no differences in any STI positivity (i.e. either syphilis, gonorrhoea or
12 chlamydia) between MSMO and MSMW.¹⁷ Furthermore, MSMW are also less likely to ever
13 have an HIV/STI test compared to MSMO,^{17,21,22} which is consistent with an Australian
14 qualitative study suggesting MSMW have a poor sexual health knowledge compared to
15 MSMO.²³

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35 Our data also show that MSMW are less likely to have RAI with male partners and less likely
36 to have condomless RAI. These findings may explain the reasons why MSMW have a lower
37 positivity for anorectal gonorrhoea and chlamydia than MSMO in our study. Importantly, we
38 did not find any significant differences in urethral gonorrhoea and chlamydia between
39 MSMO and MSMW despite differences in anal sex and condom use. This may be because
40 some urethral chlamydial infection in MSMW is acquired from women and that urethral
41 gonorrhoea is commonly acquired from no anal sexual activity.^{24,25} The disparities of HIV
42 and syphilis positivity between MSMO and MSMW were more pronounced compared to
43 other gonorrhoea and chlamydia, and there was a striking increase in syphilis positivity in
44 both groups.

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3 With the unique characteristics and sexual practices among MSMW, it is plausible that
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5 MSMW act as a potential bridge for HIV/STI transmission from MSM to heterosexual
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7 population and this concept has been proposed elsewhere.^{26–28} MSMW has been considered
8
9 as a more vulnerable and hidden population due to the social stigma and self-identity.¹¹ Some
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11 MSMW may marry a woman to hide their homosexuality particularly in countries due to the
12
13 stigma and discrimination against MSM.¹¹ MSMW may be more likely not to discuss their
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15 sexual health and disclose their sexual orientation with their GPs and hence these men may
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17 not receive the appropriate sexual health care and management. A LGBT-friendly and non-
18
19 judgemental approach clinic is essential to build up the trust between clinicians and patients.
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21 Furthermore, the current health promotion and prevention programmes mainly targeting the
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23 MSM population as a whole. It is possible that some hidden MSMW may not be engaged in
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25 the LGBT community and hence they may not be targeted with the current programmes.
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27 Future public health campaigns and prevention programmes should also tailor for MSMW via
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29 different channels.
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38 There are a number of limitations in the study that have to be taken into account. First, data
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40 on sexual orientation was not collected. The categorisation of MSMO and MSMW was based
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42 on self-reported sexual practice rather than sexual identity. This means that MSMW in this
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44 study might not define themselves as bisexual men. Second, this study was conducted in one
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46 urban major sexual health clinic. It is possible that MSM attending a sexual health clinic are
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48 more likely to be at increased sexual risk and hence our findings may not be generalizable to
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50 the whole MSM population in Australia or in other settings. Third, we were unable to
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52 examine the temporal trends for gonorrhoea and chlamydia over the 8-year period because
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54 we changed the diagnostic test for gonorrhoea and chlamydia at our clinic in 2015.
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CONCLUSION

MSMW is a heterogeneous group in which the sexual practices and STI positivity vary between MSMW with mainly female partners and MSMW with mainly male partners.

Compared to MSMO, MSMW have overall lower sexual risk practices and lower STI/HIV positivity. In the last years, changes in the sexual practices in MSM have affected both MSMW and MSMO leading to an increased risk of STI in both subgroups. The increase in syphilis positivity among MSMW in concert with a decrease in the use of condoms with casual female partners may have led to rises in the incidence of STIs in the female population. Nevertheless, further studies also including heterosexual men and women are needed to better understand the recent changes in the STI epidemiology.

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AUTHOR DISCLOSURE STATEMENT(S)

None

CONTRIBUTORS

EPFC and CKF conceived and designed the study. RC conducted some preliminary analyses. MMS performed the literature review, conducted the statistical analysis and wrote the first draft of the manuscript. EPFC provided statistical advice and oversaw the study. All authors assisted with data interpretation, critically revised it for important intellectual content and approved the final version of the manuscript.

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FIGURES

Figure 1 Proportion of condomless anal or vaginal sex with casual sexual partners in past 12 months with casual partners between 2011 and 2018, stratified by men who have sex with men only (MSMO) and men who have sex with men and women (MSMW).

*For anal sex with male partners and for anal or vaginal sex with female partners, MSM reporting condomless anal sex includes MSM who sometimes, usually or never used a condom with their sexual partners in the past 12 months. MSM: men who have sex with men, MSMO: men who have sex with men only, MSMW: men who have sex with men and women

Figure 2 Positivity for syphilis and HIV between 2011 and 2018, stratified by men who have sex with men only (MSMO) and men who have sex with men and women (MSMW).

MSMO: men who have sex with men only, MSMW: men who have sex with men and women

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TABLES

Table 1 Demographic characteristics and sexual practices among men who have sex with men, stratified by men who have sex with men only (MSMO) and men who have sex with men and women (MSMW).

		Men who have sex with men only (N=13,282) n(%)	Men who have sex with men and women (N=2030) n(%)	P- value
Age (years), median(IQR)		27 (23-33)	29 (24-38)	<0.001
Country of birth	Australia	6459 (50.5)	1117 (57.9)	<0.001
	Overseas	6335 (49.5)	813 (42.1)	
	No information	488	100	
Aboriginal and Torres Strait Islander Status	Indigenous origin	158 (1.3)	18 (1.0)	0.250
	Non-Indigenous origin	12037 (98.7)	1827 (99.0)	
	No information	1087	185	
Sex overseas past 12 months	Yes	4562 (36.7)	757 (39.5)	0.019
	No	7854 (63.3)	1158 (60.5)	
	No information	866	115	
Ever Sex Worker	Yes	77 (0.6)	13 (0.6)	0.739
	No	13205 (99.4)	2017 (99.4)	
Injected Drug Use past 12 months	Yes	221 (1.7)	50 (2.5)	0.029
	No	12823 (98.3)	1939 (97.5)	
	No information	238	41	
Number of female and male sexual partners in the past 12 months, median (IQR)		5 (3-10)	6 (4-11)	<0.001
Number of male sexual partners in the past 12 months, median (IQR)		5 (3-10)	2 (1-5)	<0.001
Regular sexual partner	No regular partner	7807 (59.5)	1085 (53.5)	-
	Regular male partner	5321 (40.5)	172 (8.5)	
	Regular female partner	NA	677 (33.4)	
	Regular female and male partner	NA	93 (4.6)	
	No information	154	3	
Anal sexual practice with regular male partners ^a	Receptive only	460 (8.8)	15 (5.8)	0.070
	Insertive only	477 (9.1)	16 (6.2)	
	Receptive and insertive	4067 (77.6)	219 (84.6)	
	No anal sex	238 (4.5)	9 (3.5)	
	No information	79	6	

Condom use with regular male partners in the past 12 months for receptive anal sex ^{b*}	Always	1274 (28.1)	87 (37.2)	0.003
	Not always	3253 (71.9)	147 (62.8)	
Condom use with regular male partners in the past 12 months for insertive anal sex ^{c*}	Always	1294 (28.5)	86 (36.6)	0.007
	Not always	3250 (71.5)	149 (63.4)	
Vaginal or anal sex with regular female partner ^d	Yes	NA	744 (98.5)	-
	No	NA	11 (1.5)	
	No information	NA	15	
Condom use with regular female partners in the past 12 months ^{e*}	Always	NA	136 (18.3)	-
	Not always	NA	608 (81.7)	
Anal sexual practice with casual male partners	Receptive only	1324 (10.5)	136 (7.0)	<0.001
	Insertive only	1392 (11.2)	292 (15.0)	
	Receptive and insertive	8126 (64.5)	1088 (55.9)	
	No anal sex	1750 (13.9)	430 (22.1)	
	No information	690	84	
Condom use with casual male partners in the past 12 months for receptive anal sex ^{f*}	Always	4319 (45.7)	610 (49.8)	0.006
	Not always	5131 (54.3)	614 (50.2)	
Condom use with casual male partners in the past 12 months for insertive anal sex ^{g*}	Always	4395 (46.2)	665 (48.2)	0.161
	Not always	5123 (53.8)	715 (51.8)	
Vaginal or anal sex with casual female partner	Yes	NA	1730 (96.9)	-
	No	NA	56 (3.1)	
	No information	NA	244	
Condom use with casual female partners in the past 12 months ^{h*}	Always	NA	564 (32.6)	-
	Not always	NA	1166 (67.4)	

^aOnly including MSM with regular male partners or regular male and female partners,

^bOnly including MSM that referred receptive only or receptive and insertive anal sex with regular male partners, ^cOnly including MSM that referred insertive only or receptive and insertive anal sex with regular male partners, ^dOnly including MSM with regular female partners or regular male and female partners ^eOnly including MSM that referred vaginal or

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7 referred insertive only or receptive and insertive anal sex with casual male partners, ^h Only
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9 including MSM that referred vaginal or anal sex with casual female partners.*'Not always'
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11 was defined as men who sometimes, usually or never used a condom with their sexual
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13 partners in the past 12 months (with female partners for vaginal or anal sex, with male
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15 partners for anal sex). IQR: Interquartile range, MSM: men who have sex with men
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For peer review only

Table 2 Positivity for gonorrhoea, chlamydia, syphilis and HIV among men who have sex with men, stratified by men who have sex with men only (MSMO) and men who have sex with men and women (MSMW).

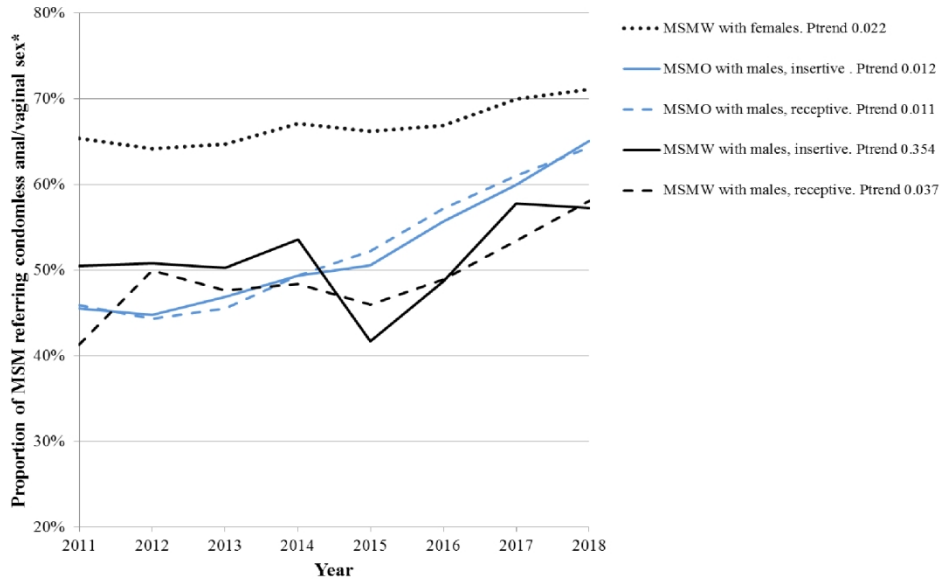
HIV/STI positivity	Men who have sex with men only	Men who have sex with men and women	P value
Gonorrhoea (oropharyngeal)	714/12253 (5.8)	72/1752 (4.1)	0.003
Gonorrhoea (urethral)*	412/12125 (3.4)	58/1935 (3.0)	0.208
Gonorrhoea (anorectal)	774/11505 (6.7)	58/1436 (4.0)	<0.001
Gonorrhoea (any anatomical site)	1384/12399 (11.2)	149/1878 (7.9)	<0.001
Chlamydia (urethral)	425/12125 (3.5)	77/1935 (4.0)	0.297
Chlamydia (anorectal)	1029/11458 (9.0)	85/1436 (5.9)	<0.001
Chlamydia (any anatomical site)	1322/12325 (10.7)	146/1957 (7.5)	<0.001
Syphilis	847/11757 (7.2)	86/1821 (4.7)	<0.001
HIV (new diagnosis)	303/11522 (2.6)	12/1819 (0.7)	<0.001
HIV (previous diagnosis)	342/12940 (2.6)	7/2023 (0.3)	<0.001

*Before 2015, MSM with no urethral symptoms were not tested for urethral gonorrhoea. The number of people tested corresponds to the number of people tested for urethral Chlamydia **Only including HIV cases diagnosed on the day of the first visit.

Table 3 Association between sexual practice and Gonorrhoea, Chlamydia, Syphilis and HIV positivity among men who have sex with men only and men who have sex with men and women from 2011 to 2018 in Melbourne (Australia)

		OR (95% CI)	P-value	aOR(95% CI)	P-value
Gonorrhoea, any anatomical site					
	MSMO	1.46 (1.22 to 1.74)	<0.001	1.32 (1.11 to 1.58)	0.002
	MSMW	1		1	ref
Chlamydia, any anatomical site					
	MSMO	1.49 (1.25 to 1.78)	<0.001	1.38 (1.15 to 1.65)	<0.001
	MSMW	1		1	ref
Syphilis					
	MSMO	1.57 (1.25 to 1.97)	<0.001	1.71 (1.35 to 2.16)	<0.001
	MSMW	1		1	ref
HIV incident *					
	MSMO	4.07 (2.28 to 7.26)	<0.001	4.41 (2.46 to 7.91)	<0.001
	MSMW	1		1	ref
Previous HIV positive					
	MSMO	7.6 (3.6 to 16.17)	<0.001	9.55 (4.48 to 20.33)	<0.001
	MSMW	1	ref	1	ref

*Only including HIV cases diagnosed on the day of the first visit. cOR: crude odds ratio, aOR: odds ratio adjusted by age, country of birth, sex overseas, injected drug use in the past 12 months, regular partner, number of male sexual partners in the past 12 months, condom use with casual male partners in the past 12 months and year of visit, MSMO: men who have sex with men only, MSMW: men who have sex with men and women.

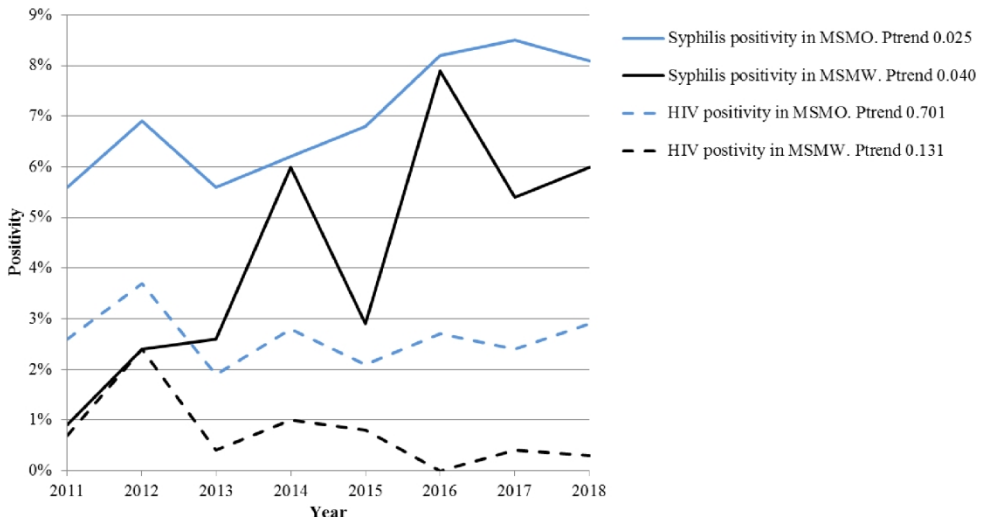


Proportion of condomless anal or vaginal sex with casual sexual partners in past 12 months with casual partners between 2011 and 2018, stratified by men who have sex with men only (MSMO) and men who have sex with men and women (MSMW).

*For anal sex with male partners and for anal or vaginal sex with female partners, MSM reporting condomless anal sex includes MSM who sometimes, usually or never used a condom with their sexual partners in the past 12 months. MSM: men who have sex with men, MSMO: men who have sex with men only, MSMW: men who have sex with men and women

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Positivity for syphilis and HIV between 2011 and 2018, stratified by men who have sex with men only (MSMO) and men who have sex with men and women (MSMW).
MSMO: men who have sex with men only, MSMW: men who have sex with men and women

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3 **SUPPLEMENTARY MATERIAL**
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6 **Trends and differences in sexual practices and sexually transmitted infections in men who have**
7 **sex with men only (MSMO) and men who have sex with men and women (MSMW) in**
8 **Melbourne, Australia.**
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11 Mario Martín-Sánchez, Richard Case, Christopher K. Fairley, Jane S. Hocking, Catriona S. Bradshaw,
12 Jason J. Ong, Marcus Y. Chen, Eric P.F. Chow
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14 **Table S1** Demographic characteristics and sexual practices among men who have sex with men only
15 and men who have sex with men and women from 2011 to 2018 in Melbourne (Australia).....2
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17 **Table S2** Temporal trend of the sexual practices among men who have sex with men only from 2011
18 to 2018 in Melbourne (Australia)5
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20 **Table S3** Temporal trend of the sexual practices among men who have sex with men and women
21 from 2011 to 2018 in Melbourne (Australia).....6
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23 **Table S4** Positivity for gonorrhoea, chlamydia, syphilis and HIV among men who have sex with men
24 only and men who have sex with men and women from 2011 to 2018 in Melbourne (Australia)7
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26 **Table S5** Association between sexual practice and Gonorrhoea, Chlamydia, Syphilis and HIV
27 positivity among men who have sex with men only and men who have sex with men and women from
28 2011 to 2018 in Melbourne (Australia)8
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30 **Table S6** Temporal trend of the positivity for sexually transmitted infections and HIV among men
31 who have sex with men only from 2011 to 2018 in Melbourne (Australia).....9
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33 **Table S7** Temporal trend of the positivity for sexually transmitted infections and HIV among men
34 that have sex with men and women from 2011 to 2018 in Melbourne (Australia)10
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Table S1 Demographic characteristics and sexual practices among men who have sex with men only and men who have sex with men and women from 2011 to 2018 in Melbourne (Australia)

	MSMO (N=13,282)	MSMW-M (N=828)	MSMW-W (N=859)	Comparison across three groups	Comparison between MSMW-M and MSMW-W
	n (%)	n (%)	n (%)	P-value	P-value
Age (years), median(IQR)	27 (23-33)	29 (24-38)	28 (24-36)	<0.001	0.976
Country of birth				<0.001	0.037
Australia	6459 (50.5)	478 (61.1)	459 (56.0)		
Overseas	6335 (49.5)	304 (38.9)	361 (44.0)		
No information	488	46	39		
Indigenous status				0.244	0.108
Indigenous origin	158 (1.3)	11 (1.5)	5 (0.6)		
Non-Indigenous origin	12037 (98.7)	736 (98.5)	780 (99.4)		
No information	1087	81	74		
Sex overseas				<0.001	0.001
Yes	4562 (36.7)	286 (37.1)	372 (45.7)		
No	7854 (63.3)	484 (62.9)	442 (54.3)		
No information	866	58	45		
Sex work during lifetime				0.587	0.730
Yes	77 (0.6)	7 (0.8)	6 (0.7)		
No	13205 (99.4)	821 (99.2)	853 (99.3)		
Injected drug use in past 12 months				0.005	0.480
Yes	221 (1.7)	25 (3.1)	21 (2.5)		
No	12823 (98.3)	786 (96.9)	816 (97.5)		
No information	238	17	22		
Number of female and male sexual partners in the past 12 months, median (IQR)	5 (3-10)	7 (5-12)	6 (4-11)	<0.001	<0.001
Number of male sexual partners in the past 12 months, median (IQR)	5 (3-10)	5 (3-10)	1 (1-2)	<0.001	<0.001
Number of female sexual partners in the past 12 months, median (IQR)	NA	1 (1-2)	5 (3-8)	NA	<0.001
Regular sexual partner				NA	<0.001
No regular partner	7807 (59.5)	445 (53.8)	466 (54.4)		
Regular male partner	5321 (40.5)	141 (17.0)	11 (1.3)		
Regular female partner	NA	204 (24.7)	355 (41.4)		
Regular female and male partner	NA	37 (4.5)	25 (2.9)		
No information	154	1	1		
Anal sexual practice with regular male partners^a				0.275	0.392
Receptive only	460 (8.8)	10 (5.6)	2 (6.3)		
Insertive only	477 (9.1)	13 (7.3)	0 (0.0)		
Receptive and insertive	4067 (77.6)	148 (83.6)	28 (87.5)		
No anal sex	238 (4.5)	6 (3.4)	2 (6.3)		
No information	79	2	5		
Condom use with casual regular partners in the past 12 months for receptive anal sex^{b*}				0.100	0.241
Always	1274 (28.1)	51 (32.3)	13 (43.3)		
Not always	3253 (71.9)	107 (67.7)	17 (56.7)		
Condom use with casual regular partners in the past 12 months for insertive anal sex^{c*}				0.116	0.975
Always	1294 (28.5)	57 (35.4)	10 (35.7)		
Not always	3250 (71.5)	104 (64.6)	18 (64.3)		
Vaginal or anal sex with regular female partner^d				NA	0.935
Yes	NA	232 (98.3)	367 (98.4)		
No	NA	4 (1.7)	6 (1.6)		
No information	NA	5	7		
Condom use with regular female				NA	0.436

partners in the past 12 months*				
Always	NA	45 (19.4)	62 (16.9)	
Not always	NA	187 (80.6)	305 (83.1)	
Anal sexual practice with casual male partners				
				<0.001
Receptive only	1324 (10.5)	46 (5.6)	68 (8.3)	<0.001
Insertive only	1392 (11.2)	122 (14.9)	122 (14.9)	
Receptive and insertive	8126 (64.5)	538 (65.9)	418 (51.0)	
No anal sex	1750 (13.9)	111 (13.6)	212 (25.9)	
No information	690	11	39	
Condom use with casual male partners in the past 12 months for receptive anal sex^{f*}				
				0.003
Always	4319 (45.7)	261 (44.7)	260 (53.5)	
Not always	5131 (54.3)	323 (55.3)	226 (46.5)	
Condom use with casual male partners in the past 12 months for insertive anal sex^{g*}				
				0.002
Always	4395 (46.2)	282 (42.7)	282 (52.6)	
Not always	5123 (53.8)	378 (57.3)	256 (47.4)	
Vaginal or anal sex with casual female partner				
				0.908
Yes	NA	675 (97.3)	819 (97.2)	
No	NA	19 (2.7)	24 (2.8)	
No information	NA	134	16	
Condom use with casual female partners in the past 12 months^{h*}				
				<0.001
Always	NA	262 (39.0)	200 (24.4)	
Not always	NA	412 (61.0)	619 (75.6)	

^aOnly including MSM with regular male partners or regular male and female partners, ^bOnly including MSM that referred receptive only or receptive and insertive anal sex with regular male partners, ^cOnly including MSM that referred insertive only or receptive and insertive anal sex with regular male partners, ^dOnly including MSM with regular female partners or regular male and female partners ^eOnly including MSM that referred vaginal or anal sex with regular female partner, ^f Only including MSM that referred receptive only or receptive and insertive anal sex with casual male partners, ^g Only including MSM that referred insertive only or receptive and insertive anal sex with casual male partners, ^h Only including MSM that referred vaginal or anal sex with casual female partners. *'Not always' was defined as men who sometimes, usually or never used a condom with their sexual partners in the past 12 months (with female partners for vaginal or anal sex, with male partners for anal sex). IQR: Interquartile range, MSM: men who have sex with men, MSMO: men who have sex with men only, MSMW-W: men who have sex with men and women and had more female than male sexual partner in the past 12 months, MSMW-M: men who have sex with men and women and had more male than female sexual partner in the past 12 months

Table S2 Temporal trend of the sexual practices among men who have sex with men only from 2011 to 2018 in Melbourne (Australia)

