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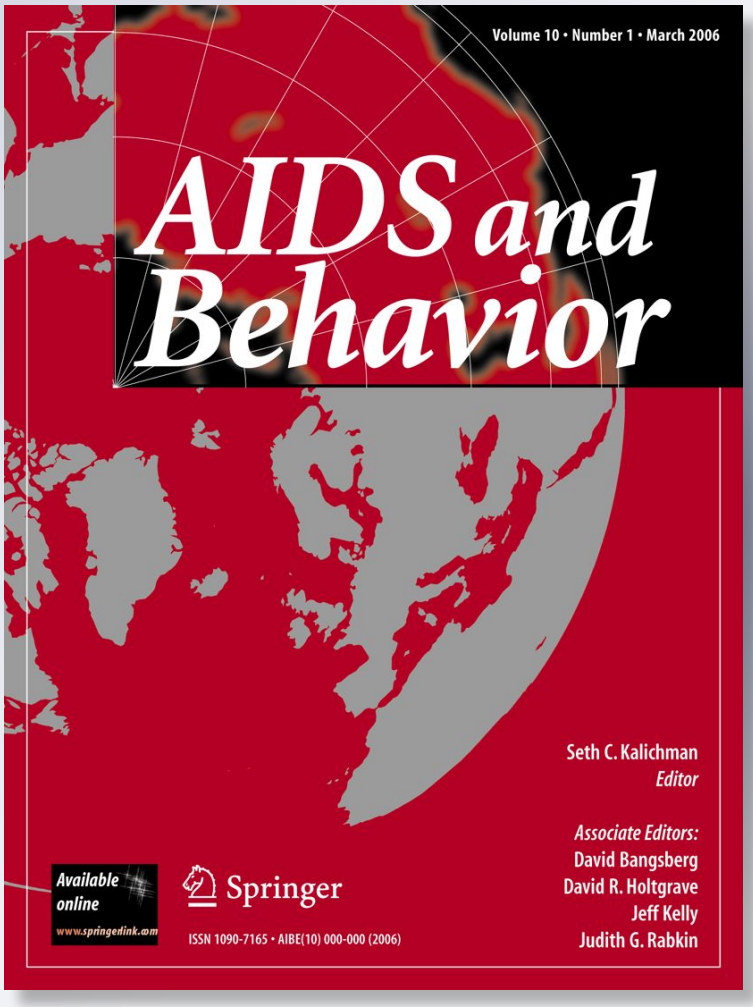

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The Difference in Self-Reported and Biological Measured HIV Prevalence: Implications for HIV Prevention

Alisa E. Pedrana · Margaret E. Hellard · Rebecca Guy · Kim Wilson · Mark Stoove

Abstract In Australia, HIV prevalence estimates among gay men have been mainly based on self-reported HIV status collected in annual behavioural surveys. We measured biological HIV prevalence among gay men in Melbourne, Australia, using a facility based sampling method. We calculated HIV prevalence and used logistic regression to assess correlates of a positive HIV test. A total of 639 gay men were recruited completed a survey and provided oral fluid for HIV testing from seven venues in 2008. The median age of the participants was 35 years (range 18–75 years). Overall biological HIV prevalence was 9.5% (95% CI 7.5–12.0%) compared with 6.3% (95% CI 4.5–8.4%) for self-reported HIV positive status. We found a significant discrepancy between test detected biological and self-report HIV status in our study, with 19 men (31.1%) unaware of their HIV infection. These results highlight the importance of repeatable biological estimates to inform and evaluate HIV prevention strategies.

