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ORIGINAL PAPER

Promoting Regular Testing: An Examination of HIV and STI Testing Routines and Associated Socio-Demographic, Behavioral and Social-Cognitive Factors Among Men Who have Sex with Men in New South Wales, Australia

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Abstract Human immunodeficiency virus (HIV) and sexually transmitted infections (STI) testing rates are amongst the highest in the world among men who have sex with men (MSM) in Australia. However, notable minorities have never tested and many MSM have not tested recently. To examine testing routines and assess covariates of testing, an online survey was conducted among MSM in New South Wales. Five hundred and eighty non-HIV positive MSM (Mean age: 29.33 years) were randomized to answer questions on barriers to testing for HIV *or* STI. One in five (20.9 %) non-HIV-positive participants had never tested for HIV, 27.2 % had no HIV testing routines, 22.8 % had a moderate HIV testing routines, and 29.1 % had strong HIV testing routines. Similar patterning was observed for STI testing. In multivariate analyses participants' knowledge, beliefs, attitudes, subjective norms and perceived behavioral control were moderately related to HIV and/or STI testing routines and some associations were specific to either HIV or STI testing or to particular routines. Findings highlight that multiple social-cognitive factors each play a role in explaining HIV and STI testing among MSM. To effectively promote regular testing in MSM, programs face the challenge of having to address a range of hurdles, rather than a few major obstacles.

Keywords MSM · HIV testing · STI testing · Barriers to testing · Sexual health promotion

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Introduction

Sexual health screening remains a critical component of efforts to control epidemics of human immunodeficiency virus (HIV) and other sexually transmitted infections (STI), providing a necessary gateway to timely antiretroviral treatment and a unique platform for prevention [1–5], including for emerging approaches making use of antiretroviral drugs to lower the likelihood of HIV transmission and acquisition [6–8]. Regular HIV and STI testing is of particular importance for gay and other men who have sex with men (MSM), who continue to be disproportionately affected by HIV and STI epidemics globally [9, 10]. Between one-quarter and one-third of HIV infections among MSM in high-income countries may be undiagnosed, possibly accounting for the majority (50–90 %) of onward transmission of HIV among MSM [11–14]. Authoritative clinical guidelines recommend that non-HIV

positive, sexually active MSM test at least annually for HIV and STI, and test more frequently if they are at higher risk [15–17]. Coverage and frequency of HIV and testing among MSM however continue to fall short of recommendations, including in Australia where rates have long been among the highest in the world [18, 19].

Various strategies are being tested to promote regular HIV and STI testing among MSM, mostly by employing nudging-type approaches making beneficial choices easy choices [20]. Supported by social marketing [21], innovative contemporary interventions aim to make HIV and STI testing more accessible, convenient, rapid, culturally appropriate and normative [22–27]. This re-orientation of health services, systems and technologies is undoubtedly an important component of promoting regular HIV and/or STI testing, and evaluations are promising [28]. To date, robust evidence from controlled studies is however limited [29], and it remains to be established to what extent interventions promote increases in rates of *regular* HIV and STI testing among MSM, and contribute to earlier detection.

Previous research illustrates that HIV and STI testing among MSM is affected by a multitude of personal, social, cultural, financial, as well as health service factors [30–32]. The complex interplay of these factors best explains changes in testing practices and may attenuate the potential benefits of welcome health service interventions. This is illustrated by a survey among MSM in Scotland that found that HIV testing had substantial increased between 2000 and 2010, and was no longer associated with service-related barriers [33]. Over time, HIV testing remained associated with fear of a positive test result, HIV testing norms, attitudes to sex with a positive partner, and perceived benefits of testing, suggesting that HIV testing had not become normalized [33]. These findings raise questions regarding what types of interventions are likely to be most effective in promoting HIV and STI testing among MSM, and underscore the importance of a comprehensive understanding of potential barriers to testing. Behavioral and social research regarding HIV and STI testing and potential barriers among MSM has to date however remained largely descriptive [30], with some studies exploring socio-demographic covariates [34] or self-reported reasons for (not) testing [35]. The development of effective interventions to promote HIV and STI testing requires robust correlational or experimental evidence of barriers and their relative influence. Evidence is in particular required regarding barriers to *regular* testing for HIV and STI, as well as with respect to similarities and differences in barriers to testing for HIV or STI.

