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SEXUAL HEALTH

Trends and associated factors in HIV testing among heterosexual men and women in Melbourne, Australia, 2011–2020

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ABSTRACT

Background. Despite the increase in the proportion of HIV notifications attributed to heterosexuals in Australia, little is known about their HIV testing behaviours. We investigated the trends and factors associated with HIV testing behaviours among heterosexuals. **Methods.** We analysed the trend and proportion of heterosexuals attending the centre for the first time between 2011 and 2020, who had ever tested and tested for HIV in the past 12 months and the median number of months since their last HIV test. We identified factors associated with HIV testing behaviours using univariable and multivariable logistic regressions. **Results.** Of the 78 652 heterosexuals included, 53.1% were men and 46.9% were women. Overall, the proportion of heterosexuals who had ever tested for HIV was 40.8%, with a declining testing trend from 40.2% in 2011 to 36.5% in 2020 ($P_{trend} < 0.001$). Overall, the proportion of heterosexuals tested for HIV in the past 12 months was 15.7%, with no significant change from 15.3% in 2011 to 14.7% in 2020 ($P_{trend} = 0.489$). The median number of months since the last HIV test decreased from 18.0 (IQR 6.9–37.3) in 2011 to 15.0 (IQR 6.4–32.5) in 2020 ($P_{trend} < 0.001$). Individuals who had condomless sex with casual partners (aOR 0.92, 95% CI 0.88–0.96) and who were diagnosed with a sexually transmitted infection (aOR 0.88, 95% CI 0.84–0.93) were less likely to have ever tested for HIV. **Conclusions.** HIV testing was low among heterosexuals, and individuals who engaged in condomless sex and had another sexually transmitted infection were less likely to be tested. To reduce HIV transmission, strategies to improve HIV testing among heterosexuals are needed.

Keywords: condoms, diagnostics, heterosexuality, HIV testing, HIV/AIDS, infection, sexual practices, STIs.

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Introduction

It is estimated that ~29 090 people were living with HIV in Australia in 2020.[1] The average lifetime cost of HIV management is more than AU$280 000 for each individual in Australia.[2] Reducing the number of HIV cases will benefit the public health system and the nation in terms of finance and workforce.[3] Given the absence of an effective cure for HIV, it is imperative to prioritise the prevention of transmission and early diagnosis to control the number of new HIV cases in Australia.[4]

HIV notification rates in Australia have significantly declined, from 4.5 per 100 000 in 2011 to 2.5 per 100 000 in 2020. This reduction was mainly due to the scale-up of effective combined antiretroviral therapy and the availability of HIV pre-exposure prophylaxis.[5] In Australia, the majority of new HIV cases were among gay, bisexual and other men who have sex with men (MSM); however, there has been an increase in the proportion of new HIV cases among the heterosexual population. Indeed, the proportion of HIV notifications among MSM decreased from 70% in 2012 to 58% in 2020, whereas new HIV cases among heterosexuals increased from 19% in 2012 to 24% in 2020.[6,7] It is estimated that up to 31% of new HIV infections were caused by transmission from a partner with

unknown HIV status to another partner,[8] and ~9% of individuals with HIV in Australia in 2020 were unaware that they are living with HIV.[6] Regular HIV testing facilitates early diagnosis and treatments for individuals, which is essential to end this pandemic.[8–10]

Numerous Australian studies have examined HIV testing patterns and factors associated with HIV testing.[5,11–13] However, most of these studies focus on MSM, and there are limited studies on heterosexuals, despite heterosexuals living with HIV accounting for 24% of the new HIV cases in 2020.[6] The Second Australian Study of Health and Relationships conducted in 2012–2013 reported that the proportion of heterosexual men who had ever tested for HIV was only 35% compared with 89% among gay men; similarly, the proportion of heterosexual women who had ever tested for HIV was 37% compared with 50% among bisexual women.[14]

Several strategies, such as an expansion of HIV testing technologies (e.g. point-of-care or HIV self-testing) and variable access to rapid HIV testing in community and clinical settings, were introduced to boost HIV testing in Australia.[15] According to the Eighth National HIV Strategy 2018–2022, in Australia, HIV testing is indicated for groups that are vulnerable to acquiring HIV, including MSM, transgender women, Aboriginal and Torres Strait Islander peoples, and other groups, such as people who inject drugs and/or those who have travelled to countries with high HIV prevalence.[15] Heterosexual individuals usually have a comparatively low risk for HIV acquisition, and thus are not recommended for regular HIV testing.

Given the rise in the proportion of new HIV notifications among heterosexuals,[16] and little is known about HIV testing behaviours among heterosexuals, particularly after 2013,[17] we, therefore, conducted this study to investigate the trends and associated factors in HIV testing behaviours among heterosexuals attending an urban public sexual health clinic in Melbourne, Australia, between 2011 and 2020.

Method

Data collection and setting

The Melbourne Sexual Health Centre (MSHC) is the largest public sexual health centre providing free testing and treatment for HIV and other sexually transmitted infections (STI) in Victoria, Australia. There were approximately 57 000 consultations in 2019.[18] Upon arrival, all new clients were invited to complete a routine questionnaire via computer-assisted self-interviewing, which collected information on demographic characteristics, sexual behaviours and HIV test history. We extracted data relevant to HIV testing (e.g. the date of the last HIV test and HIV diagnosis) from the electronic medical records. Ethics approval for this study was obtained from the Alfred Hospital Ethics Committee, Melbourne, Australia (project number 172/20).

Definition of study populations and subpopulations

We included heterosexual individuals who were aged at least 16 years, and visited MSHC for the first time between 2011 and 2020. In this study, we defined 'heterosexual' as men or women who did not have any same-sex partners in the past 12 months. We excluded individuals if they: (1) were currently working or had ever worked as sex workers, because sex workers in Victoria were required to have regular HIV tests for work during the study period;[19] (2) reported an invalid date of the last HIV test, such as the date of last HIV test was after the date of consultation or the date of the last HIV test before 1 January 1985; (3) had sex with at least one same-sex partner in the past 12 months; or (4) reported they were living with HIV. We also categorised individuals into several subgroups in relation to their risk of HIV. We defined 'individuals with an STI' as individuals who were diagnosed with an STI (i.e. chlamydia, gonorrhoea or syphilis) on the consultation day; and 'symptomatic individuals' as individuals who presented to the clinic with STI-related symptoms or other specific reasons that require testing (e.g. reported contact with sexual partners with an STI).[11] We categorised individuals' regions of birth into nine regions as per the Standard Australian Classification of Countries.[20] Furthermore, we defined 'recently arrived' individuals as individuals who arrived in Australia <5 years from the visit date.[21]

Statistical analysis

We calculated the proportion of individuals who: (1) had ever tested for HIV, and (2) had tested for HIV in the past 12 months. We also calculated the time since the last HIV test from the date of the last HIV test to the consultation day, and we reported the median and interquartile range (IQR) of the months since the last HIV test. Univariable and multivariable logistic regression analyses were performed to identify the factors associated with individuals who had ever tested for HIV and individuals who had tested for HIV in the past 12 months. Factors with $P \leq 0.2$ in univariable logistic regression analyses were considered potential confounding factors and were included in the multivariable logistic regression analyses. We adjusted for sex, age, region of birth, aboriginal status, history of STI, injecting drug use, marital status, the total number of partners, condom use with regular partners and casual partners, year of consultation, year of arrival, and STI diagnosis on the consultation day. Crude and adjusted odds ratios (OR) and the corresponding 95% confidence intervals (CIs) were reported. The Chi-squared trend test was used to examine whether there was an increasing or decreasing trend in the proportion of HIV testing over the study period (had ever tested for HIV and tested for HIV in the past 12 months). Trends were also examined among individuals with an STI and symptomatic individuals separately. The Jonckheere–Terpstra trend test

was used to examine whether there was an increasing or decreasing trend in the median number of months since the last HIV test over the study period. When comparing more than two groups, Kruskal–Wallis test was used. All statistical analyses were performed using Stata (ver. 17.0; StataCorp LP, College Station, TX, USA).