A. E. Pedrana (✉) · M. E. Hellard · M. Stoove
Centre for Population Health, Burnet Institute, GPO Box 2284, Melbourne, VIC 3004, Australia
e-mail: alisa@burnet.edu.au

A. E. Pedrana · M. E. Hellard · M. Stoove
Department of Epidemiology and Preventive Medicine, Monash University, Melbourne, VIC, Australia

M. E. Hellard
The Nossal Institute for Global Health, The University of Melbourne, Melbourne, VIC, Australia

R. Guy
Faculty of Medicine, National Centre in HIV Epidemiology and Clinical Research, Sydney, NSW, Australia

K. Wilson
National Serology Reference Laboratory, Melbourne, Australia

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Introduction

In Australia, men who have sex with men (MSM) account for more than 65% of newly diagnosed and 85% of newly acquired HIV infections each year [1]. Over the past decade there has been a steady increase in the annual number of newly acquired HIV infections among MSM, from 667 in 2001 to 909 cases in 2009 [1]. Similar trends have been observed in Melbourne the capital of Victoria, Australia, a jurisdiction with the second largest gay population in Australia [2]. The rise in HIV diagnoses has been attributed to more risky sexual behaviours among gay men [3] and dramatic increases in other sexually transmitted infections (STIs) including syphilis, gonorrhoea and chlamydia [1, 4–6], that are known to increase HIV transmission risk [7–10].

In Australia, HIV prevalence estimates among gay men have been mainly based on self-reported HIV status collected in annual behavioural surveys; recent prevalence estimates among MSM are reported between 5–9% [2, 9, 11]. However, such surveys are likely to under-estimate HIV prevalence as self-reported HIV status is affected by testing patterns and a subset of men with HIV infection who may not be aware of their positive HIV status at the time of the survey. Internationally, studies among MSM have demonstrated wide discrepancies between self-reported and biological HIV status [12, 13].

The collection of biological samples to estimate HIV prevalence alongside unlinked anonymous behavioural surveys is widely used as a surveillance tool throughout Europe, the US and Africa [14–16]. Finger-prick blood [15–17] and oral fluid specimens [14, 16, 18] were the

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preferred method of specimen collection among recent studies, offering advantages over venous blood samples; being less invasive, less costly, easier to handle and, for those offering rapid testing, can provide participants with results at the point-of-care. The use of such devices in community settings is ideal for the routine and periodic estimation of HIV prevalence. Such measurement is important for determining burden of disease, evaluating prevention initiatives and for modelling epidemic trajectories. In this paper, we estimate test detected HIV biological-prevalence among gay men using oral fluid HIV testing and compare this to self-reported HIV status. We also explore correlates of a HIV infection.

Methods

Setting

Melbourne, Australia, a jurisdiction with the second largest gay population in Australia [2]. Melbourne's gay community venues consist largely of gay social venues (bars and clubs) and sex-on-premises venues (SOPV) (including gay saunas), with at least 10 SOPVs in operation in 2007 [19].

Study Design

In June 2008 a cross-sectional sample of gay men was recruited through seven gay community venues in inner city Melbourne; four SOPVs and three gay bars and clubs. Using a facility-based sampling method [20], a convenience sample of gay men were recruited on specific days and times of the week to maximise attendance numbers and participation rates. Locations and times of the week (time-location-sampling) were chosen to maximise recruitment (Friday and Saturday nights for bars/clubs; Thursday, Friday, Saturday and Sunday evenings for SOPVs). Recruitment was preceded by a social marketing campaign to raise awareness about the survey and the novel nature of specimen collection.

Men were approached at the venues by trained field researchers and invited to participate. The study inclusion criteria were anyone aged 18 years or over, who self-identified as gay or had sex with another man in the past 5 years and able to provide verbal informed consent. Consenting men self-completed a questionnaire and provided an oral fluid specimen onsite at the venues using the OraSure collection kit (OraSure Technologies, Inc., Bethlehem, Pennsylvania, USA) according to the manufacturer's instructions. Individual HIV test results were not provided to participants because oral fluid testing for HIV infection is not registered in Australia for screening or diagnostic purposes. Given that participants were not able to benefit from receiving their test result at the point-of-care, study recruitment cards were provided that included the study website address containing details of where men could access free HIV testing or telephone counselling. Researcher recruitment logs recorded how many men were approached to participate and aimed to capture reasons for non-participation.