As health behaviors, including HIV and STI testing, are shaped by a wide range of factors [36], theories provide invaluable tools to guide the identification of critical influences on behavior and promote the success of interventions [37]. Illustrating this 'causal density', the multiplicity and complexity of potential influences [38], ecological conceptual frameworks distinguish influences on behavior at multiple, intersecting levels of analysis [39], including the individual, interpersonal, organizational, community, societal and supranational [40]. Social-cognitive factors and processes, including people's knowledge, beliefs, attitudes, emotions and self-regulation strategies, are thought to be particularly important in shaping behavior, as they are considered proximal determinants that can mediate the effects of other, more distal influences on behavior and are open to change through cost-effective health communication and health education approaches [41]. Social-cognitive factors may also signal the influence of social, cultural, financial and systems barriers, underscoring the importance of interventions promoting service, policy and regulation changes to support the creation of enabling environments [42].

Using an eclectic approach informed by various social cognitive theories of behavior [37, 41, 43], we identified a comprehensive set of social-cognitive factors that might be associated with HIV and STI testing among MSM. These factors include knowledge of HIV and STI, perceived susceptibility to and severity of infection with HIV and other STI, beliefs and attitudes regarding testing for HIV and/or STI, subjective norms regarding HIV and/or STI testing, and perceived behavioral control regarding HIV and/or STI testing. Our review of previous research suggested two additional factors that may influence HIV and/or STI testing in MSM: fears and worries about HIV or STI testing and perceived stigma related to (testing for) HIV or STI [30–33, 44].

Using data from a self-report online survey, this paper describes the HIV and STI testing practices of a convenience sample of MSM from New South Wales, Australia. The study in particular assesses men's perceptions of the extent to which they consider that they routinely test for HIV and/or STI, distinguishing between non-testers, non-routine testers, testers with moderate routines and testers with strong routines. Associations between testing routines and socio-demographic characteristics, sexual risk-taking and social-cognitive factors are examined. Analyses will assess the extent to which barriers to and facilitators of regular testing are similar or different for MSM who have never tested, have no testing routine or have a moderate testing routine. The study also explores similarities and differences in potential barriers to and facilitators of HIV and STI testing.

Methods

Recruitment and Procedures

A self-report survey entitled 'How much do you care?' was conducted online between April and October 2011 and

participants were recruited through Facebook. Using geo-location, ads were displayed only to Facebook users who lived in New South Wales or the Australian Capital Territory (i.e., Canberra and environs; landlocked within New South Wales), Australia. Participants had to identify as male, be 16 years of age or older, and have checked the option reflecting an interest in men in their Facebook profile. Participants were also required to be sufficiently fluent in English as the questionnaire was not available in other languages. Facebook users who clicked on the ads were automatically transferred to the survey website. The comprehensive survey encompassed 265 questions and took on average 35 min to fill in; HIV positive men responded to 7 additional questions regarding living with HIV. The measures included in this study are described below and available from the authors. Participants who provided complete data entered a prize draw of vouchers with a total value of AUD 400; no other reimbursement was provided. The study protocol was approved by the Human Research Ethics Committee of The University of New South Wales.

Measures

Socio-Demographic Characteristics

Participants' reported several characteristics that were dichotomized for the purpose of analyses: age (26 years and younger vs. older than 26 years), place of residence (country NSW or ACT vs. Sydney or Canberra), level of education (undergraduate degree or higher vs. no university education), cultural background (Anglo-Australian vs. other background) and sexual identity (exclusively or predominantly gay vs. non-gay).

Sexual Behaviors and Risk-Taking

Assessments encompassed the number of male partners participants had had in the 6 months prior to the survey. Participants were also asked if they had had any regular and/or casual partners in the past 6 months. Participants who reported a regular male partner in the past 6 months were asked how often they had anal sex with this partners and how often condoms were used, separately for insertive and receptive anal sex. Similar questions were asked of men who had casual male partners in the past 6 months. Two dichotomous indicators of sexual risk-taking were calculated from these data: any unprotected anal intercourse (UAI) with a regular partner in the previous 6 months (no vs. yes) and any UAI with a casual partner in the previous 6 months (no vs. yes).