Results

Demographic characteristics

There were 90 768 heterosexual individuals who first visited MSHC between 2011 and 2020. We excluded 12 116 individuals due to: being current or previous sex workers (n = 5914), having same-sex partners in the past 12 months (n = 3630), duplicated records on the same day (n = 1780), living with HIV (n = 716), having an invalid date of the last HIV test (n = 71), or missing data on age (n = 5; Supplementary Table S1). The remaining 78 652 heterosexual individuals were included in the final analysis, with 41 779 (53.1%) men and 36 873 (46.9%) women. The mean age was 28.7 years (s.d. ± 8.74 years). There were 44.0% (n = 18 399) born in Oceania and Antarctica, followed by 24.6% (n = 10 276) in North-west Europe and 5.6% (n = 2357) in the Americas. The median number of opposite-sex partners in the past 12 months was three (IQR 2, 5). There were 24 304 (58.2%) heterosexuals who reported at least one occasion of condomless sex in the past 12 months (Table 1).

Trends in ever having tested for HIV

Overall, the proportion of heterosexuals who had ever tested for HIV was 40.8% (32 078/78 652), with a decline testing trend from 40.2% (2412/5997) in 2011 to 36.5% (2164/5936) in 2020, with a significant annual decrease of 0.99% (95% CI: 0.99–0.99, $P_{trend} < 0.001$) after adjusting for other potential confounders (Table 2).

The proportions of individuals who had ever tested for HIV among heterosexual men and women were 40.0% (16 696/41 779) and 41.7% (15 382/36 873), respectively. In addition, the proportion of symptomatic heterosexuals who had ever tested was 42.8% (15 559/36 371; Table 2), with the declining trend of HIV testing from 42.1% (1318/3131) in 2011 to 39.7% (1311/3300) in 2020 ($P_{trend} < 0.001$; Fig. 1, Table S2).

After adjusting for other confounders, the odds of ever testing for HIV in women were higher than in men (aOR 1.08, 95% CI 1.05–1.12; Table 2). Compared with individuals who were born in the Oceania and Antarctica region, individuals who were born in other regions had the highest odds of ever testing; except for individuals who were born in South-east and North-east Asia regions (aOR 1.04, 95% CI 0.95–1.15 and aOR 0.89, 95% CI 0.81–0.98, respectively) after adjusting other confounders (Table 2). Furthermore, individuals who had a past STI (aOR 2.85, 95% CI 2.74–2.96) and individuals with an increased number of partners in the past 12 months (aOR 1.01, 95% CI 1.01–1.02) had higher odds of ever testing for HIV. However, individuals with an STI diagnosis on the day (aOR 0.88, 95% CI 0.84–0.93), had condomless sex with casual partners in the past 12 months (aOR 0.92, 95% CI 0.88–0.96) and arrived in Australia >5 years ago (aOR 0.95, 95% CI 0.90–0.99) had lower odds of ever testing for HIV (Table 2).

Trends in having tested for HIV in the past 12 months

Overall, the proportion of heterosexuals who had ever tested for HIV in the past 12 months was 15.7% (12 354/78 652; Table 3), and there was no significant change between 2011 and 2020 ($P_{trend} = 0.489$; Fig. S1, Table S3). The proportion of heterosexuals with an STI diagnosis on the day who had been tested for HIV in the past 12 months was 16.4% (1265/7694; Table 3), with a rising trend from 13.1% (70/536) in 2011 to 16.6% (81/475) in 2020 ($P_{trend} < 0.001$; Fig. S1, Table S3).

After adjusting for other potential confounders, sub-Saharan African born had the highest odds of testing for HIV in the past 12 months (aOR 1.84, 95% CI 1.55–2.18), whereas North-east Asia had the lowest odds of testing for HIV in the past 12 months (aOR 1.25, 95% CI 1.10–1.41) compared with Oceania- and Antarctica-born heterosexuals. The odds of testing for HIV in the past 12 months among heterosexuals with an STI diagnosis on the consultation day were higher than those without an STI (aOR 1.09, 95% CI 1.02–1.17). Additionally, the odds of testing for HIV in the past 12 months among heterosexuals who had condomless sex with casual partners was similar to that of heterosexuals who always used condoms (aOR 0.96, 95% CI 0.91–1.02). Overseas-born individuals who arrived >5 years ago had lower odds of testing for HIV in the past 12 months compared with those who recently arrived in Australia (aOR 0.91, 95% CI 0.86–0.96; Table 3).

Median number of months since the last HIV test

The median number of months since the last HIV test decreased significantly from 18.0 months (IQR 6.7–37.3 months) in 2011 to 15.0 months (IQR 6.4–32.5 months) in 2020 ($P_{trend} < 0.001$; Table 4). There was a significant difference in the median number of months since the last HIV test between men (18.0 months, IQR 6.9–38.7 months) and women (15.8 months, IQR 6.9–31.7 months; $P_{trend} < 0.001$). The median number of months since the last HIV test increased significantly with increasing age, from 9.1 months (IQR 3.4–18.1 months) in individuals aged 16–19 years, to 32.3 months (IQR 6.4–125.6 months) in individuals aged ≥60 years ($P_{trend} < 0.001$). Individuals who had a past STI had a significantly shorter median time from the last HIV test compared with those who did not have a past STI

Table 1. Demographic characteristics of 78 652 heterosexual men and women attending the Melbourne Sexual Health Centre, 2011–2020.

	Men (*N* = 41 779)	%	Women (*N* = 36 873)	%	Overall (*N* = 78 652)	%
Age (years)						
Mean (± s.d.)	30.2 (±9.7)		26.9 (±7.2)		28.7 (±8.7)	
Median (IQR)	27 (24, 33)		25 (23, 29)		26 (23, 31)	
Age (years), *n* (%)						
16–19	1293	3.1	2141	5.8	3434	4.4
20–29	24 411	58.4	26 196	71.0	50 607	64.4
30–39	10 047	24.1	6405	17.4	16 452	20.9
40–49	3536	8.5	1373	3.7	4909	6.2
50–59	1699	4.1	539	1.5	2238	2.9
≥60	793	1.9	219	0.6	1012	1.3
Region of birth, *n* (%)						
Oceania and Antarctica	18 399	44.0	11 482	31.1	29 881	38.0
North-west Europe	10 276	24.6	11 475	31.1	21 751	27.7
South-east Europe	1499	3.6	1232	3.3	2731	3.5
North Africa and Middle East	931	2.2	356	1.0	1287	1.6
South-east Asia	1259	3.0	1932	5.2	3191	4.1
North-east Asia	1567	3.8	2482	6.7	4049	5.2
South-central Asia	2019	4.8	437	1.2	2456	3.1
Americas	2357	5.6	4155	11.3	6512	8.3
Sub-Saharan Africa	680	1.6	499	1.4	1179	1.5
Unknown	2792	6.7	2823	7.7	5615	7.1
Aboriginal Torres Strait Islander, *n* (%)						
No	35 928	86.0	31 374	85.1	67 302	85.6
Yes	329	0.8	412	1.1	741	0.9
Unknown	5522	13.2	5087	13.8	10 609	13.5
Injecting drug use, *n* (%)						
Never injected	39 316	94.1	34 517	93.6	73 833	93.9
Ever injected	724	1.7	365	1.0	1089	1.4
Unknown	1739	4.2	1991	5.4	3730	4.7
Marital status, *n* (%)						
Married/defacto	5838	14.0	2985	8.1	8823	11.2
Divorced/separated/widowed	2313	5.5	1539	4.2	3852	4.9
Single/never married	28 590	68.4	28 028	76.0	56 618	72.0
Unknown	5038	12.1	4321	11.7	9359	11.9
Presence of symptoms, *n* (%)						
Asymptomatic	18 426	44.1	14 501	39.3	32 927	41.9
Symptomatic/contact of infection	18 335	43.9	18 036	48.9	36 371	46.2
Unknown	5018	12.0	4336	11.8	9354	11.9
Self-reported history of STI, *n* (%)						
No	31 824	76.2	26 240	71.2	58 064	73.8
Yes	7648	18.3	8740	23.7	16 388	20.8
Unknown	2307	5.5	1893	5.1	4200	5.3

(*Continued on next page*)

Table 1. (*Continued*).