Questionnaire

The questionnaire was adapted from the instrument used in the Melbourne Gay Community Period Surveys (MGCPS) [21]. The MGCPS is an annual behavioural survey among gay men which captures information about demographics, sexual self-identity, gay community social attachment, sexual relationships, sexual practices with regular and casual partners, knowledge of partners' HIV status, self-reported perceived HIV status and HIV/STI testing history. The sexual behaviour questions related to the past 6 months, and HIV/STI testing the past year. We included additional questions regarding confidence about knowing HIV status and acceptability of oral fluid specimen collection, which asked "How comfortable have you found the collection of saliva in this study?" and "Would you participate in future Melbourne Gay Community Periodic Surveys if a saliva specimen was collected?"

HIV Testing

Oral fluid specimens were tested for HIV by the National Serology Reference Laboratory (NRL) using an anti-HIV IgG antibody capture ELISA (GACELISA) based on the method developed by Parry et al. [22]. An internal validation study of the GACELISA at NRL demonstrated a sensitivity of 100% (95% CI: 95.0–100.0) and specificity of 100% (95% CI: 95.0–100.0%) upon repeat testing as per the testing protocol. The HIV status of all specimens testing repeatedly positive by the HIV-1 EIA test were confirmed using an oral fluid based western blot.

Statistical Analysis

The questionnaires and oral fluid specimens were matched by a numeric unique identifier. Men were asked whether they had sex with any casual male partner/s in the past 6 months (yes/no) and if they 'never', 'occasionally' or 'often' engaged as a receptive or insertive partner in anal intercourse with a condom, without a condom with ejaculation, and without a condom with withdrawal before ejaculating, in the last 6 months. From this we constructed a variable of unprotected anal intercourse with casual partners (UAIC) (no casual partner, no anal intercourse, no UAIC, any UAIC). Men were also asked about how many of their friends were gay or homosexual men (none, a few,

some, or most) and how much of their free time is spent with gay or homosexual men (none, a little, some, a lot). From these, we constructed a variable of 'social engagement with gay men' (lower, moderate, extensive) based on a matrix of the above two questions.

HIV prevalence estimates were calculated from the biological test result and also self-reported HIV status, and 95% confidence intervals were calculated for all estimates using binomial standard formulas. To assess the concordance in classification of HIV status by self-report and test detected measures, we used a matched McNemar's test. Univariable and multivariable logistic regression models were used to identify factors independently associated with both self-reported and test detected HIV status. For the multivariable analysis a backward stepwise method was used. Data analysis was performed using Stata 10.1 (StataCorp, Texas, USA) [23]. A cut off of $P < 0.05$ was used for all statistical tests.

Ethics approval was obtained from the Victorian Department of Health Human Research Ethics Committee and the Monash University Standing Committee on Ethics in Research Involving Humans.

Results

Sample

In the study, 1,027 men were approached to participate and 639 men (62.2%) completed a questionnaire that could be matched to an oral fluid sample (three questionnaires could not be matched to an oral fluid sample). Participants were recruited from the seven gay community venues (57.0% from four SOPVs and 43.0% from three bars and clubs). The median age of the participants was 35 years (range 18–75 years). The majority of participants (70.1%) were born in Australia, 89.1% reported residing in metropolitan Melbourne, 75.9% were in full-time employment and 51.0% had completed tertiary education. The majority of men reported their sexual identity as homosexual (84.2%) or bisexual (11.8%) and were either extensively engaged (42.4%) or moderately engaged with the gay community (38.6%) (Table 1). Men's sexual risk behaviours, HIV testing history, and STI testing history are summarised in Table 2 by self-reported and test detected HIV status.

HIV Prevalence–Test Detected

Of the 639 men, 61 provided specimens that were HIV positive (9.5%, 95% CI 7.5–12.0%). HIV prevalence increased significantly with increasing age up until age 50 and then fell slightly; 2.6, 7.7, 17.3 and 14.6% in 18–29, 30–39, 40–49 and 50+ year olds, respectively (Table 1). In univariable analyses, test detected HIV positive status ($n = 61$) was significantly associated with being recruited from SOPVs, older age, receiving 'a pension/social security benefits' or being unemployed, reporting knowing someone with HIV, reporting having a HIV positive current regular partner, high risk sexual practices (multiple sexual partners, UAIC, group sex) and infrequent HIV and STI testing (Table 3). HIV prevalence was highest among men reporting areas of residence in rural or regional Victoria (16.7%) compared to metropolitan Melbourne (9.5%) and other/interstate (6.7%), however this difference was not significant (Table 1). Multivariable logistic regression showed independent associations between a positive HIV result and being older (≥40 years), reporting UAIC in the past 6 months, reporting group sex with regular and/or casual partners in the past 6 months and reporting having HIV positive regular partner, after adjusting for recruitment site and residential location (Table 3).