	2011		2012		2013		2014		2015		2016		2017		2018		2011-18 P _{trend}
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	
Number of sexual partners in the past 12 months																	
<5	527	49.6%	610	46.7%	655	45.3%	640	43.6%	700	41.2%	832	42.8%	923	44.3%	986	43.4%	0.052
5+	536	50.4%	695	53.3%	792	54.7%	828	56.4%	999	58.8%	1113	57.2%	1160	55.7%	1286	56.6%	-
Condom use with regular male partners in the past 12 months*																	
Always	137	30.9%	167	31.2%	163	30.1%	143	25.9%	169	27.1%	204	27.9%	151	19.7%	174	21.5%	0.020
Not always	307	69.1%	368	68.8%	378	69.9%	410	74.1%	454	72.9%	528	72.1%	615	80.3%	636	78.5%	-
Anal sexual practice with casual male partners																	
Receptive only	76	7.6%	113	9.2%	110	8.1%	143	10.3%	153	9.4%	204	11.0%	236	11.9%	289	13.4%	0.014
Insertive only	99	9.9%	136	11.1%	156	11.5%	151	10.9%	184	11.4%	212	11.5%	204	10.3%	250	11.6%	0.336
Receptive and insertive	640	64.2%	760	62.1%	860	63.2%	904	65.0%	1078	66.5%	1219	66.0%	1301	65.4%	1364	63.1%	0.360
No anal sex	182	18.3%	214	17.5%	235	17.3%	193	13.9%	206	12.7%	212	11.5%	248	12.5%	260	12.0%	0.015
Condom use with casual male partners in the past 12 months for receptive anal sex*																	
Always	387	54.1%	486	55.7%	529	54.5%	530	50.6%	589	47.8%	609	42.8%	599	39.0%	590	35.7%	0.011
Not always	329	45.9%	387	44.3%	441	45.5%	517	49.4%	642	52.2%	814	57.2%	938	61.0%	1063	64.3%	-
Condom use with casual male partners in the past 12 months for insertive anal sex*																	
Always	403	54.5%	495	55.2%	540	53.1%	534	50.6%	623	49.4%	634	44.3%	602	40.0%	564	34.9%	0.012
Not always	336	45.5%	401	44.8%	476	46.9%	521	49.4%	639	50.6%	797	55.7%	903	60.0%	1050	65.1%	-

* 'Not always' was defined as men who sometimes, usually or never used a condom for anal sex in the past 12 months

Table S3 Temporal trend of the sexual practices among men who have sex with men and women from 2011 to 2018 in Melbourne (Australia)

	2011		2012		2013		2014		2015		2016		2017		2018		2011-18 P _{trend}
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	
Number of sexual partners past 12 months																	
<5	62	36.9%	67	36.8%	97	39.4%	84	35.0%	94	36.2%	93	31.8%	99	33.1%	100	29.2%	0.026
5+	106	63.1%	115	63.2%	149	60.6%	156	65.0%	166	63.8%	199	68.2%	200	66.9%	243	70.8%	
Number of male sexual partners past 12 months																	
<5	122	72.6%	131	72.0%	176	71.5%	170	70.8%	196	75.4%	208	71.2%	209	6	222	64.7%	0.113
5+	46	27.4%	51	28.0%	70	28.5%	70	29.2%	64	24.6%	84	28.8%	90	30.1%	121	35.3%	
Number of female sexual partners past 12 months																	
<5	129	76.8%	135	74.2%	190	77.2%	183	76.3%	187	71.9%	209	71.6%	216	72.2%	239	69.7%	0.026
5+	39	23.2%	47	25.8%	56	22.8%	57	23.8%	73	28.1%	83	28.4%	83	27.8%	104	30.3%	
Condom use with regular male partners in the past 12 months*																	
Always	11	45.8%	5	21.7%	14	41.2%	13	38.2%	9	37.5%	9	28.1%	10	25.6%	15	37.5%	0.467
Not always	13	54.2%	18	78.3%	20	58.8%	21	61.8%	15	62.5%	23	71.9%	29	74.4%	25	62.5%	
Anal sexual practice with casual male partners																	
Receptive only	6	3.8%	12	6.8%	15	6.5%	14	6.0%	17	6.9%	26	9.2%	16	5.5%	30	9.2%	0.084
Insertive only	19	11.9%	26	14.8%	33	14.2%	27	11.5%	42	17.1%	45	15.9%	44	15.2%	56	17.1%	0.072
Receptive and insertive	86	54.1%	96	54.5%	132	56.9%	139	59.4%	133	54.1%	150	53.0%	160	55.4%	192	58.7%	0.520
No anal sex	48	30.2%	42	23.9%	52	22.4%	54	23.1%	54	22.0%	62	21.9%	69	23.9%	49	15.0%	0.042
Condom use with casual male partners in the past 12 months for receptive anal sex*																	
Always	54	58.7%	54	50.0%	77	52.4%	79	51.6%	81	54.0%	90	51.1%	82	46.6%	93	41.9%	0.037
Not always	38	41.3%	54	50.0%	70	47.6%	74	48.4%	69	46.0%	86	48.9%	94	53.4%	129	58.1%	
Condom use with casual male partners in the past 12 months for insertive anal sex*																	
Always	52	49.5%	60	49.2%	82	49.7%	77	46.4%	102	58.3%	100	51.3%	86	42.2%	106	42.7%	0.354
Not always	53	50.5%	62	50.8%	83	50.3%	89	53.6%	73	41.7%	95	48.7%	118	57.8%	142	57.3%	
Condom use with regular female partners in the past 12 months*																	
Always	16	22.5%	17	23.3%	8	9.9%	10	13.0%	17	18.9%	24	19.2%	20	19.0%	24	19.7%	0.901
Not always	55	77.5%	56	76.7%	73	90.1%	67	87.0%	73	81.1%	101	80.8%	85	81.0%	98	80.3%	
Condom use with casual female partners in the past 12 months*																	
Always	46	34.6%	54	35.8%	76	35.3%	68	32.9%	75	33.8%	84	33.1%	77	30.0%	84	28.9%	0.022
Not always	87	65.4%	97	64.2%	139	64.7%	139	67.1%	147	66.2%	170	66.9%	180	70.0%	207	71.1%	

* 'Not always' was defined as men who sometimes, usually or never used a condom with their sexual partners in the past 12 months (with female partners for vaginal or anal sex, with male partners for anal sex).

Table S4 Positivity for gonorrhoea, chlamydia, syphilis and HIV among men who have sex with men only and men who have sex with men and women from 2011 to 2018 in Melbourne (Australia)

	MSMO	MSMW-M	MSMW-W	Comparison across three groups	Comparison between MSMW-M and MSM-W
	<i>n/N (%)</i>	<i>n/N (%)</i>	<i>n/N (%)</i>	P-value	P-value
Gonorrhoea					
Any anatomical site	1384/12399 (11.2)	87/794 (11.0)	49/775 (6.3)	<0.001	0.001
Oropharynx	714/12253 (5.8)	46/776 (5.9)	19/689 (2.7)	0.003	0.001
Urethra	412/12125 (3.4)	27/794 (3.4)	26/821 (3.2)	0.877	0.799
Rectum	774/11505 (6.7)	40/699 (5.7)	14/528 (2.7)	0.001	0.009
Chlamydia					
Any anatomical site	1322/12325 (10.7)	77/802 (9.6)	51/832 (6.1)	<0.001	0.009
Urethra	425/12125 (3.5)	29/794 (3.7)	39/821 (4.8)	0.178	0.272
Rectum	1029/11458 (9.0)	57/700 (8.1)	17/527 (3.2)	<0.001	<0.001
Syphilis	847/11757 (7.2)	38/761 (5.0)	26/762 (3.4)	<0.001	0.124
HIV incident**	303/11522 (2.6)	9/760 (1.2)	3/739 (0.4)	<0.001	0.091
Previous HIV positive	342/13282 (2.6)	6/828 (0.7)	1/859 (0.1)	<0.001	0.052

*Before 2015, MSM with no urethral symptoms were not tested for urethral gonorrhoea. The number of people tested corresponds to the number of people teste for urethral Chlamydia **Only including HIV cases diagnosed on the day of the first visit. MSMO: men who have sex with men only, MSMW-M: men who have sex with men and women and had more male than female sexual partner in the past 12 months, MSMW-W: men who have sex with men and women and had more female than male sexual partner in the past 12 months, MSMW-M: men who have sex with men and women and had more male than female sexual partner in the past 12 months

Table S5 Association between sexual practice and Gonorrhoea, Chlamydia, Syphilis and HIV positivity among men who have sex with men only and men who have sex with men and women from 2011 to 2018 in Melbourne (Australia)

	cOR (95% CI)	P value	aOR (95%CI)	P value
Gonorrhoea, any anatomical site				
MSMO	1.86 (1.39 to 2.50)	<0.001	1.48 (1.09 to 2.01)	0.012
MSMW-M	1.82 (1.27 to 2.63)	0.001	1.34 (0.91 to 1.98)	0.142
MSMW-W	1	ref	1	ref
Chlamydia, any anatomical site				
MSMO	1.84 (1.38 to 2.46)	<0.001	1.46 (1.08 to 1.96)	0.014
MSMW-M	1.63 (1.13 to 2.35)	0.010	1.16 (0.78 to 1.71)	0.464
MSMW-W	1	ref	1	ref
Syphilis				
MSMO	2.20 (1.48 to 3.27)	<0.001	2.10 (1.37 to 3.23)	0.001
MSMW-M	1.49 (0.89 to 2.48)	0.126	1.11 (0.63 to 1.95)	0.723
MSMW-W	1	ref	1	ref
HIV*				
MSMO	6.88 (2.20 to 21.50)	0.001	6.32 (2.01 to 19.90)	0.002
MSMW-M	3.05 (0.82 to 11.32)	0.095	1.85 (0.44 to 7.81)	0.404
MSMW-W	1	ref	1	ref
Previous HIV positive				
MSMO	22.68 (3.18 to 161.64)	0.002	18.48 (2.58 to 132.46)	0.004
MSMW-M	6.26 (0.76 to 52.13)	0.090	4.09 (0.47 to 35.34)	0.201
MSMW-W	1	ref	1	ref

*Only including HIV cases diagnosed on the day of the first visit. cOR: crude odds ratio, aOR: odds ratio adjusted by age, country of birth, sex overseas, injected drug use in the past 12 months, regular partner, number of male sexual partners in the past 12 months, condom use with casual male partners in the past 12 months and year of visit, MSMO: men who have sex with men only, MSMW-M: men who have sex with men and women and had more male than female sexual partner in the past 12 months, MSMW-W: men who have sex with men and women and had more female than male sexual partner in the past 12 months, MSMW-M: men who have sex with men and women and had more male than female sexual partner in the past 12 months.

Table S6 Temporal trend of the positivity for sexually transmitted infections and HIV among men who have sex with men only from 2011 to 2018 in Melbourne (Australia)

	2011	2012	2013	2014	2015	2016	2017	2018	2011-2014	2015-2018	2011-2018
	n/N [†] (%)	n/N [†] (%)	n/N [†] (%)	n/N [†] (%)	n/N [†] (%)	n/N [†] (%)	n/N [†] (%)	n/N [†] (%)	P _{trend}	P _{trend}	P _{trend}
Gonorrhoea											
Any anatomical site	66/1002 (6.6)	81/1195 (6.8)	124/1347 (9.2)	139/1381 (10.1)	233/1592 (14.6)	228/1805 (12.6)	256/1962 (13.0)	257/2115 (12.2)	0.099	0.144	NA
Oropharynx	18/989 (1.8)	28/1181 (2.4)	44/1330 (3.3)	44/1372 (3.2)	127/1579 (8.0)	134/1773 (7.6)	166/1937 (8.6)	153/2092 (7.3)	0.108	0.636	NA
Urethra*	38/975 (3.9)	36/1170 (3.1)	47/1312 (3.6)	47/1356 (3.5)	66/1560 (4.2)	56/1755 (3.2)	65/1915 (3.4)	57/2082 (2.7)	0.594	0.123	NA
Rectum	25/937 (2.7)	42/1098 (3.8)	71/1229 (5.8)	74/1291 (5.7)	136/1470 (9.3)	122/1651 (7.4)	137/1818 (7.5)	167/2011 (8.3)	0.102	0.480	NA
Chlamydia											
Any anatomical site	89/1005 (8.9)	117/1194 (9.8)	142/1347 (10.5)	133/1380 (9.6)	179/1574 (11.4)	206/1786 (11.5)	213/1941 (11.0)	243/2098 (11.6)	0.318	0.955	NA
Urethra	31/975 (3.2)	43/1170 (3.7)	48/1312 (3.7)	41/1356 (3.0)	69/1560 (4.4)	66/1755 (3.8)	55/1915 (2.9)	72/2082 (3.5)	0.745	0.190	NA
Rectum	65/937 (6.9)	83/1097 (7.6)	108/1230 (8.8)	101/1284 (7.9)	127/1442 (8.8)	170/1649 (10.3)	175/1813 (9.7)	200/2006 (10.0)	0.243	0.325	NA
Syphilis	44/792 (5.6)	79/1148 (6.9)	73/1312 (5.6)	83/1346 (6.2)	105/1552 (6.8)	143/1740 (8.2)	155/1832 (8.5)	165/2035 (8.1)	-	-	0.025
HIV incident**	24/914 (2.6)	41/1111 (3.7)	24/1272 (1.9)	37/1300 (2.8)	32/1516 (2.1)	45/1670 (2.7)	43/1771 (2.4)	57/1968 (2.9)	-	-	0.701

*Before 2015, MSM with no urethral symptoms were not tested for urethral gonorrhoea. The number of people tested corresponds to the number of people teste for urethral Chlamydia

**Only including HIV cases diagnosed on the day of the first visit

†The denominator corresponds to the number of MSM tested NA, not applicable

Table S7 Temporal trend of the positivity for sexually transmitted infections and HIV among men that have sex with men and women from 2011 to 2018 in Melbourne (Australia)

	2011	2012	2013	2014	2015	2016	2017	2018	2011-2014	2015-2018	2011-2018
	n/N [†] (%)	n/N [†] (%)	n/N [†] (%)	n/N [†] (%)	n/N [†] (%)	n/N [†] (%)	n/N [†] (%)	n/N [†] (%)	P _{trend}	P _{trend}	P _{trend}
Gonorrhoea											
Any anatomical site	7/153 (4.6)	9/160 (5.6)	15/225 (6.7)	15/218 (6.9)	21/232 (9.1)	30/267 (11.2)	30/293 (10.2)	22/330 (6.7)	0.093	0.354	NA
Oropharynx	1/150 (0.7)	2/155 (1.3)	7/211 (3.3)	3/214 (1.4)	14/222 (6.3)	14/243 (5.8)	19/258 (7.4)	12/299 (4.0)	0.409	0.400	NA
Urethra*	3/163 (1.8)	5/173 (2.9)	9/235 (3.8)	8/224 (3.6)	8/249 (3.2)	11/277 (4.0)	9/288 (3.1)	5/326 (1.5)	0.134	0.195	NA
Rectum	4/128 (3.1)	5/122 (4.1)	4/175 (2.3)	4/176 (2.3)	6/175 (3.4)	14/194 (7.2)	12/214 (5.6)	9/252 (3.6)	0.259	0.884	NA
Chlamydia											
Any anatomical site	14/165 (8.5)	15/174 (8.6)	17/238 (7.1)	10/232 (4.3)	19/251 (7.6)	23/279 (8.2)	18/290 (6.2)	30/328 (9.1)	0.118	0.627	NA
Urethra	4/163 (2.5)	11/173 (6.4)	12/235 (5.1)	6/224 (2.7)	10/249 (4.0)	14/277 (5.1)	6/288 (2.1)	14/326 (4.3)	0.946	0.706	NA
Rectum	10/128 (7.8)	9/122 (7.4)	6/176 (3.4)	4/176 (2.3)	10/175 (5.7)	11/194 (5.7)	15/213 (7.0)	20/252 (7.9)	0.099	0.102	NA
Syphilis	1/112 (0.9)	4/168 (2.4)	6/228 (2.6)	13/215 (6.0)	7/240 (2.9)	21/265 (7.9)	15/277 (5.4)	19/316 (6.0)	-	-	0.040
HIV incident**	1/140 (0.7)	4/168 (2.4)	1/227 (0.4)	2/209 (1.0)	2/239 (0.8)	0/258 (0.0)	1/268 (0.4)	1/310 (0.3)	-	-	0.131

*Before 2015, MSM with no urethral symptoms were not tested for urethral gonorrhoea. The number of people tested corresponds to the number of people teste for urethral Chlamydia **Only including HIV cases diagnosed on the day of the first visit. †The denominator corresponds to the number of MSM tested. NA, not applicable

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No.	Recommendation	Page No.	Relevant text from manuscript
Title and abstract	1	(a) Indicate the study’s design with a commonly used term in the title or the abstract (b) Provide in the abstract an informative and balanced summary of what was done and what was found	2	cross-sectional study We examined the annual trends of sexual practices and HIV/STI positivity and assessed its association with sexual practice using logistic regression
Introduction				
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4	The cause for the recent rise in gonorrhoea and syphilis in heterosexuals remains unclear,6–9 but a few epidemiological and genomics studies have proposed that bisexual MSM (or men who have sex with men and women) may act as a potential bridging population for STI transmission from MSM to the broader heterosexual population and hence contribute to the rise in STI in heterosexual
Objectives	3	State specific objectives, including any prespecified hypotheses	4	In this study, we aimed to compare the demographic characteristics and sexual practices, and describe the trends in HIV/STI positivity in men who have sex with men only (MSMO) and men who have sex with men and women (MSMW) attending a large sexual health clinic in Melbourne between 2011 and 2018.
Methods				

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Study design	4	Present key elements of study design early in the paper	5	We conducted a repeated cross-sectional analysis of retrospective data of MSM attending the Melbourne Sexual Health Centre (MSHC), Australia, between 2011 and 2018
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5	We conducted a repeated cross-sectional analysis of retrospective data of MSM attending the Melbourne Sexual Health Centre (MSHC), Australia, between 2011 and 2018
Participants	6	(a) Cohort study—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up Case-control study—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls Cross-sectional study—Give the eligibility criteria, and the sources and methods of selection of participants (b) Cohort study—For matched studies, give matching criteria and number of exposed and unexposed Case-control study—For matched studies, give matching criteria and the number of controls per case	5	Clients who were male, aged 18 years and above, reported having sex with another man in the past 12 months, and attended MSHC for the first time between 2011 and 2018 were included in this analysis
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	5 and 6	We categorised MSM into two main categories based on their self-reported sexual practices: (1) men who have sex with men only (MSMO), and (2) men who have sex with men and women (MSMW). (...)
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	5 and 6	Upon arrival, all clients are invited to complete a questionnaire via computer-assisted self-interviewing (CASI), which collects client's demographic characteristics (e.g. age, country of birth, Aboriginal and Torres Strait Islander [ATSI] status), sexual

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				practices (i.e. gender of partners, type of partners [regular or casual], number of partners, condom use and anal sex practice [receptive anal intercourse (RAI) and insertive anal intercourse (IAI)], sex work and injecting drug use behaviour
Bias	9	Describe any efforts to address potential sources of bias	6	(...)since July 2015, all MSM were screened for urethral gonorrhoea and chlamydia regardless of the presence of symptoms as per our clinic policy. ¹⁴ Therefore, the positivity for urethral gonorrhoea was calculated as the number of men tested positive divided by the number of men who were tested or urethral chlamydia to avoid the bias of testing urethral gonorrhoea among symptomatic MSM, and this approach was also used elsewhere
Study size	10	Explain how the study size was arrived at	-	Not applicable, all cases were included

Continued on next page

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2	Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	-	Not applicable
3					
4	Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	7	we assessed the association between sexual practices and STI/HIV positivity using univariable and multivariable logistic regression and reporting the crude odds ratio (OR) and adjusted odds ratio (aOR), and their respective 95% confidence intervals (CI). We fitted a model including the year of the visit and all potential confounding factors (i.e., variables with P<0.20 in the univariable analyses) in the multivariable analysis.
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9			(b) Describe any methods used to examine subgroups and interactions	7	For chlamydia and gonorrhoea positivity, we calculated the annual trends for 2011-2014 and 2015-2018 separately due to the change of the diagnostic assays
10					
11			(c) Explain how missing data were addressed	7	
12			(d) Cohort study—If applicable, explain how loss to follow-up was addressed	-	Not applicable
13			Case-control study—If applicable, explain how matching of cases and controls was addressed		
14			Cross-sectional study—If applicable, describe analytical methods taking account of sampling strategy		
15			(e) Describe any sensitivity analyses	-	Not applicable
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23	Results				
24	Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	7	There were 18,851 MSM attending MSHC for the first time between 2011 and 2018. We excluded 1,909 MSM (10.1%) who had had sexual contact with another man but declined to report the number of male sexual partners and 1,630 MSM (8.6%) who reported no male sexual partner in the past 12 months at the current visit but had previously reported male partners at the clinic.
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		(b) Give reasons for non-participation at each stage	7	There were 18,851 MSM attending MSHC for the first time between 2011 and 2018. We excluded 1,909 MSM (10.1%) who had had sexual contact with another man but declined to report the number of male sexual partners and 1,630 MSM (8.6%) who reported no male sexual partner in the past 12 months at the current visit but had previously reported male partners at the clinic.
		(c) Consider use of a flow diagram	-	-
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	8	Of the 15,312 MSM, the median age was 27 years (interquartile range, IQR: 23-33) but MSMW were slightly older than MSMO (median age: 29 versus 27; $p<0.001$) (Table 1). The proportion of men born in Australia was higher in MSMW than in MSMO (57.9% versus 50.5%, $p<0.001$).
		(b) Indicate number of participants with missing data for each variable of interest	20-21	Table 1
		(c) Cohort study—Summarise follow-up time (eg, average and total amount)	-	Not applicable
Outcome data	15*	Cohort study—Report numbers of outcome events or summary measures over time	-	Not applicable
		Case-control study—Report numbers in each exposure category, or summary measures of exposure	-	Not applicable
		Cross-sectional study—Report numbers of outcome events or summary measures	8-10, Table 2	
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	Table 3, Table S5	After adjusting for other potential confounding factors, MSMO had higher odds of testing positive for gonorrhoea at any anatomical site (aOR 1.32, 95% CI 1.11 to 1.58), chlamydia at any anatomical site (aOR 1.38; 95% CI 1.15 to 1.65), syphilis (aOR 1.71, 95% CI 1.35 to 2.16) and HIV (aOR 4.41, 95% CI 2.46 to 7.91) compared to MSMW (Table 3). Additionally, MSMO had higher odds of testing positive for

gonorrhoea at any anatomical site (aOR 1.48; 95% CI 1.09 to 2.01), chlamydia at any anatomical site (aOR 1.46; 95% CI 1.08 to 1.96), syphilis (aOR 2.10, 95% CI 1.37 to 3.23), and HIV (aOR 6.32, 95% CI 2.01 to 19.90) compared with MSMW-W in the adjusted analysis; however, there was no significant difference in HIV/STI positivity between MSMW-M and MSMW-W in the adjusted analysis (Table S5).

(b) Report category boundaries when continuous variables were categorized	-	Not applicable
(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	-	Not relevant

Continued on next page

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2	Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	10, Table S6, S7	There was a 44.6% increase in syphilis positivity from 5.6% in 2011 to 8.1% in 2018 (Ptrend =0.025) in MSMO and more than a six-fold increase in syphilis positivity from 0.9% in 2011 to 6.0% in 2018 (Ptrend =0.040) in MSMW. HIV positivity did not change in both groups between 2011 and 2018 (Table S6-S7).
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13	Discussion				
14	Key results	18	Summarise key results with reference to study objectives	11	we found that there were significant changes in sexual practices among bisexual men over the period in which rates of STIs had been increasing in heterosexual men and women. Specifically, we found that condomless anal sex with casual male partners and condomless anal sex with female partners had increased in bisexual men as had the positivity for syphilis
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24	Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	13	There are a number of limitations in the study that have to be taken into account. (...)
25					
26					
27	Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	11-12	Our data suggest that MSMO have a higher positivity for syphilis, chlamydia and gonorrhoea than MSMW; however, the comparison of STI positivity between MSMO and MSMW varies in published studies. (...)
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34	Generalisability	21	Discuss the generalisability (external validity) of the study results	13	this study was conducted in one urban major sexual health clinic. It is possible that MSM attending a sexual health clinic are more likely to be at increased sexual risk and hence our findings may not be generalizable to the whole MSM
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				population in Australia or in other settings
Other information				
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	14	AUTHOR DISCLOSURE STATEMENT(S) None

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

Trends and differences in sexual practices and sexually transmitted infections in men who have sex with men only (MSMO) and men who have sex with men and women (MSMW): a repeated cross-sectional study in Melbourne, Australia

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3 **Trends and differences in sexual practices and sexually transmitted infections in men**
4 **who have sex with men only (MSMO) and men who have sex with men and women**
5 **(MSMW): a repeated cross-sectional study in Melbourne, Australia**
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21
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23 have sex with men, Sexually Transmitted Diseases, HIV, Syphilis, gonorrhoea, chlamydia,
24 bisexual, condom
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ABSTRACT

Objectives

In the last decade, there has been an increase in sexually transmitted infections (STI) in men who have sex with men (MSM) in Australia, and since 2015 also in urban heterosexuals. Men who have sex with men and women (MSMW) have characteristics that may differ from both MSM only (MSMO) and heterosexual men. We aimed to compare the sexual practices and the trends in HIV/STI positivity between MSMO and MSMW.