	Men (*N* = 41 779)	%	Women (*N* = 36 873)	%	Overall (*N* = 78 652)	%
STI diagnosis on the consultation day, *n* (%)						
No	34 123	81.7	30 544	82.8	64 667	82.2
Yes	4165	10.0	3529	9.6	7694	9.8
Unknown	3491	8.4	2800	7.6	6291	8.0
No. of partners in the past 12 months						
Mean (± s.d.)	3.6 (±3.7)		4.9 (±6.2)		4.3 (±5.2)	
Median (IQR)	3 (2, 5)		3 (2, 6)		3 (2, 5)	
Condom use with regular partner in the past 12 months, *n* (%)						
Always	3143	7.5	2688	7.3	5831	7.4
Not always	14 258	34.1	12 281	33.3	26 539	33.7
No regular partner	18 987	45.5	17 178	46.6	36 165	46.0
Unknown	5391	12.9	4726	12.8	10 117	12.9
Condom use with casual partners in the past 12 months, *n* (%)						
Always	6541	15.7	4491	12.2	11 032	14.0
Not always	24 304	58.2	22 922	62.2	47 226	60.1
No casual partner	5754	13.8	5327	14.5	11 081	14.1
Unknown	5178	12.4	4132	11.2	9310	11.8
Year of consultation						
2011	3540	8.5	2457	6.7	5997	7.6
2012	4095	9.8	2900	7.9	6995	8.9
2013	4294	10.3	3485	9.5	7779	9.9
2014	4406	10.6	3553	9.6	7959	10.1
2015	4290	10.3	3793	10.3	8083	10.3
2016	4257	10.2	4084	11.1	8341	10.6
2017	3999	9.6	3844	10.4	7843	10.0
2018	4810	11.5	4556	12.4	9366	11.9
2019	5149	12.3	5204	14.1	10 353	13.2
2020	2939	7.0	2997	8.1	5936	7.6
Year of arrival						
≤5 years	6159	14.8	9188	24.9	15 347	19.5
>5 years	14 351	34.4	12 748	34.6	27 099	34.5
Unknown	21 269	50.9	14 937	40.5	36 206	46.0

Number of partners in the past 12 months includes regular and casual partners. STI, diagnosed with chlamydia, gonorrhoea or syphilis on the day of consultation.

(14.0 vs 18.9 months, $P = 0.001$). Furthermore, heterosexuals with an STI diagnosis on the day had a significantly shorter time since the last HIV test than heterosexuals without an STI (15.0 vs 18.0 months, $P < 0.001$; Table 4).

Discussion

Our study demonstrated trends and associated factors in HIV testing among heterosexual men and women attending an urban public sexual health clinic in Melbourne over a period of 9 years. We found a declining trend in the proportion of heterosexuals who had ever tested for HIV, and there was no temporal change in the proportion of heterosexuals tested for HIV in the past 12 months between 2011 and 2020. Furthermore, we found that heterosexuals who had condomless sex with casual partners or individuals with an STI diagnosis on the consultation day were less likely to ever test for HIV. With the rise in the proportion of new HIV cases among heterosexuals in Australia, our study findings indicate the need for additional approaches to increase HIV awareness and promote HIV testing in heterosexuals to reduce HIV transmission.

Despite a shift in the proportion of HIV notifications to heterosexuals,[6] we found a declining trend in heterosexuals who had ever tested for HIV between 2011 and 2020, and

Table 2. Factors associated with ever testing for HIV among 78 652 heterosexual men and women.

Factor	*n*/*N*	%	OR	95% CI	*P*-value	aOR	95% CI	*P*-value
Sex								
Male	16 696/41 779	39.96	Ref			Ref		
Female	15 382/36 873	41.71	1.08	1.04–1.11	<0.001	1.08	1.05–1.12	<0.001
Age (years), *n* (%)			1.13	1.11–1.14	<0.001	1.92	1.80–2.05	<0.001
16–19	386/3434	11.24	Ref			Ref		
20–29	20 214/50 607	39.94	5.25	4.72–5.85	<0.001	3.69	3.30–4.13	<0.001
30–39	8284/16 452	50.35	8.01	7.17–8.94	<0.001	6.59	5.88–7.40	<0.001
40–49	2202/4909	44.84	6.42	5.69–7.24	<0.001	6.27	5.52–7.14	<0.001
50–59	780/2238	34.85	4.22	3.68–4.84	<0.001	4.24	3.65–4.92	<0.001
≥60	212/1012	20.95	2.09	1.74–2.52	<0.001	2.45	2.01–3.00	<0.001
Region of birth, *n* (%)								
Oceania and Antarctica	10 723/29 881	35.88	Ref			Ref		
North-west Europe	10 998/21 751	50.56	1.83	1.76–1.89	<0.001	1.92	1.79–205	<0.001
South-wast Europe	1225/2731	44.86	1.45	1.34–1.57	<0.001	1.55	1.40–1.71	<0.001
North Africa and Middle East	542/1287	42.11	1.30	1.16–1.46	<0.001	1.56	1.36–1.78	<0.001
South-east Asia	1013/3191	31.76	0.83	0.77–0.90	<0.001	1.04	0.95–1.15	0.395
North-east Asia	1135/4049	28.03	0.70	0.65–0.75	<0.001	0.89	0.81–0.98	0.018
South-central Asia	882/2456	35.91	1.00	0.92–1.09	0.979	1.22	1.09–1.35	<0.001
Americas	3460/6512	53.12	2.03	1.92–2.14	<0.001	2.16	1.99–2.34	<0.001
Sub-Saharan Africa	625/1179	53.01	2.02	1.79–2.27	<0.001	2.58	2.25–2.95	<0.001
Unknown	1475/5615	26.25	0.64	0.60–0.68	<0.001	1.23	1.13–1.35	<0.001
Aboriginal and Torres Strait Islander, *n* (%)								
No	28 422/67 302	42.23	Ref			Ref		
Yes	222/741	29.96	0.59	0.50–0.69	<0.001	0.90	0.75–1.07	0.225
Unknown	3434/10 609	32.37	0.65	0.63–0.68	<0.001	0.90	0.85–0.95	<0.001
Self-reported history of STI, *n* (%)								
No	19 650/58 064	33.84	Ref			Ref		
Yes	10 510/16 388	64.13	3.50	3.37–3.62	<0.001	2.85	2.74–2.96	<0.001
Unknown	1918/4200	45.67	1.64	1.54–1.75	<0.001	1.57	1.47–1.68	<0.001
Injecting drug use, *n* (%)								
Never injected	31 194/73 833	42.25	Ref			Ref		
Ever injected	518/1089	47.57	1.24	1.10–1.40	0.001	1.22	1.07–1.39	0.003
Unknown	366/3730	9.81	0.15	0.13–0.17	<0.001	0.45	0.39–0.50	<0.001
Marital status, *n* (%)								
Married/defecto	3741/8823	42.40	Ref			Ref		
Divorced/separated/widowed	1769/3852	45.92	1.15	1.07–1.24	<0.001	1.03	0.95–1.13	0.429
Single/never married	23 846/56 618	42.12	0.99	0.94–1.03	0.616	0.96	0.91–1.01	0.150
Unknown	2722/9359	29.08	0.56	0.52–0.59	<0.001	0.90	0.83–0.98	0.012
Presence of symptom, *n* (%)								
Asymptomatic	13 280/32 927	40.33	Ref					
Symptomatic/contact of infection	15 559/36 371	42.78	1.11	1.07–1.14	<0.001			
Unknown	3239/9354	34.63	0.78	0.75–0.82	<0.001			

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Table 2. (*Continued*).