HIV and STI Testing Routines

Participants were first asked if they had ever tested for HIV and or STIs and, if so, how many times they had tested for HIV and/or STIs, when they had last tested and what the result of the last test was. Participants were also asked to indicate to what extent they agreed or disagreed with the following statements: '*I test for HIV on a regular basis*' (for participants in the HIV arm) *or* ''*I test for STIs on a regular basis*' (for participants in the STI arm); responses were given on a 5-point scale (totally disagree—totally agree). Responses to questions regarding testing practices and perceptions of regular testing were combined into indicators of HIV and STI testing routines. For HIV testing as well as for STI testing, men who had never tested were classified as '*non testers*', and men who had tested but indicated that they did not test regularly were classified as '*non-routine testers*'. Participants who had tested and somewhat agreed that they tested regularly were classified as '*moderate routine testers*'. Participants who had tested and totally agreed that they tested regularly were classified as '*strong routine testers*'.

Barriers to Testing

To reduce participation burden, participants were randomized into one of two arms and answered questions on social-cognitive barriers to testing for either HIV *or* STI. Random group assignment is a standard option of the software NETQ PRO (Version 6.7; Netquestionnaires, Utrecht, The Netherlands) that was used for data collection and is enabled by an in-built algorithm generating random numbers to allocate participants to study arms.

Knowledge of transmission, symptoms, health consequences and treatment related to HIV was assessed with eight items (two for each knowledge domain), which could be answered as either 'true', 'false' or 'don't know'. STI-related knowledge was assessed for STI in general and specifically for Chlamydia, gonorrhea, syphilis, herpes, human papilloma virus (HPV), lymphogranuloma venereum (LGV) and hepatitis B (32 items, 1 for each knowledge domain per STI). Correct answers were summed and recoded into a knowledge score for HIV or STI, ranging from 0–10.

Participants' perceived susceptibility to HIV infection was assessed with two items that asked them to indicate their perceived chance and likelihood of contracting HIV. Similar items assessed participants' perceived chance/likelihood of contracting an STI. Internal consistency of the assessment of perceived susceptibility was high (HIV: Cronbach's $\alpha = .91$; STIs: Cronbach's $\alpha = .95$). Responses were given on a 5-point scale (Very low chance/very unlikely—Very high chance/very likely), and items scores

for each measure were averaged; higher scores indicate higher levels of perceived susceptibility.

Perceived severity of HIV was assessed with one item that asked participants to indicate how serious it would be for them to contract HIV. Perceived severity of STIs was assessed with eight similar items, including for any STI other than HIV in general and specifically for Chlamydia, gonorrhea, syphilis, herpes, HPV, LGV, and hepatitis B; responses were given on a 5-point scale (Not serious—Very serious). Internal consistency of the eight items assessing perceived severity of STIs was very high (Cronbach's $\alpha = .94$), and scores for the STI items were averaged; a higher score indicates higher perceived severity.

Beliefs regarding testing for HIV and for STIs were each assessed with ten items referring to possible positive aspects of testing (i.e., perceived pros, advantages or benefits), for example: '*Testing has several advantages*', '*Testing gives peace of mind*', '*Testing prevents passing a potential infection on to your partners(s)*', '*Testing helps to put new relationships on the right track*'. Eleven items assessed possible negative aspects of testing (i.e., perceived cons, disadvantages or costs), for example: '*Testing is expensive*', '*It's not easy to know where to go for testing*', '*Testing is stressful when thinking about the consequences of being infected*', '*Testing could make your sexual partner angry with you*'. Responses were given on a 5-point scale (Totally disagree—Totally agree). Internal consistency of the assessments of perceived pros of testing was high (HIV: Cronbach's $\alpha = .83$; STI: Cronbach's $\alpha = .86$), as was internal consistency of assessments of perceived cons of testing (HIV: Cronbach's $\alpha = .81$; STI: Cronbach's $\alpha = .83$), and item scores for each measure were averaged; higher scores indicate more perceived pros or cons of testing.

To assess overall attitudes regarding testing, participants rated five evaluative adjectives regarding testing for either HIV *or* STI in general ('*Testing for HIV/STI is: beneficial, pointless, important, appropriate, good*'); responses were given on a 5-point scale (Totally disagree—Totally agree). Internal consistency of the assessment of attitudes regarding testing was very high (HIV: Cronbach's $\alpha = .91$; STI: Cronbach's $\alpha = .92$), and item scores for each measure were averaged; higher scores indicate more positive attitudes.