Methods

We conducted a repeated cross-sectional study using data from MSM attending the Melbourne Sexual Health Centre, Australia, between 2011 and 2018. We examined the annual trends of sexual practices and HIV/STI positivity and assessed its association with sexual practice (MSMO versus MSMW) using logistic regression.

Results

Compared to MSMW ($N=1,979$), MSMO ($N=12,795$) were more likely to practice anal sex and to have condomless receptive anal sex with casual male partners, and less likely to have a current regular relationship. Over the 8-year period, there was an increase in condomless receptive anal sex with casual male partners for both groups (MSMO: 46.2% to 63.3%, $P_{\text{trend}} < 0.001$; MSMW: 41.3% to 57.9%, $P_{\text{trend}} = 0.011$). Syphilis positivity increased in MSMO (5.5% to 7.8%, $P_{\text{trend}} = 0.012$) and MSMW (from 0.9% to 6.4%, $P_{\text{trend}} = 0.004$), and HIV remained stable. Gonorrhoea increased among MSMO from 2011 to 2014 (from 6.7% to 9.6%, $P_{\text{trend}} = 0.002$), and remained stable from 2015 to 2018. MSMO had higher odds of testing positive for gonorrhoea (adjusted odd ratio [aOR] 1.36, 95% confidence interval [CI] 1.13 to 1.64), chlamydia (aOR 1.39, 95%CI 1.16 to 1.67), syphilis (aOR 1.74, 95% CI 1.37 to 2.22) and HIV (aOR 4.60, 95%CI 2.43 to 8.70) than MSMW.

Conclusion

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3 MSMW have overall lower condomless sex and lower HIV/STI positivity. In the last years,
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5 changes in sexual practices in MSM have affected both MSMW and MSMO leading to an
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7 increased risk of STI.
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For peer review only

ARTICLE SUMMARY

Strengths and limitations of this study

- We compared sexual practices and HIV/sexually transmitted infections positivity in a high number of men who have sex with men only (N=12,795) and men who have sex with men and women (N=1,979) over an 8-year period.
- We provide a comprehensive description of sexual practices distinguishing between condom use with regular or casual sexual partners, and in receptive or insertive anal sex.
- The study was conducted in one urban major sexual health clinic and it is possible that our findings may not be generalizable to other settings.
- We were unable to analyse the statistical significance of the temporal trends during the whole study period for gonorrhoea and chlamydia due to a change in the diagnostic test in 2015.

INTRODUCTION

Despite considerable public health efforts and biomedical advances,¹ the rate of sexually transmitted infections (STIs) is increasing at an alarming rate particularly among gay, bisexual and other men who have sex with men (MSM) worldwide.² Among the Australian population, there was an 80% increase in the notification rate of gonorrhoea (from 65.5 to 118.0 per 100,000), a 14% increase in chlamydia (from 364.5 to 416.8 per 100,000) and more than a two-fold increase in syphilis (from 7.8 to 18.3 per 100,000) between 2013 and 2017.³ In males, most of the early rises in gonorrhoea and syphilis were accounted for by rises in MSM. However, in late 2010s, there has been a dramatic increase in both infections in the Australian heterosexual population to levels not seen since the 1980's. In stark contrast to the rise in the notification rate of gonorrhoea and syphilis, there has been an 11% decline in the HIV notification rate from 4.5 per 100,000 in 2013 to 4.0 in 2017 among MSM in Australia, with most of the reduction occurring between 2016 and 2017 after the introduction of pre-exposure prophylaxis (PrEP) in late 2016.³⁻⁵

Past studies have shown that sexual practices among MSM have changed over time (e.g. an increase in condomless anal sex).⁶⁻⁹ However, there have been very limited studies examining whether there are any differences in sexual practices between men who have sex with men only (MSMO) and men who have sex with men and women (MSMW or bisexual MSM).¹⁰⁻¹² Therefore, this study aimed to compare the characteristics and sexual practices, and describe the trends in HIV/STI positivity in MSMO and MSMW attending a large sexual health clinic in Melbourne between 2011 and 2018. Additionally, we aimed to explore differences within MSMW depending on the most frequent gender of their sexual partners.

METHODS

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3 We conducted a repeated cross-sectional analysis of retrospective data of MSM attending the
4 Melbourne Sexual Health Centre (MSHC), Australia, between 2011 and 2018. MSHC is a
5 public clinic that offers a range of free clinical services regarding sexual health. MSHC is the
6 largest sexual health clinic in Victoria and provides more than 50,000 clinical consultations a
7 year, approximately 40% of clients are MSM.⁴ Upon arrival, all clients are invited to
8 complete a questionnaire via computer-assisted self-interviewing (CASI), which collects
9 client's demographic characteristics (e.g. age, country of birth, Aboriginal and Torres Strait
10 Islander status), sexual practices (i.e. gender of partners, type of partners [regular or casual],
11 number of partners, condom use and anal sex practice [receptive anal sex (RAS) and
12 insertive anal sex (IAS)]), sex work status and injecting drug use behaviour. Data on sexual
13 practices and injecting drug use were measured in the past 12 months, and sex work status
14 was defined as clients who had ever worked in the sex industry during lifetime. Clients are
15 allowed to decline to answer any questions they may wish to.
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35 Clients who were male, aged 18 years and above, reported having sex with another man in
36 the past 12 months, and attended MSHC for the first time between 2011 and 2018 were
37 included in this analysis. We only included data from the client's first visit to MSHC to avoid
38 any bias including men with repeated visits as they might be at a higher risk of HIV/STI with
39 different sexual practices. We categorised MSM into two main categories based on their self-
40 reported sexual practices: (1) MSMO, and (2) MSMW. We further categorised MSMW into
41 two groups: (1) MSM who reported more female partners than male partners in the past 12
42 months (MSMW-W); and (2) MSM who reported more male partners than female partners in
43 the past 12 months (MSMW-M) and compared the characteristics between the two groups.
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56 Men with an equal number of male and female partners in the past 12 months (N=336) were
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3 excluded in the comparisons among MSMW subgroups but they were included in the overall
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5 MSMW category.
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10 We also extracted the HIV/STI testing results on the day. STI testing results included syphilis
11 (serologically confirmed by rapid plasma regain test [RPR], *T. pallidum* enzyme
12 immunoassay [EIA] and *T. pallidum* particle agglutination assay [TPPA], and including all
13 syphilis stages), gonorrhoea (stratified by anatomical site: anorectal, urethral and
14 oropharyngeal) and chlamydia (stratified by anatomical site: anorectal and urethral). For
15 HIV, we analysed separately incident cases (diagnosed on the day of the first visit using
16 screening assay followed by a confirmatory Western Blot assay) and MSM with a previous
17 HIV diagnosis visiting MSHC for the first time. There was a major change in gonorrhoea and
18 chlamydia testing at our clinic.¹³ Prior to 2015, gonorrhoea was diagnosed by using culture
19 and chlamydia was diagnosed by nucleic acid amplification test (NAAT) using the BD
20 ProbeTec Strand Displacement Amplification Assay (Becton, Dickinson and Co., Sparks,
21 MD, USA). From March 2015 onwards, testing for both gonorrhoea and chlamydia was
22 performed using the Aptima Combo 2 Transcription-Mediated Amplification Assay (AC2)
23 (Hologic Gen-Probe, San Diego, CA, USA). HIV and syphilis testing methods did not change
24 during the study period.
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47 Before July 2015, screening for urethral gonorrhoea was only performed in MSM with
48 urethral symptoms while screening for urethral gonorrhoea was performed in all MSM as per
49 the Australian guidelines.¹⁴ However, since July 2015, all MSM were screened for both
50 urethral gonorrhoea and chlamydia regardless of the presence of symptoms as per our clinic
51 policy.¹⁵ Therefore, the positivity for urethral gonorrhoea was calculated as the number of
52 men tested positive divided by the number of men who were tested for urethral chlamydia to
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3 avoid the bias of testing urethral gonorrhoea only among symptomatic MSM until July 2015,
4 and this approach was also used elsewhere.¹⁶ In addition, routine screening for oropharyngeal
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avoid the bias of testing urethral gonorrhoea only among symptomatic MSM until July 2015, and this approach was also used elsewhere.¹⁶ In addition, routine screening for oropharyngeal chlamydia among all MSM at MSHC were introduced in April 2017; before then, only MSM who reported as a contact of infection were tested. Routine screening for HIV, syphilis, oropharyngeal and anorectal gonorrhoea, and anorectal chlamydia were conducted among all MSM and the screening guidelines did not change over the study period at MSHC.

Chi-squared test was used to compare the demographic characteristics and sexual practices between risk groups. We examined the annual trends of sexual practices and HIV/STI positivity for MSMO and MSMW using chi-squared trend test. Annual trends for condomless IAS and RAS with casual male partners were examined separately. We reported any condomless sex (i.e. IAS and/or RAS) with regular male partners for the trend analysis due to the small number of participants who reported having regular male partners. For chlamydia and gonorrhoea positivity, we calculated the annual trends for 2011-2014 and 2015-2018 separately due to the change of the diagnostic assays. Univariable and multivariable logistic regression was used to examine the association between sexual practice (MSMW or MSMO) and HIV/STI positivity. We assessed HIV and each STI separately, and this included (1) gonorrhoea at any anatomical site, (2) chlamydia at any anatomical site, (3) syphilis, (4) new HIV diagnosis on the day of the first visit and (5) previous HIV diagnosis as the dependent variables. Therefore, five different logistic regression models were conducted, and the independent variables included sexual practice (being MSMW or MSMO and using MSMW as reference), the year of the visit and all potential confounding factors (i.e., variables with $P < 0.20$ in the univariable analyses) in the multivariable analysis. Missing data were presented as 'no information'. We repeated the same procedure using sexual practice categorised in MSMO, MSMW-M and MSMW-W as the independent variable with MSMW-W as the

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3 reference group. We reported the crude odds ratio (OR) and adjusted odds ratio (aOR), and
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5 their respective 95% confidence intervals (CI). The 0.05 level was used for statistical
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7 significance in all the analysis. All statistical analyses were conducted using SPSS V.25. This
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9 study was approved by the Alfred Hospital Ethics Committee, Melbourne, Australia (project
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11 number 83/18).
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17 ***Patient and Public Involvement***

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19 Patients were not directly involved in this study; only data gathered retrospectively and
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21 coming from electronic health records was used.
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26 **RESULTS**

27 ***Demographic characteristics***

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29 There were 18,851 MSM attending MSHC for the first time between 2011 and 2018. We
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31 excluded 1,909 MSM (10.1%) who had had sexual contact with another man but declined to
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33 report the number of male sexual partners, 1,630 MSM (8.6%) who reported no male sexual
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35 partner in the past 12 months at the current visit but had reported male partners at subsequent
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37 visit at the clinic, and 538 (2.9%) duplicate records from the same individual on the same
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39 day. The remaining 14,774 men were included in this data analysis, and the number of men
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41 increased from 1,215 in 2011 to 2,468 in 2018 but the proportion of MSMW remained stable
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43 over the period (Table 1). Overall, there were 12,795 MSMO (86.6%) and 1,979 MSMW
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45 (13.4%). Among 1,979 MSMW, 804 (40.6%) were MSMW-W, 839 (42.4%) MSMW-M and
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47 336 (17.0%) had an equal number of male and female partners in the past 12 months.
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56 Among the 14,774 MSM, the median age was 27 years (interquartile range, IQR: 23-33) and
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58 MSMW were slightly older than MSMO (median age: 29 *versus* 27; $P < 0.001$) (Table 2). The
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3 proportion of men born in Australia was higher in MSMW than in MSMO (55.3% *versus*
4 48.5%, $P<0.001$). The proportion of injecting drug use in the past 12 months was higher in
5 MSMW than MSMO (2.0% *versus* 1.6%, $P=0.032$; Table 2); and it was similar between
6 MSMW-W and MSMW-M (2.5% *versus* 2.1%, $P=0.777$; Table S1).
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14 ***Sexual practices***

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17 The proportion of men who reported sex overseas in the past 12 months was comparable
18 between MSMW and MSMO (37.1% *versus* 34.5%; $P=0.060$); and more MSMW-W (43.0%)
19 reported sex overseas than MSMW-M (34.6%; $P=0.002$) (Table S1). Less than half (40.1%)
20 of MSMO had a male regular partner. Among MSMW, 8.5% had a regular male partner,
21 33.5% a regular female partner, and 4.6% had regular male and female partners (Table 2).
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31 The median number sexual partners (regardless gender of the partners) in the past 12 months,
32 was higher among MSMW (7, interquartile range [IQR]: 5-12 in MSMW-M; and 6, IQR: 4-
33 11 in MSMW-W) than MSMO (5, IQR: 3-10; $P<0.001$) (Table S1). The proportion of men
34 with ≥ 5 sexual partners increased significantly in MSMW (from 63.1% in 2011 to 70.2% in
35 2018, $P_{\text{trend}}=0.014$), as well as in MSMO (from 50.8% to 56.4%; $P_{\text{trend}}=0.002$) (Table S2-
36 S3). In addition, the proportion of MSMW with ≥ 5 female sexual partners increased
37 significantly from 23.2% in 2011 to 29.5% in 2018 ($P_{\text{trend}}=0.039$) (Table S3).
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49 Anal sex practices with casual male partners varied between MSMO and MSMW. The
50 proportion of MSMO having RAS only with casual male partners was higher (9.9%) than in
51 MSMW (6.6%); however, the proportion of MSMO having IAS only with casual male
52 partners was lower (10.5%) than in MSMW (14.2%; $P<0.001$). Condomless anal sex with
53 casual male partners in the past 12 months was more common in MSMO than in MSMW for
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3 RAS (53.8% *versus* 49.9%; $P=0.012$) but there was no significant difference in IAS. Two-
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5 thirds (67.5%) of MSMW had condomless vaginal and/or anal sex with female casual
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7 partners in the past 12 months (Table 2). Among MSMO, condomless RAS with casual male
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9 partners in the past 12 months increased from 46.2% to 63.3% ($P_{\text{trend}} < 0.001$) and IAS from
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11 45.8% to 64.2% ($P_{\text{trend}} < 0.001$) from 2011 to 2018 (Figure 1, Table S2). Similarly, among
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13 MSMW, there was an increase from 41.3% to 57.9% in condomless RAS ($P_{\text{trend}} = 0.011$), the
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15 proportion of condomless IAS with casual male partners did not change during the study
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17 period ($P_{\text{trend}} = 0.354$), and the proportion of condomless sex with casual female partners
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19 remained high and only increased marginally from 65.4% to 71.0% ($P_{\text{trend}} = 0.056$) (Figure 1,
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21 Table S3). MSMW-M compared to MSMW-W showed higher condomless sex with casual
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23 male partners (55.0% *versus* 46.1% for RAS; $P=0.004$ and 57.0% *versus* 47.1% for IAS;
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25 $P=0.001$) and lower condomless sex with casual female partners (60.9% *versus* 75.6%;
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27 $P < 0.001$) (Table S1).

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35 Regarding regular male partners, both condomless RAS and condomless IAS were more
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37 commonly reported in MSMO (RAS: 71.5%; IAS: 71.4%) than in MSMW (RAS 62.9%;
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39 IAS: 63.5%; $P=0.005$; $P=0.010$) (Table 1) and condomless anal sex regardless of IAS or
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41 RAS, increased from 69.2% to 78.4% in MSMO ($P_{\text{trend}} < 0.001$) but not in MSMW (P_{trend}
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43 $= 0.435$) (Figure 1, Tables S2-S3).

44 45 46 47 48 49 ***HIV/STI positivity***

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51 Overall, MSMO had a higher HIV, syphilis, gonorrhoea and chlamydia positivity than
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53 MSMW. MSMO had higher extra-genital gonorrhoea and chlamydia positivity than MSMW;
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55 however, the positivity for urethral gonorrhoea and urethral chlamydia did not differ between
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57 the two groups (Table 3). In the period 2011-2014, there was an increase in oropharyngeal
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3 and anorectal and oropharyngeal gonorrhoea among MSMO, while chlamydia remained
4 stable. There was no increase in gonorrhoea and chlamydia positivity in the period 2015-2018
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6 in either group (Tables S4-S5). Among MSMW, MSMW-M had higher extra-genital
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8 gonorrhoea and chlamydia positivity but similar urethral gonorrhoea and chlamydia, HIV and
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10 syphilis compared to MSMW-W (Table S6).
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17 There was a 41.8% increase in syphilis positivity from 5.5% (43/778) in 2011 to 7.8%
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19 (152/1917) in 2018 ($P_{\text{trend}}=0.025$) in MSMO (Table S4) and more than a six-fold increase in
20
21 syphilis positivity from 0.9% (1/112) in 2011 to 6.4% (19/299) in 2018 ($P_{\text{trend}}=0.004$) in
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23 MSMW, although the number of infections remained low in this group (Table S5). HIV
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25 positivity did not change in either group between 2011 and 2018 (Table S4-S5).
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31 After adjusting for other potential confounding factors, MSMO had higher odds of testing
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33 positive for gonorrhoea at any anatomical site (aOR 1.36, 95% CI 1.13 to 1.64), chlamydia at
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35 any anatomical site (aOR 1.39; 95% CI 1.16 to 1.67), syphilis (aOR 1.74, 95% CI 1.37 to
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37 2.22) and HIV (aOR 4.60, 95% CI 2.43 to 8.70) compared to MSMW (Table 4).
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41 Additionally, MSMO had higher odds of testing positive for gonorrhoea at any anatomical
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43 site (aOR 1.58; 95% CI 1.15 to 2.18), chlamydia at any anatomical site (aOR 1.47; 95% CI
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45 1.09 to 1.99), syphilis (aOR 2.11, 95% CI 1.36 to 3.27), and HIV (aOR 5.49, 95% CI 1.74 to
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47 17.30) compared with MSMW-W in the adjusted analysis; however, there was no significant
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49 difference in HIV/STI positivity between MSMW-M and MSMW-W nor MSMW-M and
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51 MSMO (Table 5).
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55 56 **DISCUSSION** 57 58 59 60

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3 In this study of 12,795 men who have sex with men only (MSMO) and 1,979 men who have
4 sex with men and women (MSMW) in Melbourne, Australia, we found significant changes in
5 sexual practices among MSMW between 2011 and 2018, a period in which rates of STIs had
6 been increasing in both MSM and the heterosexual population. Specifically, we found that
7 condom use with casual female partners remained low during the study period and that
8 condomless anal sex with casual male partners had increased in MSMW, and these results
9 echo the rise in syphilis positivity over the same period. While some sexual risk practices and
10 STI positivity were generally lower in MSMW than in MSMO, their rising rates could
11 indicate more transmission from MSMW to their female partners than had occurred
12 previously. Clarifying this issue and what factors are causing the rising rates of STIs is likely
13 to contribute significantly to the design of STI control programs.
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31 Several studies have assessed HIV and sexual practices in MSMW, but their results are
32 conflicting. A meta-analysis published in 2014 concluded that MSMW had a lower HIV
33 prevalence (16.9%) compared to MSMO (33.3%) but the prevalence is higher than men who
34 have sex with women only (MSWO) (3.5%), and this is consistent with our findings.¹⁷ The
35 authors also found that MSMW (15.9%) were less likely to engage in condomless receptive
36 anal sex compared to MSMO (35.0%).¹⁷ Other factors such as drug and alcohol use, other
37 risky practices (e.g. group sex, paying for sex), frequent HIV testing and the use of
38 biomedical interventions (e.g. PrEP and PEP) are also associated with HIV acquisition,¹⁸⁻²⁰
39 and very limited studies examining these factors between MSMO and MSMW. However,
40 some other studies conducted in different settings, such as China, India and the US, have
41 shown the risk of HIV among MSMW is similar or even at a higher risk compared to
42 MSMO.²¹⁻²⁴
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3 Our data suggest that MSMO have a higher positivity for syphilis, chlamydia and gonorrhoea
4 than MSMW; however, the comparison of STI positivity between MSMO and MSMW varies
5 across published studies. For example, Davis and colleagues (2016) conducted a study among
6 Chinese MSM showing no differences between MSMW and MSMO in the lifetime
7 prevalence of syphilis, gonorrhoea, chlamydia and genital warts but a higher prevalence of
8 genital herpes in MSMW (6.6%) compared to MSMO (0.4%).²⁴ In the US, MSMW had a
9 57% increased odds of having an STI compared to heterosexuals, but no differences were
10 found between MSMO and heterosexuals or MSMO and MSMW.²³ Similarly, an Indian
11 study has shown that there were no differences in any STI positivity (i.e. either syphilis,
12 gonorrhoea or chlamydia) between MSMO and MSMW.²¹ Furthermore, MSMW are also
13 less likely to ever have an HIV/STI test compared to MSMO,^{21,25,26} which is consistent with
14 an Australian qualitative study suggesting MSMW have a poor sexual health knowledge
15 compared to MSMO.²⁷ Furthermore, the rise in antimicrobial resistance in STI,²⁸ particularly
16 gonorrhoea, is of particular concern. Transmission of antimicrobial resistance across risk
17 populations (e.g. between MSMW and female) may have occurred.^{12,29}

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40 Our data also show that MSMW are less likely to have RAS with male partners and less
41 likely to have condomless RAS. These findings may explain the reasons why MSMW have a
42 lower positivity for anorectal gonorrhoea and chlamydia than MSMO in our study.