Factor	*n*/*N*	%	OR	95% CI	*P*-value	aOR	95% CI	*P*-value
STI diagnosis on the consultation day, *n* (%)								
No	26 532/64 667	41.03	Ref			Ref		
Yes	2977/7694	38.69	0.91	0.86–0.95	<0.001	0.88	0.84–0.93	<0.001
Unknown	2569/6291	40.84	0.99	0.94–1.05	0.767	1.59	1.49–1.69	<0.001
No. of partners in the past 12 months			1.04	1.03–1.04	<0.001	1.01	1.01–1.02	<0.001
	4.83 (±5.58)							
	3 (2, 6)							
Condom use with regular partners in the past 12 months, *n* (%)								
Always	2431/5831	41.69	Ref			Ref		
Not always	11 882/26 539	44.77	1.13	1.07–1.20	<0.001	1.05	0.99–1.12	0.084
No regular partner	16 186/36 165	44.76	1.13	1.07–1.20	<0.001	0.96	0.90–1.02	0.234
Unknown	1579/10 117	15.61	0.26	0.24–0.28	<0.001	0.38	0.35–0.42	<0.001
Condom use with casual partners in the past 12 months, *n* (%)								
Always	4932/11 032	44.71	Ref			Ref		
Not always	21 272/47 226	45.04	1.01	0.97–1.06	0.522	0.92	0.88–0.96	<0.001
No casual partner	2186/11081	19.73	0.30	0.29–0.32	<0.001	0.48	0.46–0.52	<0.001
Unknown	3688/9313	39.6	0.81	0.78–0.84	<0.001	1.07	1.00–1.14	0.055
Year of consultation			0.99	0.99–0.99	<0.001	0.99	0.99–0.99	<0.001
2011	2412/5997	40.22	Ref					
2012	2920/6995	41.04	1.07	0.99–1.14	0.078			
2013	3232/7779	41.55	1.06	0.99–1.13	0.116			
2014	3312/7959	41.61	1.06	0.99–1.13	0.098			
2015	3426/8083	42.39	1.09	1.02–1.17	0.010			
2016	3510/8341	42.08	1.08	1.01–1.16	0.026			
2017	3290/7843	41.95	1.07	1.00–1.15[A]	0.041			
2018	3826/9366	40.85	1.03	0.96–1.10	0.438			
2019	3986/10 353	38.50	0.93	0.87–0.99	0.030			
2020	2164/5936	36.46	0.85	0.79–0.92	<0.001			
Year of arrival								
≤5 years	12 283/27 099	45.33	Ref			Ref		
>5 years	7182/15 347	46.80	0.94	0.91–0.98	0.003	0.95	0.90–0.99	0.022
Unknown	12 613/36 206	34.84	0.61	0.58–0.63	<0.001	1.00	0.93–1.07	0.0907

STI, diagnosed with chlamydia, gonorrhoea or syphilis on the day of consultation.
n, the number of heterosexuals tested for HIV; *N*, the number of heterosexuals in the subgroup; OR, odds ratio; CI, confidence interval; aOR, adjusted odds ratio; Ref, reference; s.d., standard deviation; IQR, interquartile range. Number of partners in the past 12 months includes regular and casual sex partners.
[A]95% CI 1.003–1.150.

<40% of heterosexuals visiting the clinic for the first time had ever tested for HIV in 2020. Meanwhile, the proportion of MSM who had ever tested for HIV was high in Australia, with >90% in 2021,[22] suggesting that we should increase awareness of HIV risk and uptake of HIV testing among heterosexuals. Barriers to HIV testing reported among heterosexuals include a low perceived risk of HIV, stigma and distrust in healthcare services.[23–25] A study comparing the experience related to HIV stigma of heterosexuals and gay people living with HIV in Australia found that heterosexual participants felt more stigmatised by living with HIV, when accessing HIV treatment and by people's reaction to their HIV status, compared with gay men, and consequently, they were less likely to access HIV treatment.[26] Community-based participatory approaches, such as crowdsourcing and designathon, could be introduced to create tailored solutions to reduce HIV-related stigma among heterosexuals, and ultimately reduce HIV transmission among this population.

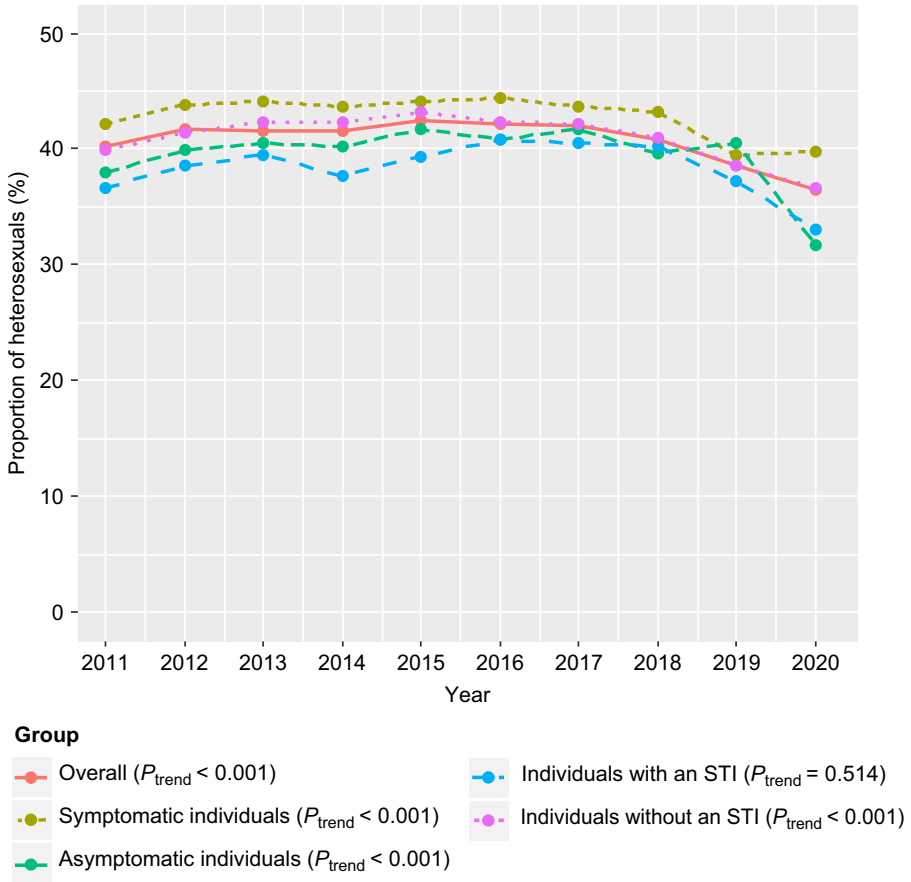

Fig. 1. The trend of the proportion of heterosexuals who had ever tested for HIV between 2011 and 2020.