HIV Prevalence–Self Report

Of the 639 men, 40 men reported being HIV positive corresponding to a HIV self-report prevalence of 6.3% (95% CI 4.5–8.4%), however four returned a negative HIV test result. HIV prevalence increased significantly with increasing age up until age 50 and then fell slightly; 1.0, 3.3, 14.0 and 12.6% in 18–29, 30–39, 40–49 and 50+ year olds, respectively (Table 1). For self-reported HIV positive status ($n = 40$), univariable analyses showed similar correlates to those found for test detected HIV, although HIV was no longer significantly associated with being recruited from SOPVs (Table 4). Multivariable logistic regression showed independent associations between a self-reported HIV positive status and being older (aged 40 years and over), reporting UAIC in the past 6 months, reporting having a HIV positive regular partner and reporting any STI testing in the past 12 months, after adjusting for recruitment site and residential location (Table 4).

Comparisons between Test Detected HIV Status and Self-Reported HIV Status

When we examined HIV prevalence according to the two outcome measures (self-reported vs. test detected), the prevalence of self-reported HIV (6.3%) was 1.5 times lower overall than test detected HIV prevalence (9.5%). According to the matched McNemar's test there was a significant misclassification of HIV status through self-report (P value < 0.01). The overall lower prevalence of HIV by self-report compared to test detected was consistent across most characteristics (Table 1, 2), with a few exceptions. Self-reported and test detected HIV results, were discrepant among those who reported being born

Table 1 Demographics and engagement with gay men by self-report HIV status and test detected HIV result ($n = 639$)

Demographics	HIV status			
	Self-report		Test detected	
	HIV+/Total	(%)	HIV+/Total	(%)
	40/639	6.3	61/639	9.5
Recruitment site				
Bars/Clubs	14/257	5.5	19/275	6.9
SOPVs	26/360	7.2	42/364	11.5
Age group (years)				
18–29	2/193	1.0	5/195	2.6
30–39	6/180	3.3	14/181	7.7
40–49	21/150	14.0	26/150	17.3
50+	11/87	12.6	13/89	14.6
Median age	45/36		44/36	
Country of birth				
Australia	32/448	7.1	43/452	9.5
Other	8/162	4.9	15/162	9.3
Residential location				
Metropolitan Melbourne	35/520	6.7	50/524	9.5
Rural & Regional Victoria	2/18	11.1	3/18	16.7
Interstate/Other	2/45	4.4	3/45	6.7
Ethnicity				
Anglo-Australian	23/336	6.9	31/339	9.2
Other	17/274	6.2	27/276	9.8
Education				
Secondary or less	11/176	6.3	19/177	10.7
Further/Vocational	9/106	8.5	12/107	11.2
Degree/postgraduate	19/324	5.9	26/326	8.0
Employment				
Employed (full/part time)	27/508	5.3	45/512	8.8
Unemployed[a]	5/77	6.5	5/77	6.5
Pensioner/social security benefits	7/22	31.8	7/22	31.8
Sexual identity				
Homosexual/Bisexual	39/594	6.6	58/612	9.5
Other[b]	1/23	4.3	3/26	11.5
Social engagement with gay men[c]				
Low/Moderate	18/356	5.1	34/364	9.3
Extensive	21/257	8.2	26/268	9.70
Knowing someone with HIV				
No	8/220	3.6	12/221	5.4
Yes	32/325	9.9	42/328	12.8
Acceptability of oral fluid testing				
Uncomfortable/Very uncomfortable	4/42	9.5	4/43	9.3
Comfortable/very comfortable	35/561	6.2	53/565	9.4