Subjective norms regarding HIV testing were measured with five items that asked participants to indicate the extent to which they thought various social referents supported their testing for HIV ('*People I know*', '*Close friends*', '*Casual sex partners*', '*Regular sex partner(s)*', '*Family*'); responses were given on a 5-point scale (Social referents think Definitely should not test—Definitely should test). Five similar items assessed subjective norms regarding STI-testing. Internal consistency of the assessments of subjective norms was very high (HIV: Cronbach's $\alpha = .92$; STI: Cronbach's $\alpha = .91$); item scores for each measure were averaged. Higher scores indicate subjective norms that are more supportive of testing.

Perceived behavioral control regarding HIV testing was measured with five items assessing the extent to which participants thought that testing for HIV was under their control or easy for them if they wanted to (e.g., '*When I decide to test, nothing will prevent me*', '*It's easy to get tested*'). Responses were given on a 5-point scale (Totally disagree—Totally agree). Five similar items assessed perceived behavioral control regarding STI-testing. Internal consistency of the assessments of perceived behavioral control regarding testing was high (HIV: Cronbachs $\alpha = .91$; STI: Cronbachs $\alpha = .94$), and item scores for each measure were averaged; higher scores indicate higher perceived behavioral control regarding testing.

Fears and worries related to testing for HIV and STIs were each assessed with eleven items that asked participants to indicate to what extent, when considering testing, they would be worried about others people's reactions (4 items), confidentiality (2 items), their reputation (1 item), medical procedures (1 item), waiting time (1 item), and attitudes of health care providers (2 items). Responses were given on a 5-point scale (Totally disagree—Totally agree). Internal consistency of the assessments of fears and worries was high (HIV: Cronbach's $\alpha = .89$; STI: Cronbach's $\alpha = .89$), and items scores for each measure were averaged; higher scores indicate higher levels of fears and worries.

HIV-related stigma encompassed assessments of expected negative self-views if infected, negative personal views of people with HIV, and perceived negative social views of people with HIV (five items each); responses were given on a 5-point scale (Totally disagree—Totally agree). Fifteen similar items assessed STI-related stigma. Internal consistency of stigma measures was very good (HIV: Cronbach's $\alpha = .85$; STI: Cronbach's $\alpha = .85$), and item scores for each measure were averaged; higher scores indicate more stigma.

Statistical Analyses

Analyses were conducted with SPSS (Version 18; Armonk NY, USA). Differences in socio-demographic and behavioral characteristics of participants in HIV and STI arms were assessed with Chi-square tests. Descriptive statistics were computed to assess frequency and recency of testing for HIV and STIs, perceived regularity of testing and testing routines; correspondence between testing routines and frequency and recency of testing was assessed with Chi-square tests. Descriptive statistics were calculated for

Table 1 Sample characteristics

	Full sample ($n = 580$) %	HIV arm ($n = 309$) %	STI arm ($n = 371$) %	Difference test	
				Chi-square test (df = 1)	p
Age over 26 years	50.9	50.2	51.7	0.13	ns
Residing in Sydney (or Canberra)	64.5	62.8	66.4	0.83	ns
Anglo-Australian background	75.7	76.1	75.3	0.05	ns
University degree	35.3	36.6	33.9	0.43	ns
More than 5 male partners in the past 6 months	27.8	29.4	25.8	0.94	ns
Regular male partner in the past 6 months	61.4	62.5	60.1	0.33	ns
Casual male partners in the past 6 months	61.4	63.1	59.4	0.83	ns
UAI with regular male partners in the past 6 months	40.9	43.4	38.0	1.72	ns
UAI with casual male partners in the past 6 months	24.5	28.8	19.6	6.68	<.01

knowledge, perceived susceptibility, perceived severity, perceived pros, perceived cons, attitudes, subjective norms, perceived behavioral control, fears and worries, and perceived stigma.

F-tests were used to assess differences in social-cognitive factors regarding HIV and STI testing, controlling for UAI with casual partners in the past 6 months as that differed significantly between arms. Bivariate analyses were conducted separately for HIV and STI testing to identify socio-demographic and behavioral characteristics and social-cognitive factors associated with testing routines, using Chi-square tests for categorical variables and F tests for continuous variables. Variables significantly ($p < .05$) associated in bivariate analyses were entered in multivariate multinomial logistic regression analyses of HIV and STI testing to assess independent contributions and examine associations with specific testing routines.