We found that the HIV testing rate in Asian-born heterosexuals was low, although free HIV testing is provided in Australia.[27] Our study showed that only 32% of South-east and 28% of North-east Asian-born heterosexuals had ever tested for HIV. As per the Victorian HIV surveillance report, there were 1072 new HIV diagnoses among overseas-born individuals in 2012–2021, and the majority (45%) were from South-east or North-east Asia; however, there was no further breakdown by the mode of transmission or population at risk. Of the 518 heterosexuals newly diagnosed with HIV in Victoria in 2012–2021, the primary HIV exposure was the index case from a high-prevalence country (25%),[28] followed by the index case having sex with a person from a high-prevalence country (13%), as per the Victorian Department of Health's definition.[29] There was an increasing trend in late HIV notifications among overseas-born heterosexuals,[7] resulting in a more advanced HIV stage among this population.[21] Other possible barriers for Asian-born individuals in accessing sexual health services include limited knowledge of HIV prevention strategies and sexual health service accessibility for Medicare-ineligible individuals and HIV stigmatisation in their country of origin.[30] We suggest clinicians should recommend HIV testing for individuals who had sex from a high-prevalence country or sexually active individuals who have recently arrived in Australia.

The proportion of heterosexuals who had ever tested for HIV was lower among those who had an STI diagnosis compared with those who did not have an STI diagnosis on the consultation day. This is an important finding, as people with an STI may also share the same risk of acquiring HIV, and untreated STI can increase the risk of HIV acquisition.[31] However, our results showed that heterosexuals diagnosed with an STI on the consultation day had a significantly shorter time since the last HIV test than heterosexuals without an STI, suggesting although the proportion of ever tested for HIV was low, this group is more likely to have a recent HIV test before their STI diagnosis. A study of 2307 heterosexuals in the US reported that only half of high-risk heterosexuals (e.g. had sex with a partner with known HIV, exchanged sex for money) tested for HIV in the past 12 months, and 37% tested for HIV annually.[32] The lack of integration of HIV testing among those who have an STI diagnosis is a known problem.[33] We recommend that HIV and STI care services should be better integrated, so that any heterosexuals who are diagnosed with an STI should have an HIV test. Another concerning finding in our study was individuals who had recent condomless sex with casual

Table 3. Factors associated with HIV testing in the past 12 months among 78 652 heterosexual men and women.

Factor	*n*/*N*	%	OR	95% CI	*P*-value	aOR	95% CI	*P*-value
Sex								
Male	6239/41 779	14.93	Ref			Ref		
Female	6115/36 873	16.58	1.13	1.09–1.18	<0.001	1.11	1.06–1.15	<0.001
Age (years), *n* (%)			0.98	0.95–1.00	0.03	1	0.97–1.03	0.86
16–19	232/3434	6.76	Ref			Ref		
20–29	8254/50 607	16.31	2.69	2.35–3.08	<0.001	2.03	1.77–2.34	<0.001
30–39	2804/16 452	17.04	2.84	2.47–3.26	<0.001	2.17	1.88–2.50	<0.001
40–49	751/4909	15.3	2.49	2.14–2.91	<0.001	2.04	1.73–2.40	<0.001
50–59	244/2238	10.9	1.69	1.40–2.04	<0.001	1.47	1.20–1.79	0.001
≥60	69/1012	6.82	1.01	0.76–1.33	0.945	1	0.74–1.33	0.981
Region of birth, *n* (%)								
Oceania and Antarctica	4496/29 881	15.05	Ref			Ref		
North-west Europe	3848/21 751	17.69	1.21	1.16–1.27	<0.001	1.32	1.22–1.44	<0.001
South-east Europe	431/2731	15.78	1.06	0.95–1.18	0.304	1.32	1.16–1.50	<0.001
North Africa and Middle East	236/1287	18.34	1.27	1.10–1.47	0.001	1.7	1.44–2.01	<0.001
South-east Asia	438/3191	13.73	0.9	0.81–1.00	0.047	1.28	1.13–1.46	<0.001
North-east Asia	540/4049	13.34	0.87	0.79–0.96	0.004	1.25	1.10–1.41	<0.001
South-central Asia	360/2456	14.66	0.97	0.86–1.09	0.605	1.43	1.24–1.64	<0.001
Americas	1243/6512	19.09	1.33	1.24–1.43	<0.001	1.54	1.39–1.70	<0.001
Sub-Saharan Africa	222/1179	18.83	1.31	1.13–1.52	<0.001	1.84	1.55–2.18	<0.001
Unknown	540/5615	9.62	0.6	0.55–0.66	<0.001	1	089–1.13	0.984
Aboriginal and Torres Strait Islander, *n* (%)								
No	10 899/67 302	16.19	Ref			Ref		
Yes	91/741	12.28	0.72	0.58–0.90	0.004	0.92	0.73–1.16	0.504
Unknown	1364/10 609	12.86	0.76	0.72–0.81	<0.001	1.01	0.94–1.09	0.754
Self-reported history of STI, *n* (%)								
No	6770/58 064	11.66	Ref			Ref		
Yes	4724/16 388	28.83	3.07	2.94–3.20	<0.001	2.53	2.42–2.64	<0.001
Unknown	860/4200	20.48	1.95	1.80–2.11	<0.001	1.78	1.64–1.93	<0.001
Injecting drug use								
Never injected	12 020/73 833	16.28	Ref			Ref		
Ever injected	193/1089	17.76	1.11	0.95–1.30	0.201	1.05	0.89–1.24	0.539
Unknown	141/3730	3.83	0.20	0.17–0.24	<0.001	0.48	0.40–0.58	<0.001
Marital status, *n* (%)								
Married/defecto	1327/8823	15.04	Ref			Ref		
Divorced/separated/widowed	669/3852	17.37	1.19	1.07–1.31	0.001	1.15	1.03–1.28	0.013
Single/never married	9391/56 618	16.59	1.12	1.06–1.20	<0.001	1.01	0.93–1.08	0.885
Unknown	967/9359	10.33	0.65	0.60–0.71	<0.001	0.83	0.75–0.93	0.001
Presence of symptom, *n* (%)								
Asymptomatic	4444/32 927	13.5	Ref					
Symptomatic/contact of infection	6442/36 371	17.71	1.38	1.32–1.44	<0.001			
Unknown	1468/9354	15.69	1.19	1.12–1.27	<0.001			

(*Continued on next page*)

Table 3. (*Continued*).