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47 Importantly, we did not find any significant differences in urethral gonorrhoea and chlamydia
48 between MSMO and MSMW despite differences in anal sex and condom use. This may be
49 because some urethral chlamydial infections in MSMW are acquired from women and
50 urethral gonorrhoea is commonly acquired from no anal sexual activity such as oral sex.^{30,31}

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56 The disparities of HIV and syphilis positivity between MSMO and MSMW were more
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3 pronounced compared to gonorrhoea and chlamydia, and there was a striking increase in
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5 syphilis positivity in both groups.
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10 The differential sexual practices and HIV/STI positivity among MSMW^{32,33} may also be due
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12 to other health issues such as mental health and substance use, that also place them as an
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14 especially vulnerable population.^{34,35} Bisexual men may face unique stressors, such as
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16 specific prejudices against them, pressures or negative attitudes from both heterosexual and
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18 LGBT individuals, which can have a negative impact on their health.^{35,36} This factors may
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20 also render bisexual men less likely to discuss their sexual health and disclose their sexual
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22 orientation with their GPs¹¹ and, hence not receive the appropriate sexual health care and
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24 management. An LGBT-friendly and non-judgemental approach is essential to build up the
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26 trust between clinicians and patients. Furthermore, the current health promotion and
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28 prevention programmes mainly targeting the MSM population as a whole. It is possible that
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30 some MSMW may not be engaged in the LGBT community and hence they may not targeted
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32 with the current programmes. Future public health campaigns and prevention programmes
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34 should also tailor for MSMW via different channels.
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42 Our study, including a high number of MSM over an 8-year period, provides relevant and
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44 updated information to understand changes in sexual practices and STI epidemiology
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46 occurring in Australia and across the world. We also provide detailed information regarding
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48 condom use, differencing between both casual or regular partners, and receptive or insertive
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50 anal sex. Nevertheless, there are several limitations in the study that must be considered.
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52 First, data were self-reported by MSHC clients which may influence the results regarding
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54 sexual practices, including the number and gender of the sexual partners due to social
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56 desirability or recall bias. However, the use of a computer-assisted self-interview to collect
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3 sexual history at the clinic has shown to improve the accuracy and reduce biased information.
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5 Besides that, data on sexual orientation was not collected and the categorisation of MSMO
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7 and MSMW was based on self-reported sexual practice rather than sexual identity. This
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9 means that MSMW in this study might not define themselves as bisexual men. Second, this
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11 study was conducted in one urban major sexual health clinic. It is possible that MSM
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13 attending a sexual health clinic are more likely to be at increased sexual risk and hence our
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15 findings may not be generalizable to the whole MSM population in Australia or in other
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17 settings. Third, other sexual practices that may increase the risk of HIV/STI (e.g., chemsex,
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19 group sex, rimming or saliva use as a lubricant)³⁷⁻³⁹ were not routinely collected in the clinic
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21 and hence not included in the study. Fourth, we only included individuals who attended the
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23 clinic for the first time. Sexual practices might change with age and further longitudinal
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25 cohort studies examining the changes in sexual practices among individuals would be
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27 required. Lastly, we were unable to examine the temporal trends for gonorrhoea and
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29 chlamydia over the 8-year period because we changed the diagnostic test for gonorrhoea and
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31 chlamydia at our clinic in 2015.
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40 CONCLUSION

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42 In our study population, MSMW were a heterogeneous group in which sexual practices and
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44 STI positivity varied between MSMW with mainly female partners and MSMW with mainly
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46 male partners. Compared to MSMO, MSMW were less likely to engage in condomless sex
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48 and had a lower HIV/STI positivity. From 2011 to 2018, changes in the sexual practices in
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50 MSM have affected both MSMW and MSMO leading to an increased risk of STI in both
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52 subgroups. Further studies also including heterosexual men and women are needed to better
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54 understand the recent changes in the STI epidemiology.
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4
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10 **CONTRIBUTORSHIP STATEMENT**

11 EPFC and CKF planned, conceived and designed the study. RC conducted some preliminary
12
13 analyses. MMS performed the literature review, conducted the statistical analysis and wrote
14
15 the first draft of the manuscript. EPFC provided statistical advice and oversaw the study. RC,
16
17 CKF, JSH, CSB, JJO, MYC and EPFC assisted with data interpretation. MMS, RC, CKF,
18
19 JSH, CSB, JJO, MYC and EPFC critically revised it for important intellectual content and
20
21 approved the final version of the manuscript.
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26 **COMPETING INTERESTS**

27
28 None declared.
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37
38 design, collection of data, writing, or decision to submit the paper for publication.
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42

43 **DATA SHARING STATEMENT**

44 All data relevant to the study are included in the article or uploaded as supplementary
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46 information.
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For peer review only

FIGURES

Figure 1 Proportion of condomless anal and/or vaginal sex in the past 12 months with casual partners between 2011 and 2018, stratified by men who have sex with men only (MSMO) and men who have sex with men and women (MSMW).

Note. MSM reporting condomless anal and/or vaginal sex includes MSM who sometimes, usually or never used a condom with their sexual partners in the past 12 months. MSMO: men who have sex with men only; MSMW: men who have sex with men and women.

Figure 2 Positivity for syphilis and HIV between 2011 and 2018, stratified by men who have sex with men only (MSMO) and men who have sex with men and women (MSMW).

Note. MSMO: men who have sex with men only; MSMW: men who have sex with men and women.

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TABLES

For peer review only

Table 1 Number of men who have sex with men attending the Melbourne Sexual Health Centre between 2011 and 2018, stratified by sexual practice.

	2011	2012	2013	2014	2015	2016	2017	2018	Total
MSMO	1047 (86.2)	1282 (87.7)	1422 (85.5)	1433 (85.9)	1658 (86.5)	1872 (86.7)	1938 (87.1)	2143 (86.8)	12795 (86.6)
MSMW	168 (13.8)	180 (12.3)	241 (14.5)	235 (14.1)	258 (13.5)	286 (13.3)	286 (12.9)	325 (13.2)	1979 (13.4)
<i>MSMW-W</i>	70 (41.7)	70 (38.9)	98 (40.7)	108 (46.0)	91 (35.3)	114 (39.9)	116 (40.6)	137 (42.2)	804 (40.6)
<i>MSMW-M</i>	64 (38.1)	78 (43.3)	96 (39.8)	90 (38.3)	127 (49.2)	117 (40.9)	124 (43.4)	143 (44.0)	839 (42.4)
<i>MSMW(=)</i>	34 (20.2)	32 (17.8)	47 (19.5)	37 (15.7)	40 (15.5)	55 (19.2)	46 (16.1)	45 (13.8)	336 (17.0)
Total	1215	1462	1663	1668	1916	2158	2224	2468	14774

Note. MSMO: men who have sex with men only; MSMW: men who have sex with men and women; MSMW-M: men who have sex with men and women and had more male than female sexual partners in the past 12 months; MSMW-W: men who have sex with men and women and had more female than male sexual partners in the past 12 month; MSMW(=): men who have sex with men and women but reported an equal number of male and female partners in the past 12 months. Data are presented as n (%) where n is the number of men in each category. The proportion of MSMO and MSMW was calculated using the total number of men each year as the denominator. The proportion of MSMW-W, MSMW-M and MSMW(=) was calculated using the total number of MSMW each year as the denominator.

Table 2 Demographic characteristics and sexual practices among men who have sex with men attending a sexual health centre in Melbourne, 2011-2018, stratified by men who have sex with men only (MSMO) and men who have sex with men and women (MSMW).

	Men who have sex with men only (N=12,795)	Men who have sex with men and women (N=1,979)	P value
	n (%)	n (%)	
Age (years), median (IQR)	27 (23-33)	29 (24-38)	<0.001
Country of birth			<0.001
<i>Australia</i>	6,208 (48.5)	1,094 (55.3)	
<i>Overseas</i>	6,110 (47.8)	790 (39.9)	
<i>No information</i>	477 (3.7)	95 (4.8)	
Aboriginal and Torres Strait Islander Status			0.224
<i>Indigenous origin</i>	150 (1.2)	17 (0.9)	
<i>Non-Indigenous origin</i>	11,595 (90.6)	1,783 (90.1)	
<i>No information</i>	1,050 (8.2)	179 (9.0)	
Sex overseas in the past 12 months			0.060
<i>Yes</i>	4,415 (34.5)	735 (37.1)	
<i>No</i>	7,571 (59.2)	1131 (57.2)	
<i>No information</i>	809 (6.3)	113 (5.7)	
Sex work during lifetime			0.574
<i>Yes</i>	71 (0.6)	13 (0.7)	
<i>No</i>	12,724 (99.4)	1,966 (99.3)	
Injected drug use in the past 12 months			0.032
<i>Yes</i>	211 (1.6)	40 (2.0)	
<i>No</i>	12,363 (96.6)	1,890 (95.5)	
<i>No information</i>	221 (1.7)	49 (2.5)	
Number of female and male sexual partners in the past 12 months, median (IQR)	5 (3-10)	6 (4-11)	<0.001
Number of male sexual partners in the past 12 months, median (IQR)	5 (3-10)	2 (1-5)	<0.001
Number of female sexual partners in the past 12 months, median (IQR)	NA	2 (1-5)	-
Regular sexual partner			-
<i>No regular partner</i>	7,513 (58.7)	1,053 (53.2)	
<i>Regular male partner</i>	5,132 (40.1)	169 (8.5)	
<i>Regular female partner</i>	NA	663 (33.5)	
<i>Regular female and male partner</i>	NA	91 (4.6)	
<i>No information</i>	150 (1.2)	3 (0.2)	

Anal sexual practice with regular male partners ^a			0.118
<i>Receptive only</i>	435 (8.5)	15 (5.8)	
<i>Insertive only</i>	465 (9.1)	16 (6.2)	
<i>Receptive and insertive</i>	3,921 (76.4)	214 (82.3)	
<i>No anal sex</i>	234 (4.6)	9 (3.5)	
<i>No information</i>	77 (1.5)	6 (2.3)	
Condom use with regular male partners in the past 12 months for receptive anal sex ^{b*}			0.005
<i>Always</i>	1,241 (28.5)	85 (37.1)	
<i>Not always</i>	3,115 (71.5)	144 (62.9)	
Condom use with regular male partners in the past 12 months for insertive anal sex ^{c*}			0.010
<i>Always</i>	1,254 (28.6)	84 (36.5)	
<i>Not always</i>	3,132 (71.4)	146 (63.5)	
Vaginal or anal sex with regular female partner ^d			-
<i>Yes</i>	NA	729 (96.7)	
<i>No</i>	NA	10 (1.3)	
<i>No information</i>	NA	15 (2.0)	
Condom use with regular female partners in the past 12 months ^{e*}			-
<i>Always</i>	NA	132 (18.1)	
<i>Not always</i>	NA	597 (81.9)	
Casual sexual partner			-
<i>No casual partner</i>	806 (6.3)	11 (0.6)	
<i>Casual male partner(s)</i>	11,969 (93.5)	194 (9.8)	
<i>Casual female partner(s)</i>	NA	30 (1.5)	
<i>Casual female and male partner(s)</i>	NA	1,744 (88.1)	
<i>No information</i>	20 (0.2)	0 (0)	
Anal sexual practice with casual male partners			<0.001
<i>Receptive only</i>	1,262 (9.9)	131 (6.6)	
<i>Insertive only</i>	1,344 (10.5)	282 (14.2)	
<i>Receptive and insertive</i>	7,835 (61.2)	1,060 (53.6)	
<i>No anal sex</i>	1,692 (13.2)	422 (21.3)	
<i>No information</i>	662 (5.2)	84 (4.2)	
Condom use with casual male partners in the past 12 months for receptive anal sex ^{f*}			
<i>Always</i>	4,207 (46.2)	597 (50.1)	0.012
<i>Not always</i>	4,890 (53.8)	594 (49.9)	
Condom use with casual male partners in the past 12 months for insertive anal sex ^{g*}			
<i>Always</i>	4,276 (46.6)	649 (48.4)	0.223

<i>Not always</i>	4,903 (53.4)	693 (51.6)	
Vaginal or anal sex with casual female partner			-
<i>Yes</i>	NA	1,686 (85.2)	
<i>No</i>	NA	56 (2.8)	
<i>No information</i>	NA	237 (12.0)	
Condom use with casual female partners in the past 12 months ^{h*}			-
<i>Always</i>	NA	548 (32.5)	
<i>Not always</i>	NA	1,138 (67.5)	

Note. NA: Not applicable; IQR: Interquartile range; MSM: men who have sex with men.

^aOnly including MSM with regular male partners or regular male and female partners, ^bOnly including MSM that referred receptive only or receptive and insertive anal sex with regular male partners, ^cOnly including MSM that referred insertive only or receptive and insertive anal sex with regular male partners, ^dOnly including MSM with regular female partners or regular male and female partners ^eOnly including MSM that referred vaginal and/or anal sex with regular female partner, ^fOnly including MSM that referred receptive only or receptive and insertive anal sex with casual male partners, ^gOnly including MSM that referred insertive only or receptive and insertive anal sex with casual male partners, ^hOnly including MSM that referred vaginal or anal sex with casual female partners. *'Not always' was defined as men who sometimes, usually or never used a condom with their sexual partners in the past 12 months (with female partners for vaginal and/or anal sex, with male partners for anal sex).

Table 3 Positivity for gonorrhoea, chlamydia, syphilis and HIV among men who have sex with men attending a sexual health centre in Melbourne, 2011-2018, stratified by men who have sex with men only (MSMO) and men who have sex with men and women (MSMW).

HIV/STI	Men who have sex with men only (N=12,795)			Men who have sex with men and women (N=1,979)			P value
	No. of men tested, <i>N</i>	No. of positive, <i>n</i>	Positivity, % (95% CI)	No. of men tested, <i>N</i>	No. of positive, <i>n</i>	Positivity, % (95% CI)	
Gonorrhoea							
<i>Oropharyngeal</i>	11,810	682	5.8 (5.4 to 6.2)	1,711	68	4.0 (3.1 to 5.0)	0.002
<i>Urethral*</i>	11,699	390	3.3 (3.0 to 3.7)	1,885	52	2.8 (2.1 to 3.6)	0.192
<i>Anorectal</i>	11,080	745	6.7 (6.3 to 7.2)	1,404	58	4.1 (3.2 to 5.3)	<0.001
<i>Any anatomical site†</i>	11,951	1,321	11.1 (10.5 to 11.6)	1,829	140	7.7 (6.5 to 9.0)	<0.001
Chlamydia							
<i>Urethral</i>	11,699	410	3.5 (3.2 to 3.9)	1,885	73	3.9 (3.0 to 4.8)	0.423
<i>Anorectal</i>	11,043	989	9.0 (8.4 to 9.5)	1,404	83	5.9 (4.7 to 7.3)	<0.001
<i>Any anatomical site†</i>	11,891	1,272	10.7 (10.1 to 11.3)	1,907	141	7.4 (6.3 to 8.7)	<0.001
Syphilis	11,317	797	7.0 (6.6 to 7.5)	1,773	81	4.6 (3.6 to 5.6)	<0.001
HIV							
<i>New diagnosis‡</i>	11,102	262	2.4 (2.1 to 2.7)	1,774	10	0.6 (0.3 to 1.0)	<0.001
<i>Previous diagnosis</i>	12,795	316	2.5 (2.2 to 2.8)	1,979	7	0.4 (0.1 to 0.7)	<0.001

Note.*Before 2015, urethral gonorrhoea testing was only performed among symptomatic MSM with urethral symptoms or self-reported as contact of infection. The number of people tested corresponds to the number of people tested for urethral chlamydia; † Any anatomical site for gonorrhoea includes urethral, anorectal and oropharyngeal; while any site for chlamydia includes urethral and anorectal; ‡ Only including HIV cases diagnosed on the day of the first visit.

Table 4 Association between sexual practice and gonorrhoea, chlamydia, syphilis and HIV positivity among men who have sex with men only and men who have sex with men and women attending a sexual health centre in Melbourne, 2011-2018.

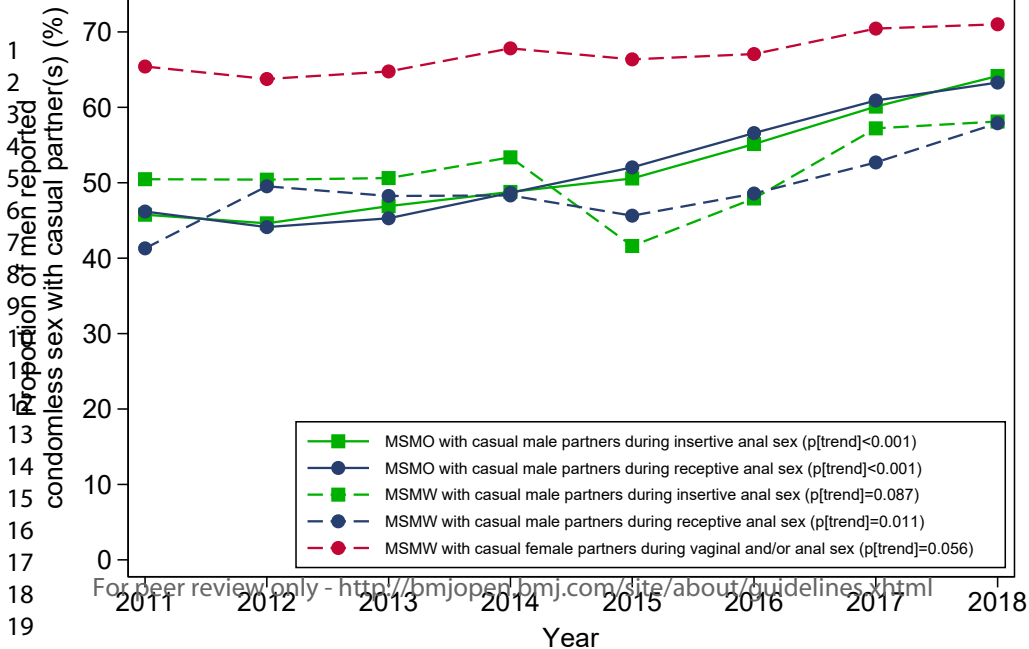
HIV/STI	OR (95% CI)	P value	aOR (95% CI)*	P value
Gonorrhoea (any anatomical site) [†]				
<i>MSMO</i>	1.50 (1.25 to 1.80)	<0.001	1.36 (1.13 to 1.64)	0.001
<i>MSMW</i>	1		1	ref
Chlamydia (any anatomical site) [†]				
<i>MSMO</i>	1.50 (1.25 to 1.80)	<0.001	1.39 (1.16 to 1.67)	<0.001
<i>MSMW</i>	1		1	ref
Syphilis				
<i>MSMO</i>	1.58 (1.25 to 2.00)	<0.001	1.74 (1.37 to 2.22)	<0.001
<i>MSMW</i>	1		1	ref
HIV (new diagnosis) [‡]				
<i>MSMO</i>	4.26 (2.26 to 8.03)	<0.001	4.60 (2.43 to 8.70)	<0.001
<i>MSMW</i>	1		1	ref
HIV (previous diagnosis)				
<i>MSMO</i>	7.13 (3.37 to 15.11)	<0.001	9.08 (4.26 to 19.37)	<0.001
<i>MSMW</i>	1	ref	1	ref

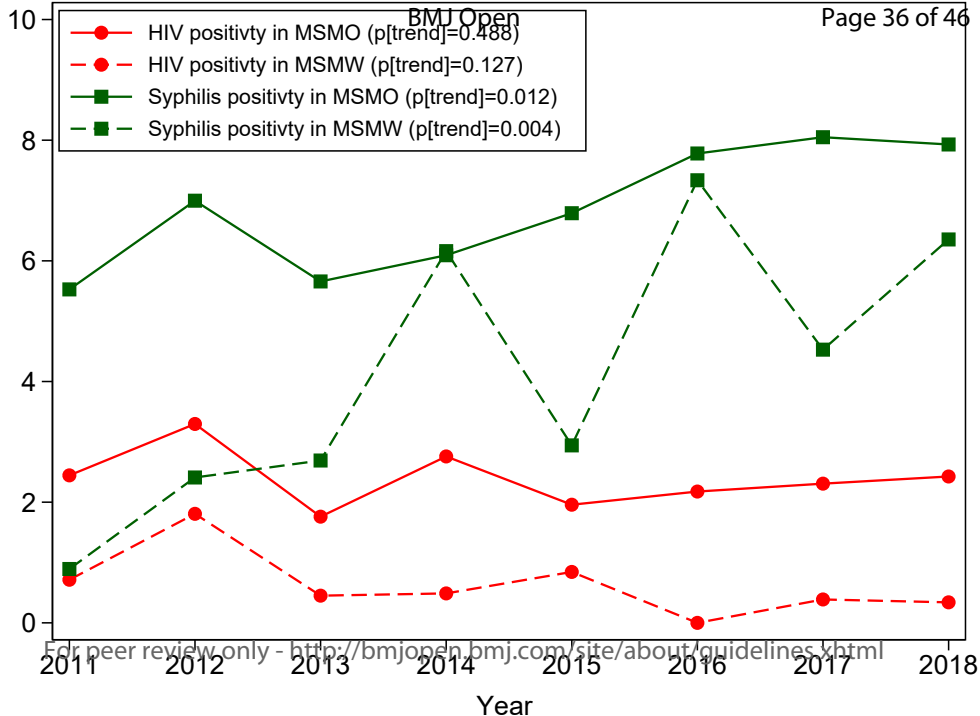
Note. OR: crude odds ratio; aOR: adjusted odds ratio; CI: confidence intervals; MSMO: men who have sex with men only; MSMW: men who have sex with men and women. *Adjusted by age, country of birth, sex overseas, injected drug use in the past 12 months, regular partner, number of male sexual partners in the past 12 months, condom use with casual male partners in the past 12 months and year of visit; [†]Any anatomical site for gonorrhoea includes urethral, anorectal and oropharyngeal; while any site for chlamydia includes urethral and anorectal; [‡]Only including HIV cases diagnosed on the day of the first visit.

Table 5 Association between sexual practice and gonorrhoea, chlamydia, syphilis and HIV positivity among men who have sex with men only and men who have sex with men and women attending a sexual health centre in Melbourne , 2011-2018.

HIV/STI	OR (95% CI)	P value	aOR (95% CI)*	P value
Gonorrhoea (any anatomical site) [†]				
<i>MSMO</i>	1.96 (1.45 to 2.67)	<0.001	1.58 (1.15 to 2.18)	0.005
<i>MSMW-M</i>	1.91 (1.31 to 2.78)	0.001	1.41 (0.94 to 2.12)	0.093
<i>MSMW-W</i>	1	ref	1	ref
Chlamydia (any anatomical site) [†]				
<i>MSMO</i>	1.87 (1.39 to 2.50)	<0.001	1.47 (1.09 to 1.99)	0.013
<i>MSMW-M</i>	1.63 (1.12 to 2.38)	0.010	1.19 (0.80 to 1.77)	0.394
<i>MSMW-W</i>	1	ref	1	ref
Syphilis				
<i>MSMO</i>	2.18 (1.45 to 3.27)	<0.001	2.11 (1.36 to 3.27)	0.001
<i>MSMW-M</i>	1.48 (0.88 to 2.49)	0.142	1.08 (0.61 to 1.93)	0.791
<i>MSMW-W</i>	1	ref	1	ref
HIV (new diagnosis) [‡]				
<i>MSMO</i>	6.01 (1.92 to 18.80)	0.002	5.49 (1.74 to 17.30)	0.004
<i>MSMW-M</i>	2.38 (0.61 to 9.24)	0.210	1.81 (0.43 to 7.63)	0.422
<i>MSMW-W</i>	1	ref	1	ref
HIV (previous diagnosis)				
<i>MSMO</i>	21.22 (2.98 to 151.30)	0.002	17.91 (2.50 to 128.43)	0.004
<i>MSMW-M</i>	6.30 (0.76 to 52.45)	0.089	4.10 (0.47 to 35.42)	0.200
<i>MSMW-W</i>	1	ref	1	ref

Note. OR: crude odds ratio; aOR: adjusted odds ratio; CI: confidence intervals; MSMO: men who have sex with men only; MSMW-M: men who have sex with men and women and had more male than female sexual partner in the past 12 months; MSMW-W: men who have sex with men and women and had more female than male sexual partner in the past 12 months; MSMW-M: men who have sex with men and women and had more male than female sexual partner in the past 12 months. *Adjusted by age, country of birth, sex overseas, injected drug use in the past 12 months, regular partner, number of male sexual partners in the past 12 months, condom use with casual male partners in the past 12 months and year of visit; †Any anatomical site for gonorrhoea includes urethral, anorectal and oropharyngeal, while any site for chlamydia includes urethral and anorectal; ‡Only including HIV cases diagnosed on the day of the first visit.



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SUPPLEMENTARY MATERIAL

Trends and differences in sexual practices and sexually transmitted infections in men who have sex with men only (MSMO) and men who have sex with men and women (MSMW): a repeated cross-sectional study in Melbourne, Australia.

Mario Martín-Sánchez, Richard Case, Christopher K. Fairley, Jane S. Hocking, Catriona S. Bradshaw, Jason J. Ong, Marcus Y. Chen, Eric P.F. Chow

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Table S1 Demographic characteristics and sexual practices among men who have sex with men only and men who have sex with men and women attending a sexual health centre in Melbourne, 2011-2018.