Unknowns excluded from table
CI confidence interval, *OR* unadjusted odd ratio

† P value < 0.05

[a] Unemployed includes: unemployed, students and other

[b] Other includes: heterosexual, open minded, sexual, undefined/unlabelled

[c] Social engagement is a summary variable made up of matrix of two questions, namely 'Proportions of friends that are gay' and 'Time is spent with gay or homosexual men'

outside Australia, those not identifying as homosexual or bisexual, and those reporting not having recently (in the past 12 months) tested for STIs or ever tested for HIV. Comparing the two multivariable logistic regression models, the two models were largely comparable. However, discrepant from self-reported HIV status, test detected HIV status was 1) not associated with recent STI testing (in the past 12 months); 2) associated with group sex with any partner; and 3) less strongly associated other UAIC and with older age.

Table 2 Reported sexual risk behaviours, HIV testing history, STI testing history by self-report HIV status and test detected HIV result ($n = 639$)

	HIV Status			
	Self-reported		Test detected	
	HIV+/ Total 40/639	(%)	HIV+/ Total 61/639	(%)
No. sex partners (in past 6 months)				
10 or less	16/422	3.8	32/436	7.3
More than 10	23/188	12.2	28/192	14.6
Look for sex on the internet				
Never	11/151	7.3	12/152	7.9
Occasionally/often	24/364	6.6	35/367	9.5
Sex with regular partner in past 6 months[a]				
Yes	23/326	7.0	34/340	10.0
UAI with regular partner[a] (in past 6 months)				
Never	7/126	5.6	15/132	11.4
Occasionally/Often	15/185	8.1	18/192	9.4
Group sex with regular partner (in past 6 months)				
No	5/146	3.4	12/153	7.8
Yes	14/86	16.3	15/90	16.7
Relationship with current regular partner				
Monogamous relationship	1/61	1.6	1/61	1.6
Open relationship[b]	8/199	6.7	15/125	12.0
Several regular male partners[c]	3/26	11.5	4/26	15.4
HIV status of current regular partner				
Negative	3/142	2.1	11/143	7.7
Positive	9/18	50.0	8/18	44.4
Don't know	1/57	1.8	2/57	3.5
Sex with casual partner in past 6 months[a]				
Yes	35/496	7.1	52/511	10.2
UAI with casual partner[a] (in past 6 months)				
Never	10/305	3.3	20/316	6.3
Occasionally/Often	25/168	14.9	32/172	18.6
Group sex with casual partner (in past 6 months)				
No	6/219	2.7	13/222	5.9
Yes	29/256	11.3	38/259	14.7
Disclose of HIV status to casual partners				
None	8/227	3.5	15/231	6.5
Some	19/157	12.1	23/158	14.6
All	8/83	9.6	11/83	13.3
Disclose of HIV status by casual partners				
None	9/239	3.8	18/243	7.4
Some/All	25/230	10.9	32/232	13.8
	40/639		61/639	
Received PEP in the past 6 months				
No	37/551	6.7	52/555	9.4
Yes	2/29	6.9	3/29	10.3
Any STI test in past 12 months				
No	1/140	0.7	7/140	5.0
Yes	36/446	8.1	48/449	10.7
Ever had a HIV Test				
No	0/142	0.0	6/142	4.2
Yes	40/475	8.4	53/475	11.2
If Yes to ever had a HIV test	40/475	8.4	53/475	11.2
HIV testing history[d]				
In the past 12 months	28/320	8.8	32/320	10.0
Between 1–4 years ago	3/74	4.1	6/74	8.1
More than 4 years ago	7/36	19.4	9/36	25.0

Unknowns excluded from table *CI* confidence interval, *OR* unadjusted odd ratio

† P value < 0.05

[a] Not mutually exclusive

[b] Open relationship refers to either/both my partner & I have casual sex with other men)