Factor	*n*/*N*	%	OR	95% CI	*P*-value	aOR	95% CI	*P*-value
STI diagnosis on the consultation day, *n* (%)								
No	9488/64 667	14.67	Ref			Ref		
Yes	1265/7694	16.44	1.14	1.07–1.22	<0.001	1.09	1.02–1.17	0.01
Unknown	1601/6291	25.45	1.99	1.87–2.11	<0.001	2.87	2.67–3.07	<0.001
No. of partners in the past 12 months, *n* (± s.d.)				1.03	1.02–1.03	<0.001	1.02	1.01–1.02
Mean (± s.d.)	5.06 (±5.97)							
Median (IQR)	4 (2, 6)							
Condom use with regular partner in the past 12 months, *n* (%)								
Always	890/5831	15.26	Ref			Ref		
Not always	4503/26 539	16.97	1.13	1.05–1.23	0.002	1.08	0.99–1.17	0.084
No regular partner	6357/36 165	17.58	1.18	1.10–1.28	<0.001	1.06	0.98–1.15	0.149
Unknown	604/10 117	5.97	0.35	0.32–0.39	<0.001	0.48	0.42–0.54	<0.001
Condom use with casual partner in the past 12 months, *n* (%)								
Always	1866/11 032	16.91	Ref			Ref		
Not always	8252/47 226	17.47	1.04	0.98–1.10	0.163	0.96	0.91–1.02	0.184
No casual partner	743/11 081	6.71	0.35	0.32–0.39	<0.001	0.49	0.45–0.55	<0.001
Unknown	1493/9313	16.04	0.94	0.87–1.01	0.093	1.09	1.00–1.18	0.04
Year of consultation			1.00	1.00–1.01	0.489	1.00	1.00–1.01	0.535
2011	919/5997	15.32	Ref					
2012	1009/6995	14.42	0.93	0.85–1.03	0.15			
2013	1131/7779	14.54	0.94	0.86–1.03	0.199			
2014	1201/7959	15.09	0.98	0.89–1.08	0.702			
2015	1278/8083	15.81	1.04	0.95–1.14	0.431			
2016	1428/8341	17.12	1.04	1.04–1.25	0.004			
2017	1285/7843	16.38	1.08	0.99–1.19	0.091			
2018	1603/9366	17.12	1.14	1.04–1.25	0.003			
2019	1627/10 353	15.72	1.03	0.94–1.12	0.506			
2020	873/5936	14.71	0.95	0.86–1.05	0.345			
Year of arrival								
≤5 years	4339/27 099	16.01	Ref			Ref		
>5 years	2763/15 347	18.00	0.87	0.82–0.92	<0.001	0.91	0.86–0.96	0.002
Unknown	5252/36 206	14.51	0.77	0.73–0.81	<0.001	1.15	1.05–1.25	0.002

Number of partners in the past 12 months includes regular and casual partners. STI, diagnosed with chlamydia, gonorrhoea or syphilis on the day of consultation. *n*, the number of heterosexuals tested for HIV; *N*, the number of heterosexuals in the subgroup; OR, odds ratio; CI, confidence interval; aOR, adjusted odd ratio; Ref, reference; s.d., standard deviation; IQR, interquartile range.

partners, which could increase their risk of HIV acquisition, were less likely to have an HIV test. In our study, we did not collect data on the reasons for condom use, but we anticipated that the main reason for condom use in heterosexuals is to prevent pregnancy rather than to prevent HIV/STIs, as suggested elsewhere.[34] Health education targeting heterosexuals on condomless sex and HIV transmission should be scaled up.

This study is subject to several limitations. First, this study was conducted in an urban sexual health clinic. Individuals attending a sexual health clinic may be more likely to be sexually active, and have better knowledge and awareness of HIV and sexual health; therefore, our data may not be generalisable to a wider heterosexual population in Australia and other settings. Second, recall bias and social desirability bias may have occurred, as the individuals were asked to self-report their sexual behaviours and the date of the last HIV test. However, we used computer-assisted self-interviewing to collect this sensitive information, which is more reliable than face-to-face interview data collection.[35] Third, we did

Table 4. Mean and median months since the last HIV test.

Factor	Mean months since last HIV test (±s.d.)	Median months since last HIV test (IQR)	*P*-value
All	29.5 (±39.7)	16.7 (6.9, 35.3)	
Sex			
Male	33.0 (±44.8)	18.0 (6.9, 38.7)	<0.001
Female	25.8 (±32.8)	15.8 (6.9, 31.7)	
Age (years)			
16–19	12.9 (±13.0)	9.1 (3.4, 18.1)	<0.001
20–29	22.0 (±22.1)	15.2 (6.8, 29.2)	
30–39	34.7 (±39.5)	20.9 (7.6, 46.2)	
40–49	59.8 (±75.2)	25.9 (6.6, 83.4)	
50–59	79.8 (±97.6)	31.8 (7.4, 128.7)	
≥60	77.8 (±94.2)	32.3 (6.4, 125.6)	
Region of birth			
Oceania and Antarctica	33.5 (±49.1)	16.1 (5.2, 38.1)	<0.001
North-west Europe	27.2 (±32.3)	17.4 (8.4, 33.8)	
South-east Europe	30.6 (±37.3)	18.9 (7.5, 38.1)	
North Africa and Middle East	24.2 (±30.5)	14.4 (5.5, 29.9)	
South-east Asia	26.1 (±34.8)	15.0 (5.3, 32.2)	
North-east Asia	23.1 (±30.6)	13.0 (4.5, 29.6)	
South-central Asia	27.6 (±33.6)	17.2 (5.3, 35.6)	
Americas	26.2 (±29.8)	16.7 (8.5, 32.2)	
Sub-Saharan Africa	31.2 (±34.4)	18.9 (7.7, 40.2)	
Unknown	34.4 (±49.0)	17.9 (7.1, 39.2)	
Aboriginal and Torres Strait Islander			
No	29.4 (±39.4)	16.8 (6.9, 68.8)	0.706
Yes	25.9 (±30.2)	16.1 (6.2, 34.1)	
Unknown	30.6 (±42.9)	16.5 (6.7, 36.3)	
Self-reported history of STI			
No	31.8 (±40.5)	18.9 (8.1, 38.2)	<0.001
Yes	25.6 (±37.7)	14.0 (5.4, 29.4)	
Unknown	27.3 (±40.6)	14.2 (4.7, 32.1)	
Injecting drug use			
Never injected	29.4 (±39.4)	16.7 (6.9, 35.2)	0.094
Ever injected	38.5(±53.3)	20.0 (6.0, 43.8)	
Unknown	27.8 (±38.6)	17.2 (6.0, 34.3)	
Marital status			
Married/defecto	43.8 (±58.8)	21.8 (6.4, 55.7)	<0.001
Divorced/separated/ widowed	48.3 (±68.5)	20.2 (5.6, 60.0)	
Single/never married	25.0 (±29.1)	16.0 (6.9, 31.9)	
Unknown	37.1 (±51.1)	18.8 (7.6, 41.0)	
Presence of symptoms			
Asymptomatic	31.1 (±38.8)	18.9 (8.6, 37.5)	<0.001
Symptomatic/contact of infection	28.7 (±40.5)	15.7 (6.0, 33.6)	
Unknown	26.9 (±39.0)	13.9 (5.4, 31.6)	
STI diagnosis on the consultation day			
No	31.5 (±40.8)	18.4 (8.1, 37.3)	<0.001
Yes	25.8 (±33.3)	15.3 (6.0, 31.1)	
Unknown	22.4 (±36.5)	10.5 (3.1, 25.7)	
Condom use with regular partner			
Always	31.9 (±41.4)	18.4 (7.3, 39.7)	<0.001
Not always	32.2 (±44.0)	17.6 (6.7, 38.0)	
No regular partner	26.7 (±34.6)	16.0 (2.9, 32.5)	
Unknown	34.6 (±48.5)	39.1 (6.2, 40.5)	
Condom use with casual partner in the past 12 months			
Always	31.4 (±43.0)	17.5 (7.0, 36.1)	<0.001
Not always	27.8 (±36.0)	16.4 (7.0, 34.1)	
No casual partner	37.2 (±49.8)	20.3 (7.0, 45.7)	
Unknown	32.3 (±47.4)	15.9 (6.0, 36.5)	
Year of consultation			
2011	30.9 (±39.7)	18.0 (6.9, 37.3)	<0.001
2012	32.8 (±40.9)	19.9 (7.7, 40.1)	
2013	30.6 (±38.1)	18.6 (7.9, 37.5)	
2014	30.0 (±36.9)	17.9 (7.7, 37.2)	
2015	30.1 (±39.9)	17.6 (7.1, 35.6)	
2016	29.2 (±41.1)	15.8 (6.2, 34.2)	
2017	29.4 (±41.3)	16.0 (6.7, 34.1)	
2018	27.6 (±39.6)	15.2 (6.0, 31.4)	
2019	27.1 (±37.4)	15.6 (6.7, 32.4)	
2020	29.0 (±43.0)	15.0 (6.4, 32.5)	
Year of arrival			
≤5 years	23.2 (±24.2)	15.8 (7.8, 29.5)	<0.001
>5 years	30.0 (±37.1)	18.3 (7.9, 36.9)	
Unknown	32.7 (±48.0)	15.9 (5.4, 37.2)	