	MSMO (N=12,795)	MSMW- M (N=804)	MSMW- W (N=839)	Comparison across three groups	Comparison between MSMW-M and MSM-W
	n (%)	n (%)	n (%)	P value	P value
Age (years), median(IQR)	27 (23-33)	29 (24-39)	28 (24-36)	<0.001	0.845
Country of birth				<0.001	0.167
<i>Australia</i>	6,208 (48.5)	465 (57.8)	452 (53.9)		
<i>Overseas</i>	6,110 (47.8)	297 (36.9)	348 (41.5)		
<i>No information</i>	477 (3.7)	42 (5.2)	39 (4.5)		
Aboriginal and Torres Strait Islander Status				0.280	0.254
<i>Indigenous origin</i>	150 (1.2)	10 (1.2)	5 (0.6)		
<i>Non-Indigenous origin</i>	11,595 (90.6)	715 (88.9)	762 (90.8)		
<i>No information</i>	1,050 (8.2)	79 (9.8)	72 (8.6)		
Sex overseas in the past 12 months				<0.001	0.002
<i>Yes</i>	4,415 (34.5)	278 (34.6)	361 (43.0)		
<i>No</i>	7,571 (59.2)	470 (58.5)	433 (51.6)		
<i>No information</i>	809 (6.3)	56 (7.0)	45 (5.4)		
Sex work during lifetime				0.454	0.722
<i>Yes</i>	71 (0.6)	7 (0.9)	6 (0.7)		
<i>No</i>	12,724 (99.4)	797 (99.1)	833 (99.3)		
Injected drug use in past 12 months				<0.001	0.777
<i>Yes</i>	211 (1.6)	17 (2.1)	21 (2.5)		
<i>No</i>	12,363 (96.6)	763 (95.7)	797 (97.5)		
<i>No information</i>	221 (1.7)	17 (2.1)	21 (2.5)		
Number of male and female sexual partners in the past 12 months, median (IQR)	5 (3-10)	7 (5-12)	6 (4-11)	<0.001	<0.001
Number of male sexual partners in the past 12 months, median (IQR)	5 (3-10)	5 (3-10)	1 (1-2)	<0.001	<0.001
Number of female sexual partners in the past 12 months, median (IQR)	NA	1 (1-2)	5 (3-8)	NA	<0.001
Regular sexual partner				NA	<0.001
<i>No regular partner</i>	7,513 (58.7)	433 (53.9)	453 (54.1)		
<i>Regular male partner</i>	5,132 (40.1)	138 (17.2)	11 (1.3)		
<i>Regular female partner</i>	NA	195 (24.3)	350 (41.7)		
<i>Regular female and male partner</i>	NA	37 (4.6)	23 (2.7)		
<i>No information</i>	150 (1.2)	1 (0.1)	2 (0.2)		
Anal sexual practice with regular male partners^a				<0.001	0.001
<i>Receptive only</i>	435 (8.5)	10 (5.7)	2 (5.7)		
<i>Insertive only</i>	465 (9.1)	13 (7.4)	0 (0)		
<i>Receptive and insertive</i>	3,921 (76.4)	145 (82.4)	26 (74.3)		
<i>No anal sex</i>	234 (4.6)	6 (3.4)	2 (5.7)		
<i>No information</i>	79 (1.5)	2 (1.1)	5 (14.3)		
Condom use with regular male partners in the past 12 months for receptive anal sex^{b*}				0.150	0.275
<i>Always</i>	1,241 (28.5)	50 (32.3)	12 (42.9)		
<i>Not always</i>	3,115 (71.5)	105 (67.7)	16 (57.1)		
Condom use with regular male partners in the past 12 months for insertive anal sex^{c*}				0.142	0.935
<i>Always</i>	1,254 (28.6)	56 (35.4)	9 (34.6)		
<i>Not always</i>	3,132 (71.4)	102 (64.6)	17 (65.4)		

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3	Vaginal or anal sex with regular				NA	0.903
4	female partner^d					
5	<i>Yes</i>	NA	223 (96.1)	361 (96.8)		
6	<i>No</i>	NA	4 (1.7)	5 (1.3)		
7	<i>No information</i>	NA	5 (2.2)	7 (1.9)		
8	Condom use with regular female				NA	0.551
9	partners in the past 12					
10	months^{e*}					
11	<i>Always</i>	NA	42 (18.8)	61 (16.9)		
12	<i>Not always</i>	NA	181 (81.2)	300 (83.1)		
13	Casual sexual partner				NA	<0.001
14	<i>No casual partner</i>	806 (6.3)	0	0		
15	<i>Casual male partner(s)</i>	11,969 (93.5)	112 (13.9)	0		
16	<i>Casual female partner(s)</i>	NA	0	19 (2.3)		
17	<i>Casual female and male</i>	NA	692 (86.1)	820 (97.7)		
18	<i>partner(s)</i>	NA	692 (86.1)	820 (97.7)		
19	<i>No information</i>	20 (0.2)	0	0		
20	Anal sexual practice with casual				<0.001	<0.001
21	male partners					
22	<i>Receptive only</i>	1,262 (9.9)	45 (5.6)	64 (7.6)		
23	<i>Insertive only</i>	1,344 (10.5)	116 (14.4)	119 (14.2)		
24	<i>Receptive and insertive</i>	7,835 (61.2)	524 (65.2)	407 (48.5)		
25	<i>No anal sex</i>	1,692 (13.2)	108 (13.4)	210 (25.0)		
26	<i>No information</i>	662 (5.2)	11 (1.4)	39 (4.6)		
27	Condom use with casual male				0.004	0.004
28	partners in the past 12 months					
29	for receptive anal sex^{f*}					
30	<i>Always</i>	4,207 (46.2)	256 (45.0)	254 (53.9)		
31	<i>Not always</i>	4,890 (53.8)	313 (55.0)	217 (46.1)		
32	Condom use with casual male				0.003	0.001
33	partners in the past 12 months					
34	for insertive anal sex^{g*}					
35	<i>Always</i>	4,276 (46.6)	275 (43.0)	278 (52.9)		
36	<i>Not always</i>	4,903 (53.4)	365 (57.0)	248 (47.1)		
37	Vaginal or anal sex with casual				-	<0.001
38	female partner					
39	<i>Yes</i>	NA	658 (81.8)	799 (95.2)		
40	<i>No</i>	NA	19 (2.4)	24 (2.9)		
41	<i>No information</i>	NA	127 (15.8)	16 (1.9)		
42	Condom use with casual female				-	<0.001
43	partners in the past 12 months^{h*}					
44	<i>Always</i>	NA	257 (39.1)	195 (24.4)		
45	<i>Not always</i>	NA	401 (60.9)	604 (75.6)		

Note. NA: Not applicable; IQR: Interquartile range; MSM: men who have sex with men; MSMO: men who have sex with men only; MSMW-W: men who have sex with men and women and had more female than male sexual partner in the past 12 months; MSMW-M: men who have sex with men and women and had more male than female sexual partner in the past 12 months; ^aOnly including MSM with regular male partners or regular male and female partners; ^bOnly including MSM that referred receptive only or receptive and insertive anal sex with regular male partners; ^cOnly including MSM that referred insertive only or receptive and insertive anal sex with regular male partners; ^dOnly including MSM with regular female partners or regular male and female partners; ^eOnly including MSM that referred vaginal or anal sex with regular female partner; ^f Only including MSM that referred receptive only or receptive and insertive anal sex with casual male partners; ^g Only including MSM that referred insertive only or receptive and insertive anal sex with casual male partners, ^h Only including MSM that referred vaginal or anal sex with casual female partners; *'Not always' was defined as men who sometimes, usually or never used a condom with their sexual partners in the past 12 months (with female partners for vaginal and/or anal sex, with male partners for anal sex).

Table S2 Temporal trend of the sexual practices among men who have sex with men only attending a sexual health centre in Melbourne, 2011-2018.

	2011		2012		2013		2014		2015		2016		2017		2018		P _{trend}
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	
Number of sexual partners in the past 12 months																	0.002
<5	515	49.2	598	46.6	645	45.4	626	43.7	686	41.4	802	42.8	859	44.3	934	43.6	-
≥5	532	50.8	684	53.4	777	54.6	807	56.3	972	58.6	1070	57.2	1079	55.7	1209	56.4	-
Condom use with regular male partners in the past 12 months*																	<0.001
<i>Always</i>	134	30.8	164	31.2	160	30.0	142	26.3	167	27.6	201	28.5	139	19.4	165	21.6	-
<i>Not always</i>	301	69.2	362	68.8	373	70.0	398	73.7	437	72.4	504	71.5	576	80.6	598	78.4	-
Anal sexual practice with casual male partners																	
<i>Receptive only</i>	74	7.5	109	9.1	109	8.1	140	10.3	151	9.5	196	11.0	218	11.8	265	13.0	<0.001
<i>Insertive only</i>	98	10.0	133	11.0	153	11.4	150	11.1	178	11.3	205	11.5	194	10.5	233	11.4	0.580
<i>Receptive and insertive</i>	634	64.5	750	62.3	847	63.3	877	64.6	1050	66.4	1177	66.2	1207	65.2	1293	63.4	0.396
<i>No anal sex</i>	177	18.0	212	17.6	229	17.1	190	14.0	203	12.8	201	11.3	233	12.6	247	12.1	<0.001
Condom use with casual male partners in the past 12 months for receptive anal sex*																	<0.001
<i>Always</i>	381	53.8	480	55.9	523	54.7	522	51.3	576	48.0	596	43.4	557	39.1	572	36.7	-
<i>Not always</i>	327	46.2	379	44.1	433	45.3	495	48.7	625	52.0	777	56.6	868	60.9	986	63.3	-
Condom use with casual male partners in the past 12 months for insertive anal sex*																	<0.001
<i>Always</i>	397	54.2	489	55.4	531	53.1	526	51.2	607	49.4	620	44.9	559	39.9	547	35.8	-
<i>Not always</i>	335	45.8	394	44.6	469	46.9	501	48.8	621	50.6	762	55.1	842	60.1	979	64.2	-

* 'Not always' was defined as men who sometimes, usually or never used a condom with their sexual partners in the past 12 months (with female partners for vaginal or anal sex, with male partners for anal sex).

Table S3 Temporal trend of the sexual practices among men who have sex with men and women attending a sexual health centre in Melbourne, 2011-2018.

	2011		2012		2013		2014		2015		2016		2017		2018		2011-18
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	P _{trend}
Number of sexual partners past 12 months																	0.014
<5	62	36.9	66	36.7	95	39.4	82	34.9	94	36.4	90	31.5	94	32.9	97	29.8	-
≥5	106	63.1	114	63.3	146	60.6	153	65.1	164	63.6	196	68.5	192	67.1	228	70.2	-
Number of male sexual partners past 12 months																	0.106
<5	122	72.6	129	71.7	172	71.4	167	71.1	195	75.6	205	71.7	202	70.6	212	65.2	-
≥5	46	27.4	51	28.3	69	28.6	68	28.9	63	24.4	81	28.3	84	29.4	113	34.8	-
Number of female sexual partners past 12 months																	0.039
<5	129	76.8	133	73.9	185	76.8	179	76.2	185	71.7	204	71.3	206	72.0	229	70.5	-
≥5	39	23.2	47	26.1	56	23.2	56	23.8	73	28.3	82	28.7	80	28.0	96	29.5	-
Condom use with regular male partners in the past 12 months*																	0.435
<i>Always</i>	11	45.8	5	21.7	13	39.4	13	39.4	9	37.5	9	29.0	10	26.3	14	35.9	-
<i>Not always</i>	13	54.2	18	78.3	20	60.6	20	60.6	15	62.5	22	71.0	28	73.7	25	64.1	-
Anal sexual practice with casual male partners																	
<i>Receptive only</i>	6	3.8	11	6.3	15	6.6	13	5.7	17	7.0	26	9.4	16	5.8	27	8.7	0.068
<i>Insertive only</i>	19	11.9	25	14.4	32	14.1	27	11.8	41	16.8	43	15.5	43	15.6	52	16.8	0.107
<i>Receptive and insertive</i>	86	54.1	96	55.2	128	56.4	136	59.4	132	54.1	149	53.8	151	54.7	182	58.9	0.670
<i>No anal sex</i>	48	30.2	42	24.1	52	22.9	53	23.1	54	22.1	59	21.3	66	23.9	48	15.5	0.003
Condom use with casual male partners in the past 12 months for receptive anal sex*																	0.011
<i>Always</i>	54	58.7	54	50.5	74	51.7	77	51.7	81	54.4	90	51.4	79	47.3	88	42.1	-
<i>Not always</i>	38	41.3	53	49.5	69	48.3	72	48.3	68	45.6	85	48.6	88	52.7	121	57.9	-
Condom use with casual male partners in the past 12 months for insertive anal sex*																	0.087
<i>Always</i>	52	49.5	60	49.6	79	49.4	76	46.6	101	58.4	100	52.1	83	42.8	98	41.9	-
<i>Not always</i>	53	50.5	61	50.4	81	50.6	87	53.4	72	41.6	92	47.9	111	57.2	136	58.1	-
Condom use with regular female partners in the past 12 months*																	0.837
<i>Always</i>	16	22.5	16	22.2	8	10.0	10	13.2	17	18.9	22	18.2	19	18.6	24	20.5	-
<i>Not always</i>	55	77.5	56	77.8	72	90.0	66	86.8	73	81.1	99	81.8	83	81.4	93	79.5	-
Condom use with casual female partners in the past 12 months*																	0.056

1																		
2																		
3	<i>Always</i>	46	34.6	54	36.2	74	35.2	65	32.2	74	33.6	82	32.9	73	29.6	80	29.0	-
4	<i>Not always</i>	87	65.4	95	63.8	136	64.8	137	67.8	146	66.4	167	67.1	174	70.4	196	71.0	-

* 'Not always' was defined as men who sometimes, usually or never used a condom with their sexual partners in the past 12 months (with female partners for vaginal or anal sex, with male partners for anal sex).

For peer review only

Table S4 Temporal trend of the positivity for sexually transmitted infections and HIV among men who have sex with men only attending a sexual health centre in Melbourne, 2011-2018.

	2011	2012	2013	2014	2015	2016	2017	2018	2011-2014	2015-2018	2011-2018
	n/N (%)	n/N (%)	n/N (%)	n/N (%)	n/N (%)	n/N (%)	n/N (%)	n/N (%)	P _{trend}	P _{trend}	P _{trend}
Gonorrhoea											
<i>Oropharyngeal</i>	18/973 (1.8)	28/1,164 (2.4)	43/1,307 (3.3)	42/1,340 (3.1)	122/1,539 (7.9)	130/1,709 (7.6)	154/1,803 (8.5)	145/1,975 (7.3)	0.037	0.755	NA
<i>Urethral</i> [*]	38/961 (4.0)	36/1,155 (3.1)	47/1,291 (3.6)	40/1,325 (3.0)	56/1,528 (3.7)	55/1,691 (3.3)	63/1,782 (3.5)	55/1,966 (2.8)	0.364	0.215	NA
<i>Anorectal</i>	25/922 (2.7)	42/1,082 (3.9)	70/1,209 (5.8)	71/1,260 (5.6)	128/1,431 (8.9)	115/1,591 (7.2)	132/1,686 (7.8)	162/1,899 (8.5)	0.001	0.954	NA
<i>Any anatomical site</i> [†]	66/986 (6.7)	81/1,178 (6.9)	122/1,324 (9.2)	130/1,349 (9.6)	215/1,552 (13.9)	220/1,738 (12.7)	241/1,826 (13.2)	246/1,998 (12.3)	0.002	0.261	NA
Chlamydia											
<i>Urethral</i>	30/961 (3.1)	43/1,155 (3.7)	48/1,291 (3.7)	38/1,325 (2.9)	68/1,528 (4.5)	64/1,691 (3.8)	51/1,782 (2.9)	68/1,966 (3.5)	0.652	0.067	NA
<i>Anorectal</i>	63/922 (6.8)	80/1,081 (7.4)	108/1,210 (8.9)	97/1,254 (7.7)	126/1,412 (8.9)	164/1,589 (10.3)	162/1,681 (9.6)	189/1,894 (10.0)	0.282	0.489	NA
<i>Any anatomical site</i> [†]	86/989 (8.7)	114/1,178 (9.7)	142/1,325 (10.7)	128/1,348 (9.5)	178/1,542 (11.5)	199/1,721 (11.6)	196/1,806 (10.9)	229/1,982 (11.6)	0.436	0.869	NA
Syphilis	43/778 (5.5)	79/1129 (7.0)	73/1,290 (5.7)	80/1,313 (6.1)	103/1,517 (6.8)	130/1,671 (7.8)	137/1,702 (8.0)	152/1,917 (7.8)	-	-	0.012
HIV (new diagnosis) [‡]	22/900 (2.4)	36/1,092 (3.3)	22/1,250 (1.8)	35/1,269 (2.8)	29/1,481 (2.0)	35/1,608 (2.2)	38/1,647 (2.3)	45/1,855 (2.4)	-	-	0.488

Note. *n* represents de number of MSM with a positive result and *N* the number of MSM tested. NA: not applicable; MSM: men who have sex with men; *Before 2015, urethral gonorrhoea testing was only performed among symptomatic MSM with urethral symptoms or self-reported as contact of infection. The number of people tested corresponds to the number of people tested for urethral chlamydia; † Any anatomical site for gonorrhoea includes urethral, anorectal and oropharyngeal; while any site for chlamydia includes urethral and anorectal; ‡ Only including HIV cases diagnosed on the day of the first visit.

Table S5 Temporal trend of the positivity for sexually transmitted infections and HIV among men who have sex with men and women attending a sexual health centre in Melbourne, 2011-2018.

	2011	2012	2013	2014	2015	2016	2017	2018	2011-2014	2015-2018	2011-2018
	n/N (%)	n/N (%)	n/N (%)	n/N (%)	n/N (%)	n/N (%)	n/N (%)	n/N (%)	P _{trend}	P _{trend}	P _{trend}
Gonorrhoea											
<i>Oropharyngeal</i>	1/150 (0.7)	2/154 (1.3)	7/209 (3.3)	3/209 (1.4)	14/220 (6.4)	12/238 (5.0)	17/246 (6.9)	12/285 (4.2)	0.387	0.448	NA
<i>Urethral</i> *	3/163 (1.8)	5/172 (2.9)	9/230 (3.8)	6/219 (2.7)	7/247 (2.8)	10/271 (3.7)	7/275 (2.5)	5/308 (1.6)	0.539	0.241	NA
<i>Anorectal</i>	4/128 (3.1)	5/122 (4.1)	4/172 (2.3)	4/172 (2.3)	6/173 (3.5)	14/191 (7.3)	12/207 (5.8)	9/239 (3.8)	0.492	0.784	NA
<i>Any anatomical site</i> †	7/153 (4.6)	9/160 (5.7)	15/225 (6.8)	13/218 (6.1)	20/232 (8.7)	27/267 (10.3)	27/293 (9.6)	22/330 (7.1)	0.530	0.304	NA
Chlamydia											
<i>Urethral</i> *	4/163 (2.5)	11/172 (6.4)	12/230 (5.2)	5/219 (2.3)	10/247 (4.0)	12/271 (4.4)	6/275 (2.2)	13/308 (4.2)	0.667	0.778	NA
<i>Anorectal</i>	10/128 (7.8)	9/122 (7.4)	6/173 (3.5)	4/172 (2.3)	10/173 (5.8)	11/191 (5.8)	14/206 (6.8)	19/239 (7.9)	0.010	0.320	NA
<i>Any anatomical site</i> †	14/165 (8.5)	15/173 (8.7)	17/233 (7.3)	9/227 (4.0)	19/249 (7.6)	21/273 (7.7)	17/277 (6.1)	29/310 (9.4)	0.057	0.627	NA
Syphilis	1/112 (0.9)	4/166 (2.4)	6/223 (2.7)	13/211 (6.2)	7/238 (2.9)	19/259 (7.3)	12/265 (4.5)	19/299 (6.4)	-	-	0.004
HIV (new diagnosis) ‡	1/140 (0.7)	3/166 (1.8)	1/222 (0.5)	1/205 (0.5)	2/237 (0.8)	0/252 (0.0)	1/258 (0.4)	1/294 (0.3)	-	-	0.127

Note. *n* represents the number of MSM with a positive result and *N* the number of MSM tested; NA: not applicable; MSM: men who have sex with men; *Before 2015, urethral gonorrhoea testing was only performed among symptomatic MSM with urethral symptoms or self-reported as contact of infection. The number of people tested corresponds to the number of people tested for urethral chlamydia; † Any anatomical site for gonorrhoea includes urethral, anorectal and oropharyngeal; while any site for chlamydia includes urethral and anorectal; ‡ Only including HIV cases diagnosed on the day of the first visit.

Table S6 Positivity for gonorrhoea, chlamydia, syphilis and HIV among men who have sex with men only and men who have sex with men and women attending a sexual health centre in Melbourne, 2011-2018.

	MSMO	MSMW-M	MSMW-W	Comparison across three groups	Comparison between MSMW-M and MSM-W
	n/N (%)	n/N (%)	n/N (%)	P value	P value
Gonorrhoea					
<i>Oropharyngeal</i>	682/11,810 (5.8)	44/756 (5.8)	18/676 (2.7)	0.003	0.003
<i>Urethral</i> *	390/11,699 (3.3)	25/771 (3.2)	23/801 (2.9)	0.775	0.669
<i>Rectum</i>	745/11,080 (6.7)	40/682 (5.9)	14/515 (2.7)	0.001	0.009
<i>Any anatomical site</i>	1321/11,951 (11.1)	83/771 (10.8)	45/756 (6.0)	<0.001	0.001
Chlamydia					
<i>Urethral</i>	410/11,699 (3.5)	27/771 (3.5)	37/801 (4.6)	0.257	0.262
<i>Anorectal</i>	989/11,043 (9.0)	56/683 (8.2)	16/514 (3.1)	<0.001	<0.001
<i>Any anatomical site</i> †	1272/11,891 (10.7)	74/779 (9.5)	49/812 (6.0)	<0.001	0.010
Syphilis	797/11,317 (7.0)	36/737 (4.9)	25/744 (3.4)	<0.001	0.140
HIV (new diagnosis) ‡	262/11,102 (2.4)	7/738 (0.9)	3/749 (0.4)	<0.001	0.196
HIV (previous positive)	316/12,795 (2.5)	6/804 (0.7)	1/839 (0.1)	<0.001	0.051

Note. *n* represents the number of MSM with a positive result and *N* the number of MSM tested. MSM: men who have sex with men; *Before 2015, urethral gonorrhoea testing was only performed among symptomatic MSM with urethral symptoms or self-reported as contact of infection. The number of people tested corresponds to the number of people tested for urethral chlamydia; † Any anatomical site for gonorrhoea includes urethral, anorectal and oropharyngeal; while any site for chlamydia includes urethral and anorectal; ‡ Only including HIV cases diagnosed on the day of the first visit.

STROBE Statement—Checklist of items that should be included in reports of *cross-sectional studies*

	Item No	Recommendation	Page, lines
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	1, 3
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	3, 1-25 4, 1-3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	6, 1-14
Objectives	3	State specific objectives, including any prespecified hypotheses	6, 16-23
Methods			
Study design	4	Present key elements of study design early in the paper	7, 1-3
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	7, 1-13
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	7, 15-19
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	7, 20-24 8, 1-18
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	7, 5-13 7, 20-24
Bias	9	Describe any efforts to address potential sources of bias	7, 17-19 8, 20-25
Study size	10	Explain how the study size was arrived at	NA, all eligible subjects were included
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7, 19-24 8, 1-2
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	9, 8-25
		(b) Describe any methods used to examine subgroups and interactions	9, 17-25
		(c) Explain how missing data were addressed	9, 23-24
		(d) If applicable, describe analytical methods taking account of sampling strategy	NA, all eligible subjects were included
		(e) Describe any sensitivity analyses	NA
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	10, 13-20
		(b) Give reasons for non-participation at each stage	10, 13-20
		(c) Consider use of a flow diagram	NA

Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	10, 24-25 11, 1-4
		(b) Indicate number of participants with missing data for each variable of interest	Table 1, Table S1
Outcome data	15*	Report numbers of outcome events or summary measures	10, 20-22 11, 6-25 12, 1-25 13, 1-12
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	Table 4, Table 5 11, 14-17
		(b) Report category boundaries when continuous variables were categorized	11, 15-19
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	13, 18-23
Discussion			
Key results	18	Summarise key results with reference to study objectives	14, 1-11
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	16, 22-25 17, 1-15
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	15, 1-24 17, 18-24 16, 1-16
Generalisability	21	Discuss the generalisability (external validity) of the study results	17, 4-8
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	20, 12-15

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

Trends and differences in sexual practices and sexually transmitted infections in men who have sex with men only (MSMO) and men who have sex with men and women (MSMW): a repeated cross-sectional study in Melbourne, Australia

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1
2
3 **Trends and differences in sexual practices and sexually transmitted infections in men**
4 **who have sex with men only (MSMO) and men who have sex with men and women**
5 **(MSMW): a repeated cross-sectional study in Melbourne, Australia**
6
7
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23 have sex with men, Sexually Transmitted Diseases, HIV, Syphilis, gonorrhoea, chlamydia,
24 bisexual, condom
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ABSTRACT

Objectives

In the last decade, there has been an increase in sexually transmitted infections (STI) in men who have sex with men (MSM) in Australia, and since 2015 also in urban heterosexuals. Men who have sex with men and women (MSMW) have characteristics that may differ from both MSM only (MSMO) and heterosexual men. We aimed to compare the sexual practices and the trends in HIV/STI positivity between MSMO and MSMW.