[c] Several male regular partners refers to more than one regular male partner

[d] Based on last HIV antibody test, exclude those never tested

Characteristics of Undiagnosed HIV Positive Cases

Of the 61 men testing HIV positive, 36 men self-reported as HIV positive (four of the men self-reporting as HIV positive returned a HIV-negative test results), 19 self-reported as HIV-negative, with six men did not report their HIV status at all. Of these 19 undiagnosed HIV positive men, six (31.6%) reported no HIV testing history, six (31.6%) reported their last HIV test as more than 12 months ago and seven (36.8%) reported a HIV test in the past 12 months. Almost a third of men (31.6%) with undiagnosed HIV reported more than 10 sex partners and over half (52.9%) reported unprotected anal intercourse (UAI) with casual partners in past 6 months. The majority (80.0%) reported group sex in the past 6 months. Almost two-thirds (63.1%) of undiagnosed HIV positive men reported being 'very confident' or 'confident' in knowing their HIV status.

Discussion

This is the first study to assess biological HIV prevalence among gay men in social and sex venues in Melbourne, Australia. Test detected biological HIV prevalence was 9.5% (95% CI 7.5–12.0), while self-reported HIV prevalence was 6.3% (95% CI 4.5–8.4%). We found a significant

Table 3 Correlates of HIV Infection: Univariable and multivariable logistic regression model of factors related to test detected HIV status ($n = 639$)

Self-report survey data	Univariable OR (95% CI)	Multivariable Adjusted OR[a] (95% CI)	*P* value
Recruitment site			
Bars/clubs	1.0	1.0	
SOPVs	1.8 (1.0–3.1)[†]	1.3 (0.6–2.6)	0.49
Residential location			
Metropolitan Melbourne	1.0	1.0	
Other[b]	1.0 (0.4–2.4)	0.9 (0.3–2.4)	0.82
Age group			
<40 years	1.0	1.0	
>=40 years	3.7 (2.1–6.5)[†]	2.7 (1.4–5.2)[†]	<0.01
Employment			
Employed (full/part time)	1.0		
Unemployed[c]	0.7 (2.8–1.9)[†]		
Pensioner/social security benefits	4.8 (1.9–12.5)[†]		
Knowing someone with HIV			
No	1.0		
Yes	2.6 (1.3–5.0)[†]		
No. sex partners (in past 6 months)			
10 or less	1.0		
More than 10	2.2 (1.3–3.7)[†]		
UAI with casual partner (in past 6 months)			
No	1.0	1.0	
Yes	3.6 (2.1–6.3)[†]	3.0 (1.6–5.6)[†]	<0.01
Group Sex with any partner[d] (in past 6 months)			
No	1.0	1.0	
Yes	2.0 (1.6–5.1)[†]	2.1 (1.0–4.2)[†]	0.04
HIV status of current regular partner[e]			
Negative/Don't know	1.0	1.0	
Positive	11.7 (5.1–26.7)[†]	10.0 (3.7–26.7)[†]	<0.01
HIV testing history			
In the past 12 months	1.0		
>12 months ago	1.4 (0.7–2.6)		
Never tested	0.4 (0.2–0.9)[†]		
Any STI test in past 12 months			
No	1.0		
Yes	2.9 (1.1–7.4)[†]		
		Goodness-of fit = 0.6760 Ω	

Unknowns excluded from table
CI confidence interval, *OR* unadjusted odd ratio

[†] *P* value <0.05

[a] Adjusted OR for recruitment site and area of residence

[b] Other include Rural/Regional Victoria, Interstate and other

[c] Unemployed includes: unemployed, students and other

[d] Group sex with regular and/or casual partners

[e] Men without a regular partner were classified as Negative/Don't know, Ω Hosmer–Lemeshow goodness-of-fit test

discrepancy between test detected biological and self-report HIV status in our study, with 19 men (31.1% of all men testing positive for HIV) unaware of their HIV infection. Men with undiagnosed HIV commonly reported high risk sexual behaviour for the transmission of HIV and infrequent HIV testing patterns. Although numbers were small, we noted that the discrepancy in prevalence was more pronounced among particular participants and independent correlates of HIV varied across self-reported and test detected HIV status. While our sample may not be representative all gay men [2] and may be considered high risk given the proportion of SOPV recruited men, sample demographics and sexual risk behaviours are largely comparable with other Australian studies [9, 11, 24]. Recruitment protocols were also likely to have provided a sample representative of gay men most at risk of HIV [25] and better placed to meet the study aims.