Results

Participant Characteristics

A total of 1,123 men 16 years of age or older accessed the online questionnaire, of whom 1,115 provided informed consent. Eligibility for the presented analyses included having had sex with a man, living in Australia and not having tested HIV positive, and were met by 787 participants. Of the eligible participants, 580 men (73.7 %) provided responses to all questions and were included in the analyses; 207 eligible participants (26.3 %) provided incomplete responses and were excluded from the analyses. Participants with complete responses did not differ significantly from participants excluded from the analyses in socio-demographic or behavioral characteristics, with the exception of cultural background. Participants who provided complete responses were more likely (75.7 %) to have an Anglo-Australian background than those excluded from the analyses (66.2 %; Chi-square (df = 1) = 7.03, $p < .001$). Men who provided complete data did not differ significantly from those with incomplete data with respect to having ever tested for HIV or STI, or in HIV and STI testing routines.

The sample of participants included in the reported analyses was restricted to the 580 men who provided complete data. Men in the final sample on average were in their late 20s (Mean = 29.33 years, Median = 27.00 years, SD = 9.96); further socio-demographic and behavioral characteristics are detailed in Table 1. Characteristics of participants in the HIV ($n = 309$) and STI ($n = 271$) arms did not differ significant, except for UAI with casual partners in the past 6 months, which was more likely among men in the HIV than STI arm (Table 1).

HIV and STI Testing Routines

Of the 580 participants, 18.3 % ($n = 106$) had never tested for either HIV or STIs. Of the 474 participants (81.7 %) who ever had a sexual health test, 93.0 % had tested for both HIV and STIs, 3.8 % had tested for HIV only and 3.2 % had tested for STIs only. Three-quarters (77.3 %) of participants who had tested for HIV had tested in the past 12 months and 56.6 % had tested in the past 6 months. Among participants who ever had tested for STIs, 79.6 % had tested in the past 12 months and 58.1 % had tested in the past 6 months. Of the 459 participants who had ever tested for HIV, around two-third agreed that they tested on a regular basis, including 29.0 % who somewhat agreed and 36.8 % who totally agreed. Of the 456 participants who had ever tested for STIs, similar proportions of men somewhat and totally agreed that they tested on a regular basis for STIs. Sexual health testing routines that reflect

Table 2 HIV and STI testing routines and correspondence with frequency and recency of testing ($n = 580$)

	% (n)	Number of lifetime tests		Last tested in the past….	
		More than 5 % (n)	More than 10 % (n)	12 months % (n)	6 months % (n)
HIV testing					
Non-testers	20.9 (121)	–	–	–	–
Non-routine testers	27.2 (158)	19.0 (30)	6.3 (10)	51.3 (81)	22.6 (42)
Moderate-routine testers	22.8 (132)	50.0 (66)	23.5 (31)	84.8 (112)	53.0 (72)
Highly routine testers	29.1 (169)	66.8 (113)	34.3 (58)	95.9 (162)	87.6 (148)
		Chi-square (2) = 76.96, $p < .001$	Chi-square (2) = 38.22, $p < .001$	Chi-square (2) = 98.61, $p < .001$	Chi-square (2) = 124.68, $p < .001$
STI testing					
Non-testers	21.4 (124)	–	–	–	–
Non-routine testers	28.6 (166)	22.9 (38)	6.0 (10)	55.5 (92)	31.4 (52)
Moderate-routine testers	21.9 (127)	48.1 (54)	20.5 (26)	60.6 (111)	56.7 (72)
Highly routine testers	28.1 (163)	66.9 (109)	36.8 (60)	98.2 (160)	86.5 (141)
		Chi-square (2) = 64.54, $p < .001$	Chi-square (2) = 46.93, $p < .001$	Chi-square (2) = 99.12, $p < .001$	Chi-square (2) = 103.01, $p < .001$

men's reported testing practices and perceived regularity of testing are presented in Table 2, which also illustrates that participants' testing routines correspond to the frequency and recency of testing. Among men who had ever tested for HIV, HIV testing routines were significantly associated with frequency and recency of HIV testing; men with stronger HIV testing routines were more likely to have tested more than 5 times and more than 10 times, and were more likely to have tested in the past 12 months and the past 6 months. Among men who had ever tested for STI, similar associations were found between STI testing routines and frequency and recency of STI testing.