Design

Repeated cross-sectional study.

Setting

Sexual Health Centre in Australia.

Participants

MSM aged 18 years and above who attended Melbourne Sexual Health Centre for the first time between 2011 and 2018. This includes 12,795 MSMO and 1,979 MSMW.

Primary outcome measures

Prevalence of sexual practices and HIV/STI positivity.

Results

Compared to MSMW, MSMO were more likely to practice anal sex and to have condomless receptive anal sex with casual male partners, and less likely to have a current regular relationship. Over the 8-year period, there was an increase in condomless receptive anal sex with casual male partners for both groups (MSMO: 46.2% to 63.3%, $P_{\text{trend}} < 0.001$; MSMW: 41.3% to 57.9%, $P_{\text{trend}} = 0.011$). Syphilis positivity increased in MSMO (5.5% to 7.8%, $P_{\text{trend}} = 0.012$) and MSMW (from 0.9% to 6.4%, $P_{\text{trend}} = 0.004$), and HIV remained stable. Gonorrhoea increased among MSMO from 2011 to 2014 (from 6.7% to 9.6%, $P_{\text{trend}} = 0.002$), and remained stable from 2015 to 2018. MSMO had higher odds of testing positive for

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3 gonorrhoea (adjusted odd ratio [aOR] 1.36, 95% confidence interval [CI] 1.13 to 1.64),
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5 chlamydia (aOR 1.39, 95%CI 1.16 to 1.67), syphilis (aOR 1.74, 95%CI 1.37 to 2.22) and
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7 HIV (aOR 4.60, 95%CI 2.43 to 8.70) than MSMW.
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10 **Conclusions**

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12 MSMW have overall lower condomless sex and lower HIV/STI positivity. In the last years,
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14 changes in sexual practices in MSM have affected both MSMW and MSMO leading to an
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16 increased STI risk.
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ARTICLE SUMMARY

Strengths and limitations of this study

- We compared sexual practices and HIV/sexually transmitted infections positivity in a high number of men who have sex with men only (N=12,795) and men who have sex with men and women (N=1,979) over an 8-year period.
- We provide a comprehensive description of sexual practices distinguishing between condom use with regular or casual sexual partners, and in receptive or insertive anal sex.
- The study was conducted in one urban major sexual health clinic and it is possible that our findings may not be generalizable to other settings.
- We were unable to analyse the statistical significance of the temporal trends during the whole study period for gonorrhoea and chlamydia due to a change in the diagnostic test in 2015.

INTRODUCTION

Despite considerable public health efforts and biomedical advances,¹ the rate of sexually transmitted infections (STIs) is increasing at an alarming rate particularly among gay, bisexual and other men who have sex with men (MSM) worldwide.² Among the Australian population, the notification rate, defined as the number of new cases reported to the national infectious diseases surveillance system, increased an 80% for gonorrhoea (from 65.5 to 118.0 per 100,000), a 14% for chlamydia (from 364.5 to 416.8 per 100,000) and has more than doubled for syphilis (from 7.8 to 18.3 per 100,000) between 2013 and 2017.³ In males, most of the early rises in gonorrhoea and syphilis were accounted for by rises in MSM. However, in late 2010s, there has been a dramatic increase in both infections in the Australian heterosexual population to levels not seen since the 1980's. In stark contrast to the rise in the notification rate of gonorrhoea and syphilis, there has been an 11% decline in the HIV notification rate from 4.5 per 100,000 in 2013 to 4.0 in 2017 among MSM in Australia, with most of the reduction occurring between 2016 and 2017 after the introduction of pre-exposure prophylaxis (PrEP) in late 2016.³⁻⁵

Past studies have shown that sexual practices among MSM have changed over time (e.g. an increase in condomless anal sex).⁶⁻⁹ However, there have been very limited studies examining whether there are any differences in sexual practices between men who have sex with men only (MSMO) and men who have sex with men and women (MSMW or bisexual MSM).¹⁰⁻¹² Therefore, this study aimed to compare the characteristics and sexual practices, and describe the trends in HIV/STI positivity in MSMO and MSMW attending a large sexual health clinic in Melbourne between 2011 and 2018. Additionally, we aimed to explore differences within MSMW depending on the most frequent gender of their sexual partners.

METHODS

We conducted a repeated cross-sectional analysis of retrospective data of MSM attending the Melbourne Sexual Health Centre (MSHC), Australia, between 2011 and 2018. MSHC is a public clinic that offers a range of free clinical services regarding sexual health. MSHC is the largest sexual health clinic in Victoria and provides more than 50,000 clinical consultations a year, approximately 40% of clients are MSM.⁴ Upon arrival, all clients are invited to complete a questionnaire via computer-assisted self-interviewing (CASI), which collects client's demographic characteristics (e.g. age, country of birth, Aboriginal and Torres Strait Islander status), sexual practices (i.e. gender of partners, type of partners [regular or casual], number of partners, condom use and anal sex practice [receptive anal sex (RAS) and insertive anal sex (IAS)]), sex work status and injecting drug use behaviour. Data on sexual practices and injecting drug use were measured in the past 12 months, and sex work status was defined as clients who had ever worked in the sex industry during lifetime. Clients are allowed to decline to answer any questions they may wish to.

Clients who were male, aged 18 years and above, reported having sex with another man in the past 12 months, and attended MSHC for the first time between 2011 and 2018 were included in this analysis. We only included data from the client's first visit to MSHC to avoid any bias including men with repeated visits as they might be at a higher risk of HIV/STI with different sexual practices. We categorised MSM into two main categories based on their self-reported sexual practices: (1) MSMO, and (2) MSMW. We further categorised MSMW into two groups: (1) MSM who reported more female partners than male partners in the past 12 months (MSMW-W); and (2) MSM who reported more male partners than female partners in the past 12 months (MSMW-M) and compared the characteristics between the two groups. Men with an equal number of male and female partners in the past 12 months (N=336) were

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3 excluded in the comparisons among MSMW subgroups but they were included in the overall
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5 MSMW category.
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10 We also extracted the HIV/STI testing results on the day. STI testing results included syphilis
11 (serologically confirmed by rapid plasma regain test [RPR], *T. pallidum* enzyme
12 immunoassay [EIA] and *T. pallidum* particle agglutination assay [TPPA], and including all
13 syphilis stages), gonorrhoea (stratified by anatomical site: anorectal, urethral and
14 oropharyngeal) and chlamydia (stratified by anatomical site: anorectal and urethral). For
15 HIV, we analysed separately incident cases (diagnosed on the day of the first visit using
16 screening assay followed by a confirmatory Western Blot assay) and MSM with a previous
17 HIV diagnosis visiting MSHC for the first time. There was a major change in gonorrhoea and
18 chlamydia testing at our clinic.¹³ Prior to 2015, gonorrhoea was diagnosed by using culture
19 and chlamydia was diagnosed by nucleic acid amplification test (NAAT) using the BD
20 ProbeTec Strand Displacement Amplification Assay (Becton, Dickinson and Co., Sparks,
21 MD, USA). From March 2015 onwards, testing for both gonorrhoea and chlamydia was
22 performed using the Aptima Combo 2 Transcription-Mediated Amplification Assay (AC2)
23 (Hologic Gen-Probe, San Diego, CA, USA). HIV and syphilis testing methods did not change
24 during the study period.
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47 Before July 2015, screening for urethral gonorrhoea was only performed in MSM with
48 urethral symptoms while screening for urethral chlamydia was performed in all MSM as per
49 the Australian guidelines.¹⁴ However, since July 2015, all MSM were screened for both
50 urethral gonorrhoea and chlamydia regardless of the presence of symptoms as per our clinic
51 policy.¹⁵ Therefore, the positivity for urethral gonorrhoea was calculated as the number of
52 men tested positive divided by the number of men who were tested for urethral chlamydia to
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3 avoid the bias of testing urethral gonorrhoea only among symptomatic MSM until July 2015,
4 and this approach was also used elsewhere.¹⁶ In addition, routine screening for oropharyngeal
5 chlamydia among all MSM at MSHC were introduced in April 2017; before then, only MSM
6 who reported as a contact of infection were tested. Routine screening for HIV, syphilis,
7 oropharyngeal and anorectal gonorrhoea, and anorectal chlamydia were conducted among all
8 MSM and the screening guidelines did not change over the study period at MSHC.
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19 Chi-squared test was used to compare the demographic characteristics and sexual practices
20 between risk groups. We examined the annual trends of sexual practices and HIV/STI
21 positivity for MSMO and MSMW using chi-squared trend test. Annual trends for condomless
22 IAS and RAS with casual male partners were examined separately. We reported any
23 condomless sex (i.e. IAS and/or RAS) with regular male partners for the trend analysis due to
24 the small number of participants who reported having regular male partners. For chlamydia
25 and gonorrhoea positivity, we calculated the annual trends for 2011-2014 and 2015-2018
26 separately due to the change of the diagnostic assays. Univariable and multivariable logistic
27 regression was used to examine the association between sexual practice (MSMW or MSMO)
28 and HIV/STI positivity. We assessed HIV and each STI separately, and this included (1)
29 gonorrhoea at any anatomical site, (2) chlamydia at any anatomical site, (3) syphilis, (4) new
30 HIV diagnosis on the day of the first visit and (5) previous HIV diagnosis as the dependent
31 variables. Therefore, five different logistic regression models were conducted, and the
32 independent variables included sexual practice (being MSMW or MSMO and using MSMW
33 as reference), the year of the visit and all potential confounding factors (i.e., variables with
34 $P < 0.20$ in the univariable analyses) in the multivariable analysis. Missing data were presented
35 as 'no information'. We repeated the same procedure using sexual practice categorised in
36 MSMO, MSMW-M and MSMW-W as the independent variable with MSMW-W as the
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3 reference group. We reported the crude odds ratio (OR) and adjusted odds ratio (aOR), and
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5 their respective 95% confidence intervals (CI). The 0.05 level was used for statistical
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7 significance in all the analysis. All statistical analyses were conducted using SPSS V.25. This
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9 study was approved by the Alfred Hospital Ethics Committee, Melbourne, Australia (project
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11 number 83/18).
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17 ***Patient and Public Involvement***

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19 Patients were not directly involved in this study; only data gathered retrospectively and
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21 coming from electronic health records was used.
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26 **RESULTS**

27 ***Demographic characteristics***

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29 There were 18,851 MSM attending MSHC for the first time between 2011 and 2018. We
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31 excluded 1,909 MSM (10.1%) who had had sexual contact with another man but declined to
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33 report the number of male sexual partners, 1,630 MSM (8.6%) who reported no male sexual
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35 partner in the past 12 months at the current visit but had reported male partners at subsequent
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37 visit at the clinic, and 538 (2.9%) duplicate records from the same individual on the same
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39 day. The remaining 14,774 men were included in this data analysis, and the number of men
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41 increased from 1,215 in 2011 to 2,468 in 2018 but the proportion of MSMW remained stable
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43 over the period (Table 1). Overall, there were 12,795 MSMO (86.6%) and 1,979 MSMW
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45 (13.4%). Among 1,979 MSMW, 804 (40.6%) were MSMW-W, 839 (42.4%) MSMW-M and
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47 336 (17.0%) had an equal number of male and female partners in the past 12 months.
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56 Among the 14,774 MSM, the median age was 27 years (interquartile range, IQR: 23-33) and
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58 MSMW were slightly older than MSMO (median age: 29 *versus* 27; $P < 0.001$) (Table 2). The
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3 proportion of men born in Australia was higher in MSMW than in MSMO (55.3% *versus*
4 48.5%, $P < 0.001$). The proportion of injecting drug use in the past 12 months was higher in
5 MSMW than MSMO (2.0% *versus* 1.6%, $P = 0.032$; Table 2); and it was similar between
6 MSMW-W and MSMW-M (2.5% *versus* 2.1%, $P = 0.777$; Table S1).
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14 ***Sexual practices***

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17 The proportion of men who reported sex overseas in the past 12 months was comparable
18 between MSMW and MSMO (37.1% *versus* 34.5%; $P = 0.060$); and more MSMW-W (43.0%)
19 reported sex overseas than MSMW-M (34.6%; $P = 0.002$) (Table S1). Less than half (40.1%)
20 of MSMO had a male regular partner. Among MSMW, 8.5% had a regular male partner,
21 33.5% a regular female partner, and 4.6% had regular male and female partners (Table 2).
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31 The median number sexual partners (regardless gender of the partners) in the past 12 months,
32 was higher among MSMW (7, interquartile range [IQR]: 5-12 in MSMW-M; and 6, IQR: 4-
33 11 in MSMW-W) than MSMO (5, IQR: 3-10; $P < 0.001$) (Table S1). The proportion of men
34 with ≥ 5 sexual partners increased significantly in MSMW (from 63.1% in 2011 to 70.2% in
35 2018, $P_{\text{trend}} = 0.014$), as well as in MSMO (from 50.8% to 56.4%; $P_{\text{trend}} = 0.002$) (Table S2-
36 S3). In addition, the proportion of MSMW with ≥ 5 female sexual partners increased
37 significantly from 23.2% in 2011 to 29.5% in 2018 ($P_{\text{trend}} = 0.039$) (Table S3).
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49 Anal sex practices with casual male partners varied between MSMO and MSMW. The
50 proportion of MSMO having RAS only with casual male partners was higher (9.9%) than in
51 MSMW (6.6%); however, the proportion of MSMO having IAS only with casual male
52 partners was lower (10.5%) than in MSMW (14.2%; $P < 0.001$). Condomless anal sex with
53 casual male partners in the past 12 months was more common in MSMO than in MSMW for
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3 RAS (53.8% *versus* 49.9%; $P=0.012$) but there was no significant difference in IAS. Two-
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5 thirds (67.5%) of MSMW had condomless vaginal and/or anal sex with female casual
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7 partners in the past 12 months (Table 2). Among MSMO, condomless RAS with casual male
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9 partners in the past 12 months increased from 46.2% to 63.3% ($P_{\text{trend}} < 0.001$) and IAS from
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11 45.8% to 64.2% ($P_{\text{trend}} < 0.001$) from 2011 to 2018 (Figure 1, Table S2). Similarly, among
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13 MSMW, there was an increase from 41.3% to 57.9% in condomless RAS ($P_{\text{trend}} = 0.011$), the
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15 proportion of condomless IAS with casual male partners did not change during the study
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17 period ($P_{\text{trend}} = 0.354$), and the proportion of condomless sex with casual female partners
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19 remained high and only increased marginally from 65.4% to 71.0% ($P_{\text{trend}} = 0.056$) (Figure 1,
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21 Table S3). MSMW-M compared to MSMW-W showed higher condomless sex with casual
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23 male partners (55.0% *versus* 46.1% for RAS; $P=0.004$ and 57.0% *versus* 47.1% for IAS;
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25 $P=0.001$) and lower condomless sex with casual female partners (60.9% *versus* 75.6%;
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27 $P < 0.001$) (Table S1).

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35 Regarding regular male partners, both condomless RAS and condomless IAS were more
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37 commonly reported in MSMO (RAS: 71.5%; IAS: 71.4%) than in MSMW (RAS 62.9%;
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39 IAS: 63.5%; $P=0.005$; $P=0.010$) (Table 1) and condomless anal sex regardless of IAS or
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41 RAS, increased from 69.2% to 78.4% in MSMO ($P_{\text{trend}} < 0.001$) but not in MSMW (P_{trend}
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43 $= 0.435$) (Figure 1, Tables S2-S3).

44 45 46 47 48 49 ***HIV/STI positivity***

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51 Overall, MSMO had a higher HIV, syphilis, gonorrhoea and chlamydia positivity than
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53 MSMW. MSMO had higher extra-genital gonorrhoea and chlamydia positivity than MSMW;
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55 however, the positivity for urethral gonorrhoea and urethral chlamydia did not differ between
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57 the two groups (Table 3). In the period 2011-2014, there was an increase in oropharyngeal
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3 and anorectal and oropharyngeal gonorrhoea among MSMO, while chlamydia remained
4 stable. There was no increase in gonorrhoea and chlamydia positivity in the period 2015-2018
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6 in either group (Tables S4-S5). Among MSMW, MSMW-M had higher extra-genital
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8 gonorrhoea and chlamydia positivity but similar urethral gonorrhoea and chlamydia, HIV and
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10 syphilis compared to MSMW-W (Table S6).
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17 There was a 41.8% increase in syphilis positivity from 5.5% (43/778) in 2011 to 7.8%
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19 (152/1917) in 2018 ($P_{\text{trend}}=0.012$) in MSMO (Table S4) and more than a six-fold increase in
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21 syphilis positivity from 0.9% (1/112) in 2011 to 6.4% (19/299) in 2018 ($P_{\text{trend}}=0.004$) in
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23 MSMW, although the number of infections remained low in this group (Figure 2, Table S5).
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25 HIV positivity did not change in either group between 2011 and 2018 (Figure 2, Table S4-
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27 S5).
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33 After adjusting for other potential confounding factors, MSMO had higher odds of testing
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35 positive for gonorrhoea at any anatomical site (aOR 1.36, 95% CI 1.13 to 1.64), chlamydia at
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37 any anatomical site (aOR 1.39; 95% CI 1.16 to 1.67), syphilis (aOR 1.74, 95% CI 1.37 to
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39 2.22) and HIV (aOR 4.60, 95% CI 2.43 to 8.70) compared to MSMW (Table 4).
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42 Additionally, MSMO had higher odds of testing positive for gonorrhoea at any anatomical
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44 site (aOR 1.58; 95% CI 1.15 to 2.18), chlamydia at any anatomical site (aOR 1.47; 95% CI
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46 1.09 to 1.99), syphilis (aOR 2.11, 95% CI 1.36 to 3.27), and HIV (aOR 5.49, 95% CI 1.74 to
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48 17.30) compared with MSMW-W in the adjusted analysis; however, there was no significant
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50 difference in HIV/STI positivity between MSMW-M and MSMW-W nor MSMW-M and
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52 MSMO (Table 5).
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58 DISCUSSION

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3 In this study of 12,795 men who have sex with men only (MSMO) and 1,979 men who have
4 sex with men and women (MSMW) in Melbourne, Australia, we found significant changes in
5 sexual practices among MSMW between 2011 and 2018, a period in which rates of STIs had
6 been increasing in both MSM and the heterosexual population. Specifically, we found that
7 condom use with casual female partners remained low during the study period and that
8 condomless anal sex with casual male partners had increased in MSMW, and these results
9 echo the rise in syphilis positivity over the same period. While some sexual risk practices and
10 STI positivity were generally lower in MSMW than in MSMO, their rising rates could
11 indicate more transmission from MSMW to their female partners than had occurred
12 previously. Clarifying this issue and what factors are causing the rising rates of STIs is likely
13 to contribute significantly to the design of STI control programs.
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31 Several studies have assessed HIV and sexual practices in MSMW, but their results are
32 conflicting. A meta-analysis published in 2014 concluded that MSMW had a lower HIV
33 prevalence (16.9%) compared to MSMO (33.3%) but the prevalence is higher than men who
34 have sex with women only (MSWO) (3.5%), and this is consistent with our findings.¹⁷ The
35 authors also found that MSMW (15.9%) were less likely to engage in condomless receptive
36 anal sex compared to MSMO (35.0%).¹⁷ Other factors such as drug and alcohol use, other
37 risky practices (e.g. group sex, paying for sex), frequent HIV testing and the use of
38 biomedical interventions (e.g. PrEP and PEP) are also associated with HIV acquisition,¹⁸⁻²⁰
39 and very limited studies examining these factors between MSMO and MSMW. However,
40 some other studies conducted in different settings, such as China, India and the US, have
41 shown the risk of HIV among MSMW is similar or even at a higher risk compared to
42 MSMO.^{10,21-23}
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3 Our data suggest that MSMO have a higher positivity for syphilis, chlamydia and gonorrhoea
4 than MSMW; however, the comparison of STI positivity between MSMO and MSMW varies
5 across published studies. For example, Davis and colleagues (2016) conducted a study among
6 Chinese MSM showing no differences between MSMW and MSMO in the lifetime
7 prevalence of syphilis, gonorrhoea, chlamydia and genital warts but a higher prevalence of
8 genital herpes in MSMW (6.6%) compared to MSMO (0.4%).²³ In the US, MSMW had a
9 57% increased odds of having an STI compared to heterosexuals, but no differences were
10 found between MSMO and heterosexuals or MSMO and MSMW.²² Similarly, an Indian
11 study has shown that there were no differences in any STI positivity (i.e. either syphilis,
12 gonorrhoea or chlamydia) between MSMO and MSMW.²¹ Furthermore, MSMW are also
13 less likely to ever have an HIV/STI test compared to MSMO,^{21,24,25} which is consistent with
14 an Australian qualitative study suggesting MSMW have a poor sexual health knowledge
15 compared to MSMO.²⁶ Furthermore, the rise in antimicrobial resistance in STI,²⁷ particularly
16 gonorrhoea, is of particular concern. Transmission of antimicrobial resistance across risk
17 populations (e.g. between MSMW and female) may have occurred.^{12,28}

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40 Our data also show that MSMW are less likely to have RAS with male partners and less
41 likely to have condomless RAS. These findings may explain the reasons why MSMW have a
42 lower positivity for anorectal gonorrhoea and chlamydia than MSMO in our study.