The test detected biological HIV prevalence of 9.5% is similar to that reported in the only other community-based HIV prevalence study conducted among gay men in Australia (8.8%) [11] and in the UK (9.1%) [26], though slightly lower than studies in the US (12.1–19%) [16, 27].

Table 4 Correlates of HIV Infection: Univariable and multivariable logistic regression model of factors related to self-reported HIV Status ($n = 639$)

Self-report survey data	Univariable OR (95% CI)	Multivariable Adjusted OR[a] (95% CI)	*P* value
Recruitment site			
Bars/clubs	1.0	1.0	
SOPVs	1.3 (0.7–2.6)	1.3 (0.5–3.3)	0.58
Residential location			
Metropolitan Melbourne	1.0	1.0	
Other[b]	1.0 (0.3–2.7)	0.8 (0.2–3.7)	0.94
Age group			
<40 years	1.0	1.0	
>=40 years	7.1 (3.2–15.7)[†]	8.0 (3.0–21.1)[†]	<0.01
Employment			
Employed (full/part time)	1.0		
Unemployed[b]	0.7 (0.3–1.9)		
Pensioner/social security benefits	4.8 (1.9–12.5)[†]		
Knowing someone with HIV			
No	1.0		
Yes	2.9 (1.3–6.4)[†]		
No. sex partners (in past 6 months)			
10 or less	1.0		
More than 10	3.5 (1.8–6.9)[†]		
UAI with casual partner (in past 6 months)			
No	1.0	1.0	
Yes	5.1 (2.6–10.1)[†]	6.5 (2.8–15.3)[†]	<0.01
Group sex with any partner[c] (in past 6 months)			
No	1.0		
Yes	4.0 (1.8–8.5)[†]		
HIV status of current regular partner[c]			
Negative/Don't know	1.0	1.0	
Positive	20.9 (8.8–49.4)[†]	26.7 (7.5–95.8)[†]	<0.01
HIV testing history			
In the past 12 months	1.0		
>12 months ago	1.1 (0.5–2.4)		
Never tested			
Any STI test in past 12 months			
No	1.0	1.0	
Yes	12.2 (1.7–89.8)[†]	10.8 (1.4–83.7)	0.02
		Goodness-of fit = 0.9993 Ω	

[†] *P* value < 0.05

[a] Adjusted OR for recruitment site and area of residence, Ω Hosmer–Lemeshow goodness-of-fit test

[b] Other include Rural/Regional Victoria, Interstate and other

[c] Group sex with regular and/or casual partners

[d] Men without a regular partner were classified as Negative/Don't know. *CI* confidence interval, OR unadjusted odd ratio

The self-report prevalence of 6.3% in our study is consistent with previous HIV prevalence estimates in Australia based on self-report surveillance data which vary between ~5–10% [9, 28, 29]. Despite a high proportion of men accurately self-reporting their HIV status, 31% (19/61) of HIV positive participants in this study were unaware of their infection. Importantly undiagnosed HIV infections are known to contribute disproportionately to new transmissions [9] and pose a serious threat to the effectiveness of sero-sorting strategies for reducing HIV transmission [30]. However, given the relatively small numbers of undiagnosed infections in this study ($n = 19$), results should be interpreted cautiously. This study provided useful data on the prevalence and characteristics of undiagnosed infection that can only be captured by the addition of a biological outcome to behavioural surveillance data. Such data can be used to target men who may be more likely to have undiagnosed HIV with initiatives to promote regular testing and prevent secondary transmissions.

In the context of a HIV prevalence estimate approaching 10% in this sample and continuing high rates of other STIs in this population [1], further consideration of the

effectiveness of current HIV testing as prevention approaches in Australia is warranted. Current Australian testing guidelines recommend HIV testing annually for sexually active gay men and more frequent testing (3–6 monthly) for men at 'high risk' [31]. Despite these recommended testing frequencies applying to a large proportion of our study sample, most men reported much lower than the recommended testing rates with only 52% reporting recent (within the past 12 months) HIV testing. Although previous self-reported annual HIV testing rates among gay men in Australia are high (60–70%) [24, 32, 33] compared to other countries (e.g., ~40.0% in the UK [34]), our findings suggest that current HIV testing rates may be insufficient to limit the impact of undiagnosed HIV on transmissions among Australian gay men.