Social-Cognitive Factors Regarding HIV and STI Testing

Scores on measures of social-cognitive factors potentially associated with HIV and/or STI testing are presented in Table 3. Knowledge of HIV was found to be fair. Perceived susceptibility regarding HIV was low, but perceived severity of HIV was high. Participants perceived many pros of HIV testing and few cons, and attitudes towards HIV testing were positive. Participants perceived moderately supportive subjective norms regarding HIV testing, while perceived behavioral control regarding HIV testing was high. Participants reported moderate level of fears and worries regarding HIV testing and HIV-related stigma was limited. Attitude, subjective norm, perceived behavioral control, fears and worries and perceived stigma did not differ significantly between HIV testing and STI testing. However, knowledge and perceived severity were significantly higher for HIV than STI, while perceived susceptibility, and perceived pros and cons of testing were lower for HIV than STI.

Correlates of HIV Testing Routines

Participants' socio-demographic and behavioral characteristics and their scores on social-cognitive variables are presented by HIV testing routines in Table 4. Bivariate analyses show that HIV testing routines were significantly associated with age, place of residence, education, numbers of partners in the past 6 months, having had a regular male partner in the past 6 months, having had casual male partners in the past 6 months, knowledge of HIV, perceived pros of HIV testing, perceived cons of HIV testing, attitudes regarding HIV testing, subjective norms regarding HIV testing, perceived behavioral control regarding HIV testing, fears and worries about HIV testing and HIV-related stigma. No significant associations were found between HIV testing routines and cultural background, UAI with any partners in the past 6 months, or perceived susceptibility to and perceived severity of HIV.

In the multivariate analysis HIV testing routines overall remained significantly associated with age, knowledge of HIV, perceived pros of HIV testing, attitudes regarding HIV testing and perceived behavioral control regarding HIV testing (see Table 4). The full model explained for more than half of the variance in HIV testing routines (Nagelkerke $R^2 = .55$), with the social-cognitive factors accounting for most of this explained variance (Nagelkerke $R^2 = .45$). Tests of differences between specific testing

Table 3 Social-cognitive factors regarding HIV and STI testing

	HIV ($n = 309$)		STI ($n = 271$)		Difference test[b]	
	M	SD	*M*	SD	*F*(1,577)	*p*
Knowledge[a]	6.57	2.36	5.15	2.17	56.86	<.001
Perceived susceptibility	1.91	0.95	2.12	1.07	15.31	<.001
Perceived severity	4.70	0.70	4.12	0.80	92.26	<.001
Perceived pros of testing	4.23	0.55	4.37	0.53	10.85	<.001
Perceived cons of testing	2.28	0.71	2.49	0.75	10.84	<.001
Attitudes regarding testing	4.24	0.93	4.19	0.96	0.00	ns
Subjective norms regarding testing	3.62	1.07	3.66	1.05	0.88	ns
Perceived behavioral control regarding testing	4.54	0.04	4.47	0.05	1.09	ns
Fears and worries about testing	2.79	1.01	2.84	0.99	0.48	ns
Perceived stigma	2.76	0.69	2.77	0.69	0.02	ns

[a] Knowledge scores range 0–10; all other scores range 1–5

[b] Controlling for UAI with casual partners in the past 6 months

routines show that, compared to participants with strong HIV testing routines, moderate-routine testers perceived less pros of testing for HIV (Adjusted Odds Ratio (AOR) = .20, $p < .001$), held less positive attitudes towards HIV testing (AOR = .54, $p < .05$) and experienced less perceived behavioral control regarding HIV testing (AOR = .32, $p < .05$). Compared to participants with strong HIV testing routine, non-routine testers perceived less pros of testing for HIV (AOR = .15, $p < .001$), held less positive attitudes towards HIV testing (AOR = .36, $p < .001$), experienced less perceived behavioral control regarding HIV testing (AOR = .27, $p < .01$) and reported more stigma related to HIV (AOR = 1.91, $p < .05$). Non-routine HIV testers were marginally significantly less likely than HIV testers with strong routines to have had a regular partner in the past 6 months (AOR = .48, $p < .10$). Compared to participants with strong HIV testing routines, non-testers were less likely to be older than 26 years (AOR = .11, $p < .001$), less likely to have had a regular partner in the past 6 months (AOR = .39, $p < .05$), reported less perceived pros of testing for HIV (AOR = .09, $p < .001$), held less positive attitudes towards HIV testing (AOR = .36, $p < .01$), and experienced less perceived behavioral control regarding HIV testing (AOR = .16, $p < .001$). Non-HIV-testers were also marginally significantly less likely than men with strong HIV testing routines to live in Sydney or Canberra (AOR = .44, $p < .10$).