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47 Importantly, we did not find any significant differences in urethral gonorrhoea and chlamydia
48 between MSMO and MSMW despite differences in anal sex and condom use. This may be
49 because some urethral chlamydial infections in MSMW are acquired from women and
50 urethral gonorrhoea is commonly acquired from no anal sexual activity such as oral sex.^{29,30}

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56 The disparities of HIV and syphilis positivity between MSMO and MSMW were more
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3 pronounced compared to gonorrhoea and chlamydia, and there was a striking increase in
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5 syphilis positivity in both groups.
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10 The differential sexual practices and HIV/STI positivity among MSMW^{31,32} may also be due
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12 to other health issues such as mental health and substance use, that also place them as an
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14 especially vulnerable population.^{33,34} Bisexual men may face unique stressors, such as
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16 specific prejudices against them, pressures or negative attitudes from both heterosexual and
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18 LGBT individuals, which can have a negative impact on their health.^{34,35} This factors may
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20 also render bisexual men less likely to discuss their sexual health and disclose their sexual
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22 orientation with their GPs¹¹ and, hence not receive the appropriate sexual health care and
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24 management. An LGBT-friendly and non-judgemental approach is essential to build up the
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26 trust between clinicians and patients. Furthermore, the current health promotion and
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28 prevention programmes mainly targeting the MSM population as a whole. It is possible that
29
30 some MSMW may not be engaged in the LGBT community and hence they may not targeted
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32 with the current programmes. Future public health campaigns and prevention programmes
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34 should also tailor for MSMW via different channels.
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42 Our study, including a high number of MSM over an 8-year period, provides relevant and
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44 updated information to understand changes in sexual practices and STI epidemiology
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46 occurring in Australia and across the world. We also provide detailed information regarding
47
48 condom use, differencing between both casual or regular partners, and receptive or insertive
49
50 anal sex. Nevertheless, there are several limitations in the study that must be considered.
51
52 First, data were self-reported by MSHC clients which may influence the results regarding
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54 sexual practices, including the number and gender of the sexual partners due to social
55
56 desirability or recall bias. However, the use of a computer-assisted self-interview to collect
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3 sexual history at the clinic has shown to improve the accuracy and reduce biased information.
4
5 Besides that, data on sexual orientation was not collected and the categorisation of MSMO
6
7 and MSMW was based on self-reported sexual practice rather than sexual identity. This
8
9 means that MSMW in this study might not define themselves as bisexual men. Second, this
10
11 study was conducted in one urban major sexual health clinic. It is possible that MSM
12
13 attending a sexual health clinic are more likely to be at increased sexual risk and hence our
14
15 findings may not be generalizable to the whole MSM population in Australia or in other
16
17 settings. Third, other sexual practices that may increase the risk of HIV/STI (e.g., chemsex,
18
19 group sex, rimming or saliva use as a lubricant)³⁶⁻³⁸ were not routinely collected in the clinic
20
21 and hence not included in the study. Fourth, we only included individuals who attended the
22
23 clinic for the first time. Sexual practices might change with age and further longitudinal
24
25 cohort studies examining the changes in sexual practices among individuals would be
26
27 required. Lastly, we were unable to examine the temporal trends for gonorrhoea and
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29 chlamydia over the 8-year period because we changed the diagnostic test for gonorrhoea and
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31 chlamydia at our clinic in 2015.
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40 CONCLUSION

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42 In our study population, MSMW were a heterogeneous group in which sexual practices and
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44 STI positivity varied between MSMW with mainly female partners and MSMW with mainly
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46 male partners. Compared to MSMO, MSMW were less likely to engage in condomless sex
47
48 and had a lower HIV/STI positivity. From 2011 to 2018, changes in the sexual practices in
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50 MSM have affected both MSMW and MSMO leading to an increased risk of STI in both
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52 subgroups. Further studies also including heterosexual men and women are needed to better
53
54 understand the recent changes in the STI epidemiology.
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11 EPFC and CKF planned, conceived and designed the study. RC conducted some preliminary
12
13 analyses. MMS performed the literature review, conducted the statistical analysis and wrote
14
15 the first draft of the manuscript. EPFC provided statistical advice and oversaw the study. RC,
16
17 CKF, JSH, CSB, JJO, MYC and EPFC assisted with data interpretation. MMS, RC, CKF,
18
19 JSH, CSB, JJO, MYC and EPFC critically revised it for important intellectual content and
20
21 approved the final version of the manuscript.
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23
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27
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41 **DATA SHARING STATEMENT**

42
43 All data relevant to the study are included in the article or uploaded as supplementary
44
45 information.
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FIGURES

Figure 1 Proportion of condomless anal and/or vaginal sex in the past 12 months with casual partners between 2011 and 2018, stratified by men who have sex with men only (MSMO) and men who have sex with men and women (MSMW).

Note. MSM reporting condomless anal and/or vaginal sex includes MSM who sometimes, usually or never used a condom with their sexual partners in the past 12 months. MSMO: men who have sex with men only; MSMW: men who have sex with men and women.

Figure 2 Positivity for syphilis and HIV between 2011 and 2018, stratified by men who have sex with men only (MSMO) and men who have sex with men and women (MSMW).

Note. MSMO: men who have sex with men only; MSMW: men who have sex with men and women.

TABLES

For peer review only

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Table 1 Number of men who have sex with men attending the Melbourne Sexual Health Centre between 2011 and 2018, stratified by men who have sex with men only (MSMO) and men who have sex with men and women (MSMW).

	2011	2012	2013	2014	2015	2016	2017	2018	Total
MSMO	1047 (86.2)	1282 (87.7)	1422 (85.5)	1433 (85.9)	1658 (86.5)	1872 (86.7)	1938 (87.1)	2143 (86.8)	12795 (86.6)
MSMW	168 (13.8)	180 (12.3)	241 (14.5)	235 (14.1)	258 (13.5)	286 (13.3)	286 (12.9)	325 (13.2)	1979 (13.4)
<i>MSMW-W</i>	70 (41.7)	70 (38.9)	98 (40.7)	108 (46.0)	91 (35.3)	114 (39.9)	116 (40.6)	137 (42.2)	804 (40.6)
<i>MSMW-M</i>	64 (38.1)	78 (43.3)	96 (39.8)	90 (38.3)	127 (49.2)	117 (40.9)	124 (43.4)	143 (44.0)	839 (42.4)
<i>MSMW(=)</i>	34 (20.2)	32 (17.8)	47 (19.5)	37 (15.7)	40 (15.5)	55 (19.2)	46 (16.1)	45 (13.8)	336 (17.0)
Total	1215	1462	1663	1668	1916	2158	2224	2468	14774

Note. MSMO: men who have sex with men only; MSMW: men who have sex with men and women; MSMW-M: men who have sex with men and women and had more male than female sexual partners in the past 12 months; MSMW-W: men who have sex with men and women and had more female than male sexual partners in the past 12 month; MSMW(=): men who have sex with men and women but reported an equal number of male and female partners in the past 12 months. Data are presented as n (%) where n is the number of men in each category. The proportion of MSMO and MSMW was calculated using the total number of men each year as the denominator. The proportion of MSMW-W, MSMW-M and MSMW(=) was calculated using the total number of MSMW each year as the denominator.

Table 2 Demographic characteristics and sexual practices among men who have sex with men attending a sexual health centre in Melbourne, 2011-2018, stratified by men who have sex with men only (MSMO) and men who have sex with men and women (MSMW).

	Men who have sex with men only (N=12,795)	Men who have sex with men and women (N=1,979)	P value
	n (%)	n (%)	
Age (years), median (IQR)	27 (23-33)	29 (24-38)	<0.001
Country of birth			<0.001
<i>Australia</i>	6,208 (48.5)	1,094 (55.3)	
<i>Overseas</i>	6,110 (47.8)	790 (39.9)	
<i>No information</i>	477 (3.7)	95 (4.8)	
Aboriginal and Torres Strait Islander Status			0.224
<i>Indigenous origin</i>	150 (1.2)	17 (0.9)	
<i>Non-Indigenous origin</i>	11,595 (90.6)	1,783 (90.1)	
<i>No information</i>	1,050 (8.2)	179 (9.0)	
Sex overseas in the past 12 months			0.060
<i>Yes</i>	4,415 (34.5)	735 (37.1)	
<i>No</i>	7,571 (59.2)	1131 (57.2)	
<i>No information</i>	809 (6.3)	113 (5.7)	
Sex work during lifetime			0.574
<i>Yes</i>	71 (0.6)	13 (0.7)	
<i>No</i>	12,724 (99.4)	1,966 (99.3)	
Injected drug use in the past 12 months			0.032
<i>Yes</i>	211 (1.6)	40 (2.0)	
<i>No</i>	12,363 (96.6)	1,890 (95.5)	
<i>No information</i>	221 (1.7)	49 (2.5)	
Number of female and male sexual partners in the past 12 months, median (IQR)	5 (3-10)	6 (4-11)	<0.001
Number of male sexual partners in the past 12 months, median (IQR)	5 (3-10)	2 (1-5)	<0.001
Number of female sexual partners in the past 12 months, median (IQR)	NA	2 (1-5)	-
Regular sexual partner			-
<i>No regular partner</i>	7,513 (58.7)	1,053 (53.2)	
<i>Regular male partner</i>	5,132 (40.1)	169 (8.5)	
<i>Regular female partner</i>	NA	663 (33.5)	
<i>Regular female and male partner</i>	NA	91 (4.6)	
<i>No information</i>	150 (1.2)	3 (0.2)	

Anal sexual practice with regular male partners ^a			0.118
<i>Receptive only</i>	435 (8.5)	15 (5.8)	
<i>Insertive only</i>	465 (9.1)	16 (6.2)	
<i>Receptive and insertive</i>	3,921 (76.4)	214 (82.3)	
<i>No anal sex</i>	234 (4.6)	9 (3.5)	
<i>No information</i>	77 (1.5)	6 (2.3)	
Condom use with regular male partners in the past 12 months for receptive anal sex ^{b*}			0.005
<i>Always</i>	1,241 (28.5)	85 (37.1)	
<i>Not always</i>	3,115 (71.5)	144 (62.9)	
Condom use with regular male partners in the past 12 months for insertive anal sex ^{c*}			0.010
<i>Always</i>	1,254 (28.6)	84 (36.5)	
<i>Not always</i>	3,132 (71.4)	146 (63.5)	
Vaginal or anal sex with regular female partner ^d			-
<i>Yes</i>	NA	729 (96.7)	
<i>No</i>	NA	10 (1.3)	
<i>No information</i>	NA	15 (2.0)	
Condom use with regular female partners in the past 12 months ^{e*}			-
<i>Always</i>	NA	132 (18.1)	
<i>Not always</i>	NA	597 (81.9)	
Casual sexual partner			-
<i>No casual partner</i>	806 (6.3)	11 (0.6)	
<i>Casual male partner(s)</i>	11,969 (93.5)	194 (9.8)	
<i>Casual female partner(s)</i>	NA	30 (1.5)	
<i>Casual female and male partner(s)</i>	NA	1,744 (88.1)	
<i>No information</i>	20 (0.2)	0 (0)	
Anal sexual practice with casual male partners			<0.001
<i>Receptive only</i>	1,262 (9.9)	131 (6.6)	
<i>Insertive only</i>	1,344 (10.5)	282 (14.2)	
<i>Receptive and insertive</i>	7,835 (61.2)	1,060 (53.6)	
<i>No anal sex</i>	1,692 (13.2)	422 (21.3)	
<i>No information</i>	662 (5.2)	84 (4.2)	
Condom use with casual male partners in the past 12 months for receptive anal sex ^{f*}			
<i>Always</i>	4,207 (46.2)	597 (50.1)	0.012
<i>Not always</i>	4,890 (53.8)	594 (49.9)	
Condom use with casual male partners in the past 12 months for insertive anal sex ^{g*}			
<i>Always</i>	4,276 (46.6)	649 (48.4)	0.223

<i>Not always</i>	4,903 (53.4)	693 (51.6)	
Vaginal or anal sex with casual female partner			-
<i>Yes</i>	NA	1,686 (85.2)	
<i>No</i>	NA	56 (2.8)	
<i>No information</i>	NA	237 (12.0)	
Condom use with casual female partners in the past 12 months ^{h*}			-
<i>Always</i>	NA	548 (32.5)	
<i>Not always</i>	NA	1,138 (67.5)	

Note. NA: Not applicable; IQR: Interquartile range; MSM: men who have sex with men.

^aOnly including MSM with regular male partners or regular male and female partners, ^bOnly including MSM that referred receptive only or receptive and insertive anal sex with regular male partners, ^cOnly including MSM that referred insertive only or receptive and insertive anal sex with regular male partners, ^dOnly including MSM with regular female partners or regular male and female partners ^eOnly including MSM that referred vaginal and/or anal sex with regular female partner, ^fOnly including MSM that referred receptive only or receptive and insertive anal sex with casual male partners, ^gOnly including MSM that referred insertive only or receptive and insertive anal sex with casual male partners, ^hOnly including MSM that referred vaginal or anal sex with casual female partners. *'Not always' was defined as men who sometimes, usually or never used a condom with their sexual partners in the past 12 months (with female partners for vaginal and/or anal sex, with male partners for anal sex).

Table 3 Positivity for gonorrhoea, chlamydia, syphilis and HIV among men who have sex with men attending a sexual health centre in Melbourne, 2011-2018, stratified by men who have sex with men only (MSMO) and men who have sex with men and women (MSMW).

HIV/STI	Men who have sex with men only (N=12,795)			Men who have sex with men and women (N=1,979)			P value
	No. of men tested, <i>N</i>	No. of positive, <i>n</i>	Positivity, % (95% CI)	No. of men tested, <i>N</i>	No. of positive, <i>n</i>	Positivity, % (95% CI)	
Gonorrhoea							
<i>Oropharyngeal</i>	11,810	682	5.8 (5.4 to 6.2)	1,711	68	4.0 (3.1 to 5.0)	0.002
<i>Urethral*</i>	11,699	390	3.3 (3.0 to 3.7)	1,885	52	2.8 (2.1 to 3.6)	0.192
<i>Anorectal</i>	11,080	745	6.7 (6.3 to 7.2)	1,404	58	4.1 (3.2 to 5.3)	<0.001
<i>Any anatomical site</i> [†]	11,951	1,321	11.1 (10.5 to 11.6)	1,829	140	7.7 (6.5 to 9.0)	<0.001
Chlamydia							
<i>Urethral</i>	11,699	410	3.5 (3.2 to 3.9)	1,885	73	3.9 (3.0 to 4.8)	0.423
<i>Anorectal</i>	11,043	989	9.0 (8.4 to 9.5)	1,404	83	5.9 (4.7 to 7.3)	<0.001
<i>Any anatomical site</i> [†]	11,891	1,272	10.7 (10.1 to 11.3)	1,907	141	7.4 (6.3 to 8.7)	<0.001
Syphilis	11,317	797	7.0 (6.6 to 7.5)	1,773	81	4.6 (3.6 to 5.6)	<0.001
HIV							
<i>New diagnosis</i> [‡]	11,102	262	2.4 (2.1 to 2.7)	1,774	10	0.6 (0.3 to 1.0)	<0.001
<i>Previous diagnosis</i>	12,795	316	2.5 (2.2 to 2.8)	1,979	7	0.4 (0.1 to 0.7)	<0.001

Note.*Before 2015, urethral gonorrhoea testing was only performed among symptomatic MSM with urethral symptoms or self-reported as contact of infection. The number of people tested corresponds to the number of people tested for urethral chlamydia; † Any anatomical site for gonorrhoea includes urethral, anorectal and oropharyngeal; while any site for chlamydia includes urethral and anorectal; ‡ Only including HIV cases diagnosed on the day of the first visit.

Table 4 Association between sexual practice and gonorrhoea, chlamydia, syphilis and HIV positivity among men who have sex with men only (MSMO) and men who have sex with men and women (MSMW) attending a sexual health centre in Melbourne, 2011-2018.

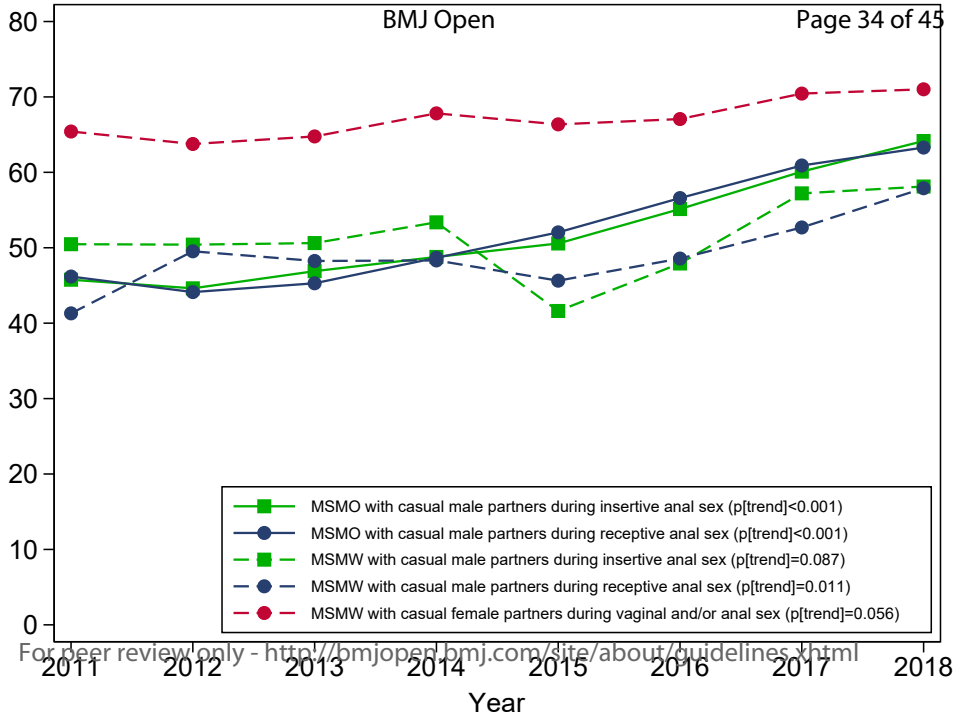
HIV/STI	OR (95% CI)	P value	aOR (95% CI)*	P value
Gonorrhoea (any anatomical site) [†]				
<i>MSMO</i>	1.50 (1.25 to 1.80)	<0.001	1.36 (1.13 to 1.64)	0.001
<i>MSMW</i>	1		1	ref
Chlamydia (any anatomical site) [†]				
<i>MSMO</i>	1.50 (1.25 to 1.80)	<0.001	1.39 (1.16 to 1.67)	<0.001
<i>MSMW</i>	1		1	ref
Syphilis				
<i>MSMO</i>	1.58 (1.25 to 2.00)	<0.001	1.74 (1.37 to 2.22)	<0.001
<i>MSMW</i>	1		1	ref
HIV (new diagnosis) [‡]				
<i>MSMO</i>	4.26 (2.26 to 8.03)	<0.001	4.60 (2.43 to 8.70)	<0.001
<i>MSMW</i>	1		1	ref
HIV (previous diagnosis)				
<i>MSMO</i>	7.13 (3.37 to 15.11)	<0.001	9.08 (4.26 to 19.37)	<0.001
<i>MSMW</i>	1	ref	1	ref

Note. OR: crude odds ratio; aOR: adjusted odds ratio; CI: confidence intervals; MSMO: men who have sex with men only; MSMW: men who have sex with men and women. *Adjusted by age, country of birth, sex overseas, injected drug use in the past 12 months, regular partner, number of male sexual partners in the past 12 months, condom use with casual male partners in the past 12 months and year of visit; [†]Any anatomical site for gonorrhoea includes urethral, anorectal and oropharyngeal; while any site for chlamydia includes urethral and anorectal; [‡]Only including HIV cases diagnosed on the day of the first visit.

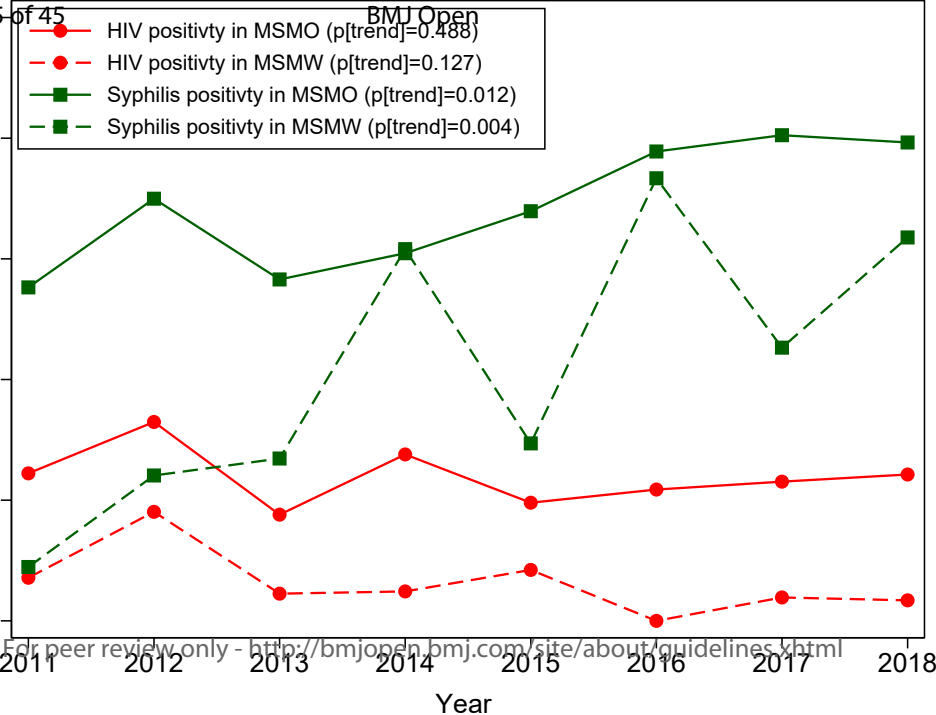
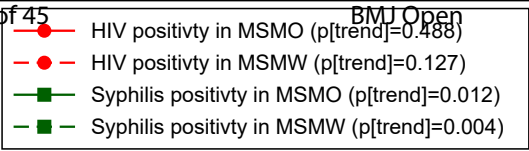
Table 5 Association between sexual practice and gonorrhoea, chlamydia, syphilis and HIV positivity among men who have sex with men only (MSMO) and men who have sex with men and women (MSMW) attending a sexual health centre in Melbourne , 2011-2018.

HIV/STI	OR (95% CI)	P value	aOR (95% CI)*	P value
Gonorrhoea (any anatomical site) [†]				
<i>MSMO</i>	1.96 (1.45 to 2.67)	<0.001	1.58 (1.15 to 2.18)	0.005
<i>MSMW-M</i>	1.91 (1.31 to 2.78)	0.001	1.41 (0.94 to 2.12)	0.093
<i>MSMW-W</i>	1	ref	1	ref
Chlamydia (any anatomical site) [†]				
<i>MSMO</i>	1.87 (1.39 to 2.50)	<0.001	1.47 (1.09 to 1.99)	0.013
<i>MSMW-M</i>	1.63 (1.12 to 2.38)	0.010	1.19 (0.80 to 1.77)	0.394
<i>MSMW-W</i>	1	ref	1	ref
Syphilis				
<i>MSMO</i>	2.18 (1.45 to 3.27)	<0.001	2.11 (1.36 to 3.27)	0.001
<i>MSMW-M</i>	1.48 (0.88 to 2.49)	0.142	1.08 (0.61 to 1.93)	0.791
<i>MSMW-W</i>	1	ref	1	ref
HIV (new diagnosis) [‡]				
<i>MSMO</i>	6.01 (1.92 to 18.80)	0.002	5.49 (1.74 to 17.30)	0.004
<i>MSMW-M</i>	2.38 (0.61 to 9.24)	0.210	1.81 (0.43 to 7.63)	0.422
<i>MSMW-W</i>	1	ref	1	ref
HIV (previous diagnosis)				
<i>MSMO</i>	21.22 (2.98 to 151.30)	0.002	17.91 (2.50 to 128.43)	0.004
<i>MSMW-M</i>	6.30 (0.76 to 52.45)	0.089	4.10 (0.47 to 35.42)	0.200
<i>MSMW-W</i>	1	ref	1	ref

Note. OR: crude odds ratio; aOR: adjusted odds ratio; CI: confidence intervals; MSMO: men who have sex with men only; MSMW-M: men who have sex with men and women and had more male than female sexual partner in the past 12 months; MSMW-W: men who have sex with men and women and had more female than male sexual partner in the past 12 months; MSMW-M: men who have sex with men and women and had more male than female sexual partner in the past 12 months. *Adjusted by age, country of birth, sex overseas, injected drug use in the past 12 months, regular partner, number of male sexual partners in the past 12 months, condom use with casual male partners in the past 12 months and year of visit; †Any anatomical site for gonorrhoea includes urethral, anorectal and oropharyngeal, while any site for chlamydia includes urethral and anorectal; ‡Only including HIV cases diagnosed on the day of the first visit.

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20Proportion of men reported
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SUPPLEMENTARY MATERIAL

Trends and differences in sexual practices and sexually transmitted infections in men who have sex with men only (MSMO) and men who have sex with men and women (MSMW): a repeated cross-sectional study in Melbourne, Australia.

Mario Martín-Sánchez, Richard Case, Christopher K. Fairley, Jane S. Hocking, Catriona S. Bradshaw, Jason J. Ong, Marcus Y. Chen, Eric P.F. Chow

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Table S1 Demographic characteristics and sexual practices among men who have sex with men only and men who have sex with men and women attending a sexual health centre in Melbourne, 2011-2018.