The Jonchkeere test was used to analyse median months since the last HIV test regarding sex, age, year of consultation and year of arrival. The Kruskal–Walis was used to analyse median months since the last HIV test regarding region of birth, Aboriginal and Torres Strait Islander, self-reported history of STI, injecting drug use, marital status, presence of symptoms, STI diagnosis on the consultation day, condom use with regular partner, and condom use with casual partners in the past 12 months. s.d., standard deviation; IQR, interquartile range.

not collect data on the reason for the last HIV test. Some individuals might have tested for HIV, not because of their sexual risk, and this may include the requirement for certain Australian visas or occupations.[36,37] Fourth, our study period included 1 year of the coronavirus disease 2019 (COVID-19) pandemic (i.e. 2020), which led to a significant decline in the

number of heterosexuals clinic attendance in 2020.[38] Past studies have shown that there was a significant reduction in the number of HIV tests in Australia during the COVID-19 pandemic, and this might partly be due to changes in sexual behaviours, such as the reduced number of casual sex partners, during the pandemic.[39–41]

To conclude, the declining trend in the proportion of heterosexuals who have ever tested for HIV in our study highlights the importance of scaling up HIV testing among heterosexuals to reduce HIV transmission in Australia. Existing campaigns, such as The Drama Downunder (https://www.thedramadownunder.info/) and Ending HIV,[27] provide information about HIV testing and clinics offering HIV testing services, with the aim of optimising access to and increasing the uptake of HIV testing in Australia. However, these campaigns mainly target MSM population, which have coincided with a consistently increasing trend in HIV testing among this group.[11,13] In contrast, HIV prevention interventions for heterosexuals have been neglected. HIV testing in heterosexuals is not specifically recommended unless they engage in sexual behaviours that increase their risk of acquiring HIV (e.g. new sexual partners, living in or travelling to areas of higher HIV prevalence in Australia or in other countries). Among those who face barriers in accessing healthcare services for HIV testing, including heterosexuals, HIV self-testing is highly feasible, and can provide privacy and convenience to users and, in turn, help in the scaling up of HIV testing.[42,43] Since December 2021, HIV self-testing kits have been made available through Australian pharmacies, providing an opportunity to increase HIV testing uptake.[44] Furthermore, novel approaches, such as using opt-out HIV testing,[45] HIV self-testing vending machines,[46,47] online HIV self-testing[48] and using behavioural economics to improve engagement,[49] could be investigated to scale up the uptake of HIV testing among heterosexuals, and ultimately reduce HIV transmission in Australia.

Supplementary material

Supplementary material is available online.

References

1 Joint United Nations Programme on HIV/AIDS (UNAIDS). Fact sheet: latest global and regional statistics on the status of the AIDS epidemic. 2021. Available at https://www.unaids.org/sites/default/files/media_asset/UNAIDS_FactSheet_en.pdf

2 Lim M, Devine A, Gray RT, Kwon JA, Hutchinson JL, Ong JJ. Lifetime cost of HIV management in Australia: an economic model. *Sexual Health* 2022; 19(6): 517–524. doi:10.1071/SH21250

3 Department of Health and Aged Care. Now more than ever, the fight against HIV must continue. Available at https://www.health.gov.au/ministers/the-hon-greg-hunt-mp/media/now-more-than-ever-the-fight-against-hiv-must-continue [accessd 12 July 2023]

4 Department of Health and Human Services Victoria. Guidelines for the use of antiretroviral agents in adults and adolescents with HIV: panel on antiretroviral guidelines for adults and adolescents. 2023. Available at https://clinicalinfo.hiv.gov/sites/default/files/guidelines/documents/adult-adolescent-arv/guidelines-adult-adolescent-arv.pdf

5 Grulich A, Bavinton B, Stoové M, Wright PE, Treloar C. Agenda 2025 ending HIV transmission in Australia. 2021. Available at https://www.afao.org.au/wp-content/uploads/2021/06/Agenda-25-Technical-Paper.pdf

6 Australian Federation of AIDS Organisation (AFAO). HIV in Australia 2022. Australian Federation of AIDS Organisation; 2022.

7 Kirby institute and UNSW. HIV notification rates by year. 2022. Available at https://data.kirby.unsw.edu.au/hiv

8 Leidel S, McConigley R, Boldy D, Girdler S, Wilson S. Should Australia consider opt-out HIV testing? *Australas Med J* 2015; 8(1): 30–32. doi:10.4066/AMJ.2015.2290

9 Centers for Disease Control and Prevention. HIV testing. 2021. Available at https://www.cdc.gov/hiv/testing/index.html [accessed 20 December 2021].

10 Bond KT, Frye V, Taylor R, *et al.* Knowing is not enough: a qualitative report on HIV testing among heterosexual African-American men. *AIDS Care* 2015; 27(2): 182–188. doi:10.1080/09540121.2014.963009

11 Lin A-C, Fairley CK, Dutt K, *et al.* Testing for HIV among men who have sex with men needs a paradigm shift in Australia, given the minimal increase between 2003 and 2013 in Melbourne, Australia. *Sexual Health* 2015; 12(5): 373. doi:10.1071/SH14167

12 MacGibbon J, Lea T, Ellard J, *et al.* Attitudes to biomedical HIV prevention among Australian gay and bisexual men: key findings from the PrEPARE Project 2019. Centre for Social Research in Health, UNSW Sydney; 2019. Available at http://unsworks.unsw.edu.au/fapi/datastream/unsworks:61623/bin7a4eb73c-e570-4882-8c69-c8a1a5de4d49?view=true&xy=012021

13 Grulich AE, Nigro SJ, Chan C, Patel P, *et al.* Trends in HIV and HIV prevention indicators in gay, bisexual and other men who have sex with men in NSW, 2015-2019: implications for new interventions and for monitoring and evaluation in a new NSW HIV strategy. Kirby Institute, UNSW Sydney; 2020.

14 Grulich AE, de Visser RO, Badcock PB, *et al.* Knowledge about and experience of sexually transmissible infections in a representative sample of adults: the Second Australian Study of Health and Relationships. *Sex Health* 2014; 11(5): 481–494. doi:10.1071/SH14121

15 Australian Government Department of Health. The eight national HIV strategy 2018-2022. 2022. Available at https://www.health.gov.au/sites/default/files/documents/2022/06/eighth-national-hiv-strategy-2018-2022.pdf [accessed 19 May 2023].

16 King J. National HIV notifications Q1 2016 – Q4 2020. Kirby Institute, University of New South Wales; 2021.

17 Department of Health. National HIV testing policy. Canberra: Department of Health; 2020.

18 Melbourne Sexual Health Centre. Annual report 2019 – services and consultations. 2019. Available at https://www.mshc.org.au/images/downloads/AnnualReports/MSHC_AnnualReport_2019.pdf [accessed 30 May 2023].

19 Chow EPF, Fehler G, Chen MY, *et al.* Testing commercial sex workers for sexually transmitted infections in Victoria, Australia: an evaluation of the impact of reducing the frequency of testing. *PLoS ONE* 2014; 9(7): e103081. doi:10.1371/journal.pone.0103081

20 Australian Bureau of Statistics. Standard Australian Classification of Countries (SACC). 2016. Available at https://www.abs.gov.au/statistics/classifications/standard-australian-classification-countries-sacc/latest-release [accessed 22 December 2021].