Correlates of STI Testing Routines

Participants' socio-demographic characteristics, sexual behaviors and potential psychosocial barriers according to their STI routines are presented in Table 5. As can be seen, in bivariate analyses STI testing routines were significantly associated with age, place of residence, numbers of male partners in the past 6 months, having had casual male partners in the past 6 months, knowledge of STI, perceived pros of STI testing, perceived cons of STI testing, attitudes regarding STI testing, subjective norms regarding STI testing, perceived behavioral control regarding STI testing and fears and worries about STI testing. No significant associations were found between STI testing routines and cultural background, education, having had a regular partner in the past 6 months, reporting UAI with a regular male partner in the past 6 months, reporting UAI with casual male partners in the past 6 months, perceived susceptibility to STIs, perceived severity of STIs and STI-related stigma.

The multivariate analysis found that STI testing routines overall remained significantly associated with age, place of residence, knowledge of STI, perceived pros of STI testing, attitudes regarding STI testing, and subjective norms regarding STI testing. Marginally significant associations were found with number of male partners in the past 6 months and perceived behavioral control regarding STI testing. The full model explained more than half of the variance in STI testing routines (Nagelkerke $R^2 = .54$), with social-cognitive factors accounting for most of this explained variance (Nagelkerke $R^2 = .45$). Tests of differences between specific STI testing routines showed that, compared to participants with strong STI testing routines, moderate-routine testers perceived less pros of testing for STIs (AOR = .38, $p < .05$). Compared to participants with strong STI testing routines, non-routine testers were more likely to live in Sydney or Canberra (AOR = 3.44, $p < .01$), less likely to have had more than five male partners in the last 6 months (AOR = .34, $p < .05$), had less knowledge of STI (AOR = .78, $p < .05$), held less positive attitudes towards STI testing (AOR = .46, $p < .01$), and perceived less positive subjective norms regarding STI testing (AOR = .63, $p < .05$). Non-routine testers also experienced marginally significantly lower perceived behavioral control regarding STI testing than strong routine STI testers (AOR = .42, $p < .10$). Compared to participants with strong STI testing routines, non-testers were less likely to be older than 26 years (AOR = .25, $p < .01$), less likely to have had more than five male partners in the past 6 months (AOR = .21, $p < .05$), reported less knowledge of STIs (AOR = .64, $p < .001$), held less positive attitudes towards STI testing (AOR = .50, $p < .05$), perceived less positive subjective

Table 4 Socio-demographic and behavioral characteristics and social-cognitive factors according to HIV testing routines ($n = 309$)

Socio-demographic and behavioral characteristics	Full sample (%)	Never tested (%)	No routine (%)	Moderate routine (%)	Strong routine (%)	Univariate association		Multivariate multinomial regression	
						Chi-square test (df = 3)	p	Chi-square test (df = 3)	p
Age over 26 years	50.2	15.0	49.4	64.4	62.4	41.14	<.001	24.93	<.001
Residing in Sydney (or Canberra)	62.8	45.0	62.7	74.0	65.6	12.35	<.01	2.93	ns
Anglo-Australian background	76.1	76.7	79.5	72.6	75.3	1.07	ns		
University degree	36.6	20.0	42.2	43.8	36.6	9.89	<.05	2.58	ns
More than 5 male partners in the past 6 months	29.4	11.7	20.5	38.4	41.9	22.11	<.001	3.31	ns
Regular male partner in the past 6 months	62.5	46.7	55.4	69.9	73.1	14.35	<.01	4.80	ns
Casual male partners in the past 6 months	63.1	51.7	50.6	68.5	77.4	18.04	<.001	1.30	ns
UAI with regular male partners in the past 6 months	43.4	31.7	41.0	43.8	52.7	6.84	ns		
UAI with casual male partners in the past 6 months	28.8	21.7	26.5	24.7	38.7	6.77	ns		
Social-cognitive factors		M	M	M	M	M	$F(3,308)$	p	Chi-square test (df = 3)	p
Knowledge of HIV[a]		6.57	5.48	6.11	7.41	7.03	10.53	<.001	8.14	<.05
Perceived susceptibility to HIV		1.91	1.85	1.87	1.79	2.08	1.50	ns		
Perceived severity of HIV		4.70	4.85	4.71	4.74	4.57	2.07	ns		
Perceived pros of HIV testing		4.23	4.03	4.07	4.17	4.55	18.39	<.001	27.39	<.001
Perceived cons of HIV testing		2.28	2.60	2.46	2.23	1.95	14.50	<.001	0.77	ns
Attitudes regarding HIV testing		4.24	3.93	3.82	4.35	4.73	19.73	<.001	14.26	<.01
Subjective norms regarding HIV testing		3.62	3.30	3.23	3.76	4.06	12.22	<.001	1.97	ns
Perceived behavioral control regarding HIV testing		4.54	4.10	4.41	4.58	4.90	18.50	<.001	17.77	<.001
Fears and worries about HIV testing		2.79	3.11	2.93	2.76	2.47	5.89	<.001	1.01	ns
Perceived HIV stigma		2.76	2.93	2.94	2.63	2.59	6.26	<.001	5.36	ns