	MSMO (N=12,795)	MSMW- M (N=804)	MSMW- W (N=839)	Comparison across three groups	Comparison between MSMW-M and MSM-W
	n (%)	n (%)	n (%)	P value	P value
Age (years), median(IQR)	27 (23-33)	29 (24-39)	28 (24-36)	<0.001	0.845
Country of birth				<0.001	0.167
<i>Australia</i>	6,208 (48.5)	465 (57.8)	452 (53.9)		
<i>Overseas</i>	6,110 (47.8)	297 (36.9)	348 (41.5)		
<i>No information</i>	477 (3.7)	42 (5.2)	39 (4.5)		
Aboriginal and Torres Strait Islander Status				0.280	0.254
<i>Indigenous origin</i>	150 (1.2)	10 (1.2)	5 (0.6)		
<i>Non-Indigenous origin</i>	11,595 (90.6)	715 (88.9)	762 (90.8)		
<i>No information</i>	1,050 (8.2)	79 (9.8)	72 (8.6)		
Sex overseas in the past 12 months				<0.001	0.002
<i>Yes</i>	4,415 (34.5)	278 (34.6)	361 (43.0)		
<i>No</i>	7,571 (59.2)	470 (58.5)	433 (51.6)		
<i>No information</i>	809 (6.3)	56 (7.0)	45 (5.4)		
Sex work during lifetime				0.454	0.722
<i>Yes</i>	71 (0.6)	7 (0.9)	6 (0.7)		
<i>No</i>	12,724 (99.4)	797 (99.1)	833 (99.3)		
Injected drug use in past 12 months				<0.001	0.777
<i>Yes</i>	211 (1.6)	17 (2.1)	21 (2.5)		
<i>No</i>	12,363 (96.6)	763 (95.7)	797 (97.5)		
<i>No information</i>	221 (1.7)	17 (2.1)	21 (2.5)		
Number of male and female sexual partners in the past 12 months, median (IQR)	5 (3-10)	7 (5-12)	6 (4-11)	<0.001	<0.001
Number of male sexual partners in the past 12 months, median (IQR)	5 (3-10)	5 (3-10)	1 (1-2)	<0.001	<0.001
Number of female sexual partners in the past 12 months, median (IQR)	NA	1 (1-2)	5 (3-8)	NA	<0.001
Regular sexual partner				NA	<0.001
<i>No regular partner</i>	7,513 (58.7)	433 (53.9)	453 (54.1)		
<i>Regular male partner</i>	5,132 (40.1)	138 (17.2)	11 (1.3)		
<i>Regular female partner</i>	NA	195 (24.3)	350 (41.7)		
<i>Regular female and male partner</i>	NA	37 (4.6)	23 (2.7)		
<i>No information</i>	150 (1.2)	1 (0.1)	2 (0.2)		
Anal sexual practice with regular male partners^a				<0.001	0.001
<i>Receptive only</i>	435 (8.5)	10 (5.7)	2 (5.7)		
<i>Insertive only</i>	465 (9.1)	13 (7.4)	0 (0)		
<i>Receptive and insertive</i>	3,921 (76.4)	145 (82.4)	26 (74.3)		
<i>No anal sex</i>	234 (4.6)	6 (3.4)	2 (5.7)		
<i>No information</i>	79 (1.5)	2 (1.1)	5 (14.3)		
Condom use with regular male partners in the past 12 months for receptive anal sex^{b*}				0.150	0.275
<i>Always</i>	1,241 (28.5)	50 (32.3)	12 (42.9)		
<i>Not always</i>	3,115 (71.5)	105 (67.7)	16 (57.1)		
Condom use with regular male partners in the past 12 months for insertive anal sex^{c*}				0.142	0.935
<i>Always</i>	1,254 (28.6)	56 (35.4)	9 (34.6)		
<i>Not always</i>	3,132 (71.4)	102 (64.6)	17 (65.4)		

Vaginal or anal sex with regular female partner^d				NA	0.903
<i>Yes</i>	NA	223 (96.1)	361 (96.8)		
<i>No</i>	NA	4 (1.7)	5 (1.3)		
<i>No information</i>	NA	5 (2.2)	7 (1.9)		
Condom use with regular female partners in the past 12 months^{e*}				NA	0.551
<i>Always</i>	NA	42 (18.8)	61 (16.9)		
<i>Not always</i>	NA	181 (81.2)	300 (83.1)		
Casual sexual partner				NA	<0.001
<i>No casual partner</i>	806 (6.3)	0	0		
<i>Casual male partner(s)</i>	11,969 (93.5)	112 (13.9)	0		
<i>Casual female partner(s)</i>	NA	0	19 (2.3)		
<i>Casual female and male partner(s)</i>	NA	692 (86.1)	820 (97.7)		
<i>No information</i>	20 (0.2)	0	0		
Anal sexual practice with casual male partners				<0.001	<0.001
<i>Receptive only</i>	1,262 (9.9)	45 (5.6)	64 (7.6)		
<i>Insertive only</i>	1,344 (10.5)	116 (14.4)	119 (14.2)		
<i>Receptive and insertive</i>	7,835 (61.2)	524 (65.2)	407 (48.5)		
<i>No anal sex</i>	1,692 (13.2)	108 (13.4)	210 (25.0)		
<i>No information</i>	662 (5.2)	11 (1.4)	39 (4.6)		
Condom use with casual male partners in the past 12 months for receptive anal sex^{f*}				0.004	0.004
<i>Always</i>	4,207 (46.2)	256 (45.0)	254 (53.9)		
<i>Not always</i>	4,890 (53.8)	313 (55.0)	217 (46.1)		
Condom use with casual male partners in the past 12 months for insertive anal sex^{g*}				0.003	0.001
<i>Always</i>	4,276 (46.6)	275 (43.0)	278 (52.9)		
<i>Not always</i>	4,903 (53.4)	365 (57.0)	248 (47.1)		
Vaginal or anal sex with casual female partner				-	<0.001
<i>Yes</i>	NA	658 (81.8)	799 (95.2)		
<i>No</i>	NA	19 (2.4)	24 (2.9)		
<i>No information</i>	NA	127 (15.8)	16 (1.9)		
Condom use with casual female partners in the past 12 months^{h*}				-	<0.001
<i>Always</i>	NA	257 (39.1)	195 (24.4)		
<i>Not always</i>	NA	401 (60.9)	604 (75.6)		

Note. NA: Not applicable; IQR: Interquartile range; MSM: men who have sex with men; MSMO: men who have sex with men only; MSMW-W: men who have sex with men and women and had more female than male sexual partner in the past 12 months; MSMW-M: men who have sex with men and women and had more male than female sexual partner in the past 12 months; ^aOnly including MSM with regular male partners or regular male and female partners; ^bOnly including MSM that referred receptive only or receptive and insertive anal sex with regular male partners; ^cOnly including MSM that referred insertive only or receptive and insertive anal sex with regular male partners; ^dOnly including MSM with regular female partners or regular male and female partners; ^eOnly including MSM that referred vaginal or anal sex with regular female partner; ^f Only including MSM that referred receptive only or receptive and insertive anal sex with casual male partners; ^g Only including MSM that referred insertive only or receptive and insertive anal sex with casual male partners, ^h Only including MSM that referred vaginal or anal sex with casual female partners; *'Not always' was defined as men who sometimes, usually or never used a condom with their sexual partners in the past 12 months (with female partners for vaginal and/or anal sex, with male partners for anal sex).

Table S2 Temporal trend of the sexual practices among men who have sex with men only attending a sexual health centre in Melbourne, 2011-2018.

	2011		2012		2013		2014		2015		2016		2017		2018		2011-18
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	P _{trend}
Number of sexual partners in the past 12 months																	0.002
<5	515	49.2	598	46.6	645	45.4	626	43.7	686	41.4	802	42.8	859	44.3	934	43.6	-
≥5	532	50.8	684	53.4	777	54.6	807	56.3	972	58.6	1070	57.2	1079	55.7	1209	56.4	-
Condom use with regular male partners in the past 12 months*																	<0.001
<i>Always</i>	134	30.8	164	31.2	160	30.0	142	26.3	167	27.6	201	28.5	139	19.4	165	21.6	-
<i>Not always</i>	301	69.2	362	68.8	373	70.0	398	73.7	437	72.4	504	71.5	576	80.6	598	78.4	-
Anal sexual practice with casual male partners																	
<i>Receptive only</i>	74	7.5	109	9.1	109	8.1	140	10.3	151	9.5	196	11.0	218	11.8	265	13.0	<0.001
<i>Insertive only</i>	98	10.0	133	11.0	153	11.4	150	11.1	178	11.3	205	11.5	194	10.5	233	11.4	0.580
<i>Receptive and insertive</i>	634	64.5	750	62.3	847	63.3	877	64.6	1050	66.4	1177	66.2	1207	65.2	1293	63.4	0.396
<i>No anal sex</i>	177	18.0	212	17.6	229	17.1	190	14.0	203	12.8	201	11.3	233	12.6	247	12.1	<0.001
Condom use with casual male partners in the past 12 months for receptive anal sex*																	<0.001
<i>Always</i>	381	53.8	480	55.9	523	54.7	522	51.3	576	48.0	596	43.4	557	39.1	572	36.7	-
<i>Not always</i>	327	46.2	379	44.1	433	45.3	495	48.7	625	52.0	777	56.6	868	60.9	986	63.3	-
Condom use with casual male partners in the past 12 months for insertive anal sex*																	<0.001
<i>Always</i>	397	54.2	489	55.4	531	53.1	526	51.2	607	49.4	620	44.9	559	39.9	547	35.8	-
<i>Not always</i>	335	45.8	394	44.6	469	46.9	501	48.8	621	50.6	762	55.1	842	60.1	979	64.2	-

* 'Not always' was defined as men who sometimes, usually or never used a condom with their sexual partners in the past 12 months (with female partners for vaginal or anal sex, with male partners for anal sex).

Table S3 Temporal trend of the sexual practices among men who have sex with men and women attending a sexual health centre in Melbourne, 2011-2018.

	2011		2012		2013		2014		2015		2016		2017		2018		2011-18
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	P _{trend}
Number of sexual partners past 12 months																	0.014
<5	62	36.9	66	36.7	95	39.4	82	34.9	94	36.4	90	31.5	94	32.9	97	29.8	-
≥5	106	63.1	114	63.3	146	60.6	153	65.1	164	63.6	196	68.5	192	67.1	228	70.2	-
Number of male sexual partners past 12 months																	0.106
<5	122	72.6	129	71.7	172	71.4	167	71.1	195	75.6	205	71.7	202	70.6	212	65.2	-
≥5	46	27.4	51	28.3	69	28.6	68	28.9	63	24.4	81	28.3	84	29.4	113	34.8	-
Number of female sexual partners past 12 months																	0.039
<5	129	76.8	133	73.9	185	76.8	179	76.2	185	71.7	204	71.3	206	72.0	229	70.5	-
≥5	39	23.2	47	26.1	56	23.2	56	23.8	73	28.3	82	28.7	80	28.0	96	29.5	-
Condom use with regular male partners in the past 12 months*																	0.435
<i>Always</i>	11	45.8	5	21.7	13	39.4	13	39.4	9	37.5	9	29.0	10	26.3	14	35.9	-
<i>Not always</i>	13	54.2	18	78.3	20	60.6	20	60.6	15	62.5	22	71.0	28	73.7	25	64.1	-
Anal sexual practice with casual male partners																	
<i>Receptive only</i>	6	3.8	11	6.3	15	6.6	13	5.7	17	7.0	26	9.4	16	5.8	27	8.7	0.068
<i>Insertive only</i>	19	11.9	25	14.4	32	14.1	27	11.8	41	16.8	43	15.5	43	15.6	52	16.8	0.107
<i>Receptive and insertive</i>	86	54.1	96	55.2	128	56.4	136	59.4	132	54.1	149	53.8	151	54.7	182	58.9	0.670
<i>No anal sex</i>	48	30.2	42	24.1	52	22.9	53	23.1	54	22.1	59	21.3	66	23.9	48	15.5	0.003
Condom use with casual male partners in the past 12 months for receptive anal sex*																	0.011
<i>Always</i>	54	58.7	54	50.5	74	51.7	77	51.7	81	54.4	90	51.4	79	47.3	88	42.1	-
<i>Not always</i>	38	41.3	53	49.5	69	48.3	72	48.3	68	45.6	85	48.6	88	52.7	121	57.9	-
Condom use with casual male partners in the past 12 months for insertive anal sex*																	0.087
<i>Always</i>	52	49.5	60	49.6	79	49.4	76	46.6	101	58.4	100	52.1	83	42.8	98	41.9	-
<i>Not always</i>	53	50.5	61	50.4	81	50.6	87	53.4	72	41.6	92	47.9	111	57.2	136	58.1	-
Condom use with regular female partners in the past 12 months*																	0.837
<i>Always</i>	16	22.5	16	22.2	8	10.0	10	13.2	17	18.9	22	18.2	19	18.6	24	20.5	-
<i>Not always</i>	55	77.5	56	77.8	72	90.0	66	86.8	73	81.1	99	81.8	83	81.4	93	79.5	-
Condom use with casual female partners in the past 12 months*																	0.056

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<i>Always</i>	46	34.6	54	36.2	74	35.2	65	32.2	74	33.6	82	32.9	73	29.6	80	29.0	-
<i>Not always</i>	87	65.4	95	63.8	136	64.8	137	67.8	146	66.4	167	67.1	174	70.4	196	71.0	-

* 'Not always' was defined as men who sometimes, usually or never used a condom with their sexual partners in the past 12 months (with female partners for vaginal or anal sex, with male partners for anal sex).

For peer review only

Table S4 Temporal trend of the positivity for sexually transmitted infections and HIV among men who have sex with men only attending a sexual health centre in Melbourne, 2011-2018.

	2011	2012	2013	2014	2015	2016	2017	2018	2011-2014	2015-2018	2011-2018
	n/N (%)	n/N (%)	n/N (%)	n/N (%)	n/N (%)	n/N (%)	n/N (%)	n/N (%)	P _{trend}	P _{trend}	P _{trend}
Gonorrhoea											
<i>Oropharyngeal</i>	18/973 (1.8)	28/1,164 (2.4)	43/1,307 (3.3)	42/1,340 (3.1)	122/1,539 (7.9)	130/1,709 (7.6)	154/1,803 (8.5)	145/1,975 (7.3)	0.037	0.755	NA
<i>Urethral</i> [*]	38/961 (4.0)	36/1,155 (3.1)	47/1,291 (3.6)	40/1,325 (3.0)	56/1,528 (3.7)	55/1,691 (3.3)	63/1,782 (3.5)	55/1,966 (2.8)	0.364	0.215	NA
<i>Anorectal</i>	25/922 (2.7)	42/1,082 (3.9)	70/1,209 (5.8)	71/1,260 (5.6)	128/1,431 (8.9)	115/1,591 (7.2)	132/1,686 (7.8)	162/1,899 (8.5)	0.001	0.954	NA
<i>Any anatomical site</i> [†]	66/986 (6.7)	81/1,178 (6.9)	122/1,324 (9.2)	130/1,349 (9.6)	215/1,552 (13.9)	220/1,738 (12.7)	241/1,826 (13.2)	246/1,998 (12.3)	0.002	0.261	NA
Chlamydia											
<i>Urethral</i>	30/961 (3.1)	43/1,155 (3.7)	48/1,291 (3.7)	38/1,325 (2.9)	68/1,528 (4.5)	64/1,691 (3.8)	51/1,782 (2.9)	68/1,966 (3.5)	0.652	0.067	NA
<i>Anorectal</i>	63/922 (6.8)	80/1,081 (7.4)	108/1,210 (8.9)	97/1,254 (7.7)	126/1,412 (8.9)	164/1,589 (10.3)	162/1,681 (9.6)	189/1,894 (10.0)	0.282	0.489	NA
<i>Any anatomical site</i> [†]	86/989 (8.7)	114/1,178 (9.7)	142/1,325 (10.7)	128/1,348 (9.5)	178/1,542 (11.5)	199/1,721 (11.6)	196/1,806 (10.9)	229/1,982 (11.6)	0.436	0.869	NA
Syphilis	43/778 (5.5)	79/1,129 (7.0)	73/1,290 (5.7)	80/1,313 (6.1)	103/1,517 (6.8)	130/1,671 (7.8)	137/1,702 (8.0)	152/1,917 (7.8)	-	-	0.012
HIV (new diagnosis) [‡]	22/900 (2.4)	36/1,092 (3.3)	22/1,250 (1.8)	35/1,269 (2.8)	29/1,481 (2.0)	35/1,608 (2.2)	38/1,647 (2.3)	45/1,855 (2.4)	-	-	0.488

Note. *n* represents the number of MSM with a positive result and *N* the number of MSM tested. NA: not applicable; MSM: men who have sex with men;

*Before 2015, urethral gonorrhoea testing was only performed among symptomatic MSM with urethral symptoms or self-reported as contact of infection. The number of people tested corresponds to the number of people tested for urethral chlamydia; † Any anatomical site for gonorrhoea includes urethral, anorectal and oropharyngeal; while any site for chlamydia includes urethral and anorectal; ‡ Only including HIV cases diagnosed on the day of the first visit.

Table S5 Temporal trend of the positivity for sexually transmitted infections and HIV among men who have sex with men and women attending a sexual health centre in Melbourne, 2011-2018.

	2011	2012	2013	2014	2015	2016	2017	2018	2011-2014	2015-2018	2011-2018
	n/N (%)	n/N (%)	n/N (%)	n/N (%)	n/N (%)	n/N (%)	n/N (%)	n/N (%)	P _{trend}	P _{trend}	P _{trend}
Gonorrhoea											
<i>Oropharyngeal</i>	1/150 (0.7)	2/154 (1.3)	7/209 (3.3)	3/209 (1.4)	14/220 (6.4)	12/238 (5.0)	17/246 (6.9)	12/285 (4.2)	0.387	0.448	NA
<i>Urethral</i> *	3/163 (1.8)	5/172 (2.9)	9/230 (3.8)	6/219 (2.7)	7/247 (2.8)	10/271 (3.7)	7/275 (2.5)	5/308 (1.6)	0.539	0.241	NA
<i>Anorectal</i>	4/128 (3.1)	5/122 (4.1)	4/172 (2.3)	4/172 (2.3)	6/173 (3.5)	14/191 (7.3)	12/207 (5.8)	9/239 (3.8)	0.492	0.784	NA
<i>Any anatomical site</i> †	7/153 (4.6)	9/160 (5.7)	15/225 (6.8)	13/218 (6.1)	20/232 (8.7)	27/267 (10.3)	27/293 (9.6)	22/330 (7.1)	0.530	0.304	NA
Chlamydia											
<i>Urethral</i> *	4/163 (2.5)	11/172 (6.4)	12/230 (5.2)	5/219 (2.3)	10/247 (4.0)	12/271 (4.4)	6/275 (2.2)	13/308 (4.2)	0.667	0.778	NA
<i>Anorectal</i>	10/128 (7.8)	9/122 (7.4)	6/173 (3.5)	4/172 (2.3)	10/173 (5.8)	11/191 (5.8)	14/206 (6.8)	19/239 (7.9)	0.010	0.320	NA
<i>Any anatomical site</i> †	14/165 (8.5)	15/173 (8.7)	17/233 (7.3)	9/227 (4.0)	19/249 (7.6)	21/273 (7.7)	17/277 (6.1)	29/310 (9.4)	0.057	0.627	NA
Syphilis	1/112 (0.9)	4/166 (2.4)	6/223 (2.7)	13/211 (6.2)	7/238 (2.9)	19/259 (7.3)	12/265 (4.5)	19/299 (6.4)	-	-	0.004
HIV (new diagnosis) ‡	1/140 (0.7)	3/166 (1.8)	1/222 (0.5)	1/205 (0.5)	2/237 (0.8)	0/252 (0.0)	1/258 (0.4)	1/294 (0.3)	-	-	0.127

Note. *n* represents the number of MSM with a positive result and *N* the number of MSM tested; NA: not applicable; MSM: men who have sex with men; *Before 2015, urethral gonorrhoea testing was only performed among symptomatic MSM with urethral symptoms or self-reported as contact of infection. The number of people tested corresponds to the number of people tested for urethral chlamydia; † Any anatomical site for gonorrhoea includes urethral, anorectal and oropharyngeal; while any site for chlamydia includes urethral and anorectal; ‡ Only including HIV cases diagnosed on the day of the first visit.

Table S6 Positivity for gonorrhoea, chlamydia, syphilis and HIV among men who have sex with men only and men who have sex with men and women attending a sexual health centre in Melbourne, 2011-2018.

	MSMO	MSMW-M	MSMW-W	Comparison across three groups	Comparison between MSMW-M and MSM-W
	n/N (%)	n/N (%)	n/N (%)	P value	P value
Gonorrhoea					
<i>Oropharyngeal</i>	682/11,810 (5.8)	44/756 (5.8)	18/676 (2.7)	0.003	0.003
<i>Urethral*</i>	390/11,699 (3.3)	25/771 (3.2)	23/801 (2.9)	0.775	0.669
<i>Rectum</i>	745/11,080 (6.7)	40/682 (5.9)	14/515 (2.7)	0.001	0.009
<i>Any anatomical site</i>	1321/11,951 (11.1)	83/771 (10.8)	45/756 (6.0)	<0.001	0.001
Chlamydia					
<i>Urethral</i>	410/11,699 (3.5)	27/771 (3.5)	37/801 (4.6)	0.257	0.262
<i>Anorectal</i>	989/11,043 (9.0)	56/683 (8.2)	16/514 (3.1)	<0.001	<0.001
<i>Any anatomical site†</i>	1272/11,891 (10.7)	74/779 (9.5)	49/812 (6.0)	<0.001	0.010
Syphilis	797/11,317 (7.0)	36/737 (4.9)	25/744 (3.4)	<0.001	0.140
HIV (new diagnosis)‡	262/11,102 (2.4)	7/738 (0.9)	3/749 (0.4)	<0.001	0.196
HIV (previous positive)	316/12,795 (2.5)	6/804 (0.7)	1/839 (0.1)	<0.001	0.051

Note. *n* represents the number of MSM with a positive result and *N* the number of MSM tested. MSM: men who have sex with men; *Before 2015, urethral gonorrhoea testing was only performed among symptomatic MSM with urethral symptoms or self-reported as contact of infection. The number of people tested corresponds to the number of people tested for urethral chlamydia; † Any anatomical site for gonorrhoea includes urethral, anorectal and oropharyngeal; while any site for chlamydia includes urethral and anorectal; ‡ Only including HIV cases diagnosed on the day of the first visit.

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60STROBE Statement—Checklist of items that should be included in reports of *cross-sectional studies*

	Item No	Recommendation	Page, lines
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	1, 3
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	3, 1-25 4, 1-3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	6, 1-14
Objectives	3	State specific objectives, including any prespecified hypotheses	6, 16-23
Methods			
Study design	4	Present key elements of study design early in the paper	7, 1-3
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	7, 1-13
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	7, 15-19
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	7, 20-24 8, 1-18
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	7, 5-13 7, 20-24
Bias	9	Describe any efforts to address potential sources of bias	7, 17-19 8, 20-25
Study size	10	Explain how the study size was arrived at	NA, all eligible subjects were included
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7, 19-24 8, 1-2
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	9, 8-25
		(b) Describe any methods used to examine subgroups and interactions	9, 17-25
		(c) Explain how missing data were addressed	9, 23-24
		(d) If applicable, describe analytical methods taking account of sampling strategy	NA, all eligible subjects were included
		(e) Describe any sensitivity analyses	NA
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	10, 13-20
		(b) Give reasons for non-participation at each stage	10, 13-20
		(c) Consider use of a flow diagram	NA

Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	10, 24-25 11, 1-4
		(b) Indicate number of participants with missing data for each variable of interest	Table 1, Table S1
Outcome data	15*	Report numbers of outcome events or summary measures	10, 20-22 11, 6-25 12, 1-25 13, 1-12
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	Table 4, Table 5 11, 14-17
		(b) Report category boundaries when continuous variables were categorized	11, 15-19
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	13, 18-23
Discussion			
Key results	18	Summarise key results with reference to study objectives	14, 1-11
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	16, 22-25 17, 1-15
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	15, 1-24 17, 18-24 16, 1-16
Generalisability	21	Discuss the generalisability (external validity) of the study results	17, 4-8
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	20, 12-15

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.