21 Blackshaw LCD, Chow EPF, Varma R, *et al.* Characteristics of recently arrived Asian men who have sex with men diagnosed with HIV through sexual health services in Melbourne and Sydney. *Aust N Z J Public Health* 2019; 43(5): 424–428. doi:10.1111/1753-6405.12926

22 Mao L, Broady T, Holt M, Newman C, Treloar C. Annual report of trends in behaviour 2021: HIV and STIs in Australia. Sydney: Centre for Social Research in Health, UNSW Sydney; 2021.

23 Lopez-Quintero C, Shtarkshall R, Neumark YD. Barriers to HIV-testing among Hispanics in the United States: analysis of the National Health Interview Survey, 2000. *AIDS Patient Care STDS* 2005; 19(10): 672–683. doi:10.1089/apc.2005.19.672

24 Schwarcz S, Richards TA, Frank H, *et al.* Identifying barriers to HIV testing: personal and contextual factors associated with late HIV

testing. *AIDS Care* 2011; 23(7): 892–900. doi:10.1080/09540121.2010.534436
25 Ward EG, Disch WB, Schensul JJ, Levy JA. Understanding low-income, minority older adult self-perceptions of HIV risk. *J Assoc Nurses AIDS Care* 2011; 22(1): 26–37. doi:10.1016/j.jana.2010.05.002
26 Brener L, Wilson H, Slavin S, de Wit J. The impact of living with HIV: differences in experiences of stigma for heterosexual and homosexual people living with HIV in Australia. *Sexual Health* 2013; 10(4): 316. doi:10.1071/SH12170
27 AIDS Council of NSW (ACON). Ending HIV: how I get tested for HIV for free. 2022. Available at https://endinghiv.org.au/ending-hiv/
28 Khin SO, Hone S, Lin C, Comulada WS, Detels R, Lee S-J. Factors associated with lifetime HIV testing among women in four Southeast Asian countries: evidence from the demographic and health surveys. *Int J STD AIDS* 2023; 34(7): 439–447. doi:10.1177/09564624231162417
29 Victorian Department of Health and Human Services. HIV quarterly surveillance report. Melbourne, Australia: State Government of Victoria; 2022. Available at https://www.health.vic.gov.au/infectious-diseases/hiv-quarterly-surveillance-report [accessed 21 April 2022].
30 Phillips TR, Medland N, Chow EPF, *et al.* Newly arrived Asian-born gay men in Australia: exploring men's HIV knowledge, attitudes, prevention strategies and facilitators toward safer sexual practices. *BMC Infect Dis* 2022; 22(1), 209. doi:10.1186/s12879-022-07174-z
31 Barker EK, Malekinejad M, Merai R, *et al.* Risk of HIV acquisition among high-risk heterosexuals with nonviral sexually transmitted infections: a systematic review and meta-analysis. *Sex Transm Dis* 2022; 49(6):383–397. doi:10.1097/OLQ.0000000000001601
32 Gwadz M, Cleland CM, Kutnick A, *et al.* Factors associated with recent HIV testing among heterosexuals at high risk for HIV infection in New York City. *Front Public Health* 2016; 4: 76. doi:10.3389/fpubh.2016.00076
33 Saleem K, Ting EL, Loh AJW, *et al.* Missed opportunities for HIV testing among those who accessed sexually transmitted infection (STI) services, tested for STIs and diagnosed with STIs: a systematic review and meta-analysis. *J Int AIDS Soc* 2023; 26(4), e26049. doi:10.1002/jia2.26049
34 Anderson JE, Wilson R, Doll L, Jones TS, Barker P. Condom use and HIV risk behaviors among U.S. adults: data from a national survey. *Fam Plan Perspect* 1999; 31(1): 24–28. doi:10.2307/2991553
35 Ghanem KG. Audio computer assisted self interview and face to face interview modes in assessing response bias among STD clinic patients. *Sex Transm Infect* 2005; 81(5): 421–425. doi:10.1136/sti.2004.013193
36 Australian Federation of AIDS organisation (AFAO). Applying for permanent residence in Australia Information for people with HIV and their advisors. 2011. Available at https://napwha.org.au/files/factsheet_0311_immigration.pdf [accessed 21 April 2022].
37 WA AIDS Council (WAAC). HIV and employment. 2023. Available at https://www.waac.com.au/learn/living-with-hiv/employment/ [accessed 21 April 2022].
38 Chow EPF, Hocking JS, Ong JJ, Phillips TR, Fairley CK. Sexually transmitted infection diagnoses and access to a sexual health service before and after the national lockdown for COVID-19 in Melbourne, Australia. *Open Forum Infect Dis* 2021; 8(1), ofaa275. doi:10.1093/ofid/ofaa536
39 Chow EPF, Ong JJ, Donovan B, *et al.* Comparing HIV post-exposure prophylaxis, testing, and new diagnoses in two Australian cities with different lockdown measures during the COVID-19 pandemic. *Int J Environ Res Public Health* 2021; 18(20): 10814. doi:10.3390/ijerph182010814
40 Chow EPF, Ong JJ, Denham I, Fairley CK. HIV testing and diagnoses during the COVID-19 pandemic in Melbourne, Australia. *J Acquir Immune Defic Syndr* 2021; 86(4): e114–e115. doi:10.1097/QAI.0000000000002604
41 Coombe J, Kong FYS, Bittleston H, *et al.* Love during lockdown: findings from an online survey examining the impact of COVID-19 on the sexual health of people living in Australia. *Sex Transm Infect* 2021; 97(5): 357–362. doi:10.1136/sextrans-2020-054688
42 Krause J, Subklew-Sehume F, Kenyon C, Colebunders R. Acceptability of HIV self-testing: a systematic literature review. *BMC Public Health* 2013; 13(1): 735. doi:10.1186/1471-2458-13-735
43 Figueroa C, Johnson C, Verster A, Baggaley R. Attitudes and acceptability on HIV self-testing among key populations: a literature review. *AIDS Behav* 2015; 19(11): 1949–1965. doi:10.1007/s10461-015-1097-8
44 Attwooll J. HIV self-tests to be sold in pharmacies. 2021. Available at https://www1.racgp.org.au/newsgp/clinical/hiv-self-tests-to-be-sold-in-pharmacies [accessed 19 June 2023].
45 Soh QR, Oh LYJ, Chow EPF, Johnson CC, Jamil MS, Ong JJ. HIV testing uptake according to opt-in, opt-out or risk-based testing approaches: a systematic review and meta-analysis. *Curr HIV/AIDS Rep* 2022; 19: 375–383. doi:10.1007/s11904-022-00614-0
46 Queensland Positive People. Rapid: test for HIV at home. 2023. Available at https://www.rapid.org.au/vend
47 Vera JH, Suneeta S, Alex P, *et al.* Acceptability and feasibility of using digital vending machines to deliver HIV self-tests to men who have sex with men. *Sex Transm Infect* 2019; 95(8): 557. doi:10.1136/sextrans-2018-053857
48 Bell SFE, Lemoire J, Debattista J, *et al.* Online HIV self-testing (HIVST) dissemination by an Australian Community Peer HIV Organisation: a scalable way to increase access to testing, particularly for suboptimal testers. *Int J Environ Res Public Health* 2021; 18(21): 11252. doi:10.3390/ijerph182111252
49 Aung ET, Fairley CK, Chow EPF, *et al.* Exploring the use of "nudges" to improve HIV and other sexually transmitted infection testing among men who have sex with men. *Arch Sexual Behav* 2022; 51: 2641–2650. doi:10.1007/s10508-022-02321-8

Data availability. The data that support this study cannot be publicly shared due to ethical or privacy reasons and may be shared upon reasonable request to the corresponding author if appropriate.

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