A range of strategies should be considered to address self-perceived and structural barriers [35] to testing and increase the frequency of HIV testing among gay men in Australia. Greater awareness of the need for more frequent testing through health promotion should be considered, including enhancing awareness of personal risk profiles in driving testing frequency. Optimising clinical systems should also be explored such as utilising nurses or peer-educators for testing or using recall systems and electronic prompts to encourage more frequent testing patterns. The use of new technologies, including text messaging [36] and computer based-technology [37] have shown positive results in improving clinic attendance and short-term behavioural outcomes. For men who have never tested, it may be worth exploring other testing models such as community-based sites [38] and HIV rapid testing [39]. Unlike many other countries [38, 40, 41], Australia does not offer rapid testing as part of HIV screening despite increasing evidence of strong consumer and provider support for this form of testing [42, 43].

The collection of oral fluid specimens alongside behavioural surveys was well received with a participation rate of over 60%, similar to the annual Gay Community Periodic Surveys which do not include oral fluid testing [21], demonstrating a high degree of acceptability of community-based biological prevalence testing in this population. Nearly all participants reported they were 'comfortable' or 'very comfortable' with having an oral fluid sample collected for HIV testing and over 90% of participants reported that they would participate in future MCGPS if oral fluid specimens were collected. These findings suggest that it would be feasible to incorporate oral fluid specimen collection in future behavioural surveys or similar community-recruited studies. HIV testing using finger-prick and oral fluid specimen collection for estimating HIV prevalence among MSM has been widely adopted in the U.S [16] and throughout Europe [14], Africa [44] and Asia [45], to enhance surveillance systems and the accuracy of HIV estimates.

The findings in this study are subject to several limitations. The recruitment strategy and sampling method may have resulted in selection bias, thus limiting the representativeness of this sample and the generalisability of the results. Our recruitment protocol replicated only the venue-based recruitment for the MGCPS. We did not recruit at the gay fair day or 'Midsumma Carnival', which constitutes approximately two-thirds of MGCPS respondents. This contributed to the higher proportion of men recruited at SOPVs compared to gay bars/clubs and thus somewhat limits direct comparisons between the two samples; although demographically the samples are very similar [21, 33]. But in relation to the aims of this study, given the places gay men report meeting sex partners [33, 35], social venue recruitment is likely to better represent those most at risk of HIV. Reporting bias may have affected data collection; a small number of participant's ($n = 4$) self-reported they were HIV positive but returned a negative HIV test. The reasons for this are not clear but could relate to incorrect form completion, misinterpretation of the question, a belief that they really were HIV positive or the test result was a false negative (although unlikely given the well documented high performance of the test) [22, 46]. Responder bias may have also have affected data collection however, given that individual test results were not provided back to participants and, as written researcher logs and verbal feedback from recruiters suggest, only a very small proportion of men approached chose not to participate because of oral fluid specimen collection, we believe this was minimised. As the paper-based surveys were self-administered, there is no way to definitively verify men's self-reported HIV status. This study did provide some advantages over current self-report HIV prevalence estimates in Australia; oral fluid testing provided non-invasive specimen collection allowing the measurement of the true HIV prevalence among this population in an acceptable manner.

Conclusions

HIV prevalence in Australian MSM remains high. Self-report HIV prevalence under estimates actual prevalence, with over 30% of HIV positive MSM in this study being unaware of their status. These data add greatly to our understanding of the HIV epidemic in Australia, by providing information about self-reported versus test detected HIV prevalence and factors associated with HIV infection. These results also highlight the importance of ongoing HIV prevention programs to encourage regular testing to reduce high transmission rates, and also to ensure that HIV biological testing is undertaken in conjunction with community-based surveys about HIV to improve HIV surveillance in Australia.

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Conflict of interests No competing interests to report.

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