[a] HIV knowledge range 0–10; all other psychosocial variables range 1–5

norms regarding STI testing (AOR = .44, $p < .001$), experienced less perceived behavioral control regarding STI testing (AOR = .34, $p < .05$), and reported more fears and worries about STI testing (AOR = 1.85, $p < .05$).

Discussion

This study amongst non-HIV-positive MSM in Australia, predominantly from Sydney and wider New South Wales, finds that around 80 % of participants had ever tested for HIV; a similar proportion of men had ever tested for STI. Of the men who had ever tested for HIV and/or STI, nearly 80 % had done so in the past 12 months and almost 60 % tested in the past 6 months. These rates of recent HIV testing compare somewhat favorably with annual behavioral surveillance data collected through the venue-based Sydney Gay Community Periodic Surveys, which find that over the past decade proportions of non-HIV-positive participants reporting testing for HIV in the previous 12 months has been mostly stable at around 70 % [45]. The Sydney Gay Community Periodic Surveys further find that the proportion of participants reporting any STI test in the previous 12 months in recent years has increased to nearly 80 % [45], comparable to our findings. Comprehensive STI testing (i.e., multiple tests from different anatomical sites) in the previous year has also increased among Gay Community Periodic Survey participants [19]. While Australia is well known for the early uptake and sustained high rates of HIV testing among MSM, rates of recent testing for HIV and STI among MSM in Sydney are comparable to those among MSM in San Francisco [46] and Scotland [33, 47], where testing has been substantially promoted in recent years.

Table 5 Socio-demographic and behavioral characteristics and social-cognitive factors according to STI testing routines ($n = 271$)

Socio-demographic and behavioral characteristics	Full sample (%)	Never tested (%)	No routine (%)	Moderate routine (%)	Strong routine (%)	Univariate association		Multivariate multinomial regression	
						Chi-square test (df = 3)	*p*	Chi-square test (df = 3)	*p*
Age over 26 years	51.7	16.4	60.8	67.2	58.9	40.17	<.001	18.24	<.001
Residing in Sydney (or Canberra)	66.4	52.5	75.9	70.7	64.4	9.16	<.05	8.32	<.05
Anglo-Australian background	75.3	75.4	65.8	79.3	82.2	6.18	ns		
University degree	33.9	29.5	31.6	36.2	38.4	1.49	ns		
More than 5 male partners in the past 6 months	25.8	9.8	21.5	27.6	42.5	19.55	<.001	7.51	<.10
Regular male partner in the past 6 months	60.1	50.8	58.2	67.2	64.4	4.01	ns		
Casual male partners in the past 6 months	59.4	47.5	53.2	63.8	72.6	10.57	<.05	1.23	ns
UAI with regular male partners in the past 6 months	38.0	24.6	39.2	44.8	42.5	6.47	ns		
UAI with casual male partners in the past 6 months	19.6	13.1	17.7	22.4	24.7	3.29	ns		

Social-cognitive factors	*M*	*M*	*M*	*M*	*M*	*F*(3,270)	*p*	Chi-square test (df = 3)	*p*
Knowledge of STI[a]	5.15	3.90	4.87	5.96	5.86	14.34	<.001	23.82	<.001
Perceived susceptibility to STI	2.12	1.93	2.06	2.31	2.19	1.41	ns		
Perceived severity of STI	4.12	4.27	4.08	4.11	4.06	0.87	ns		
Perceived pros of STI testing	4.37	4.27	4.22	4.38	4.61	8.45	<.001	9.13	<.05
Perceived cons of STI testing	2.49	2.93	2.62	2.31	2.11	18.09	<.001	1.94	ns
Attitudes towards STI testing	4.19	3.91	3.82	4.40	4.65	14.05	<.001	13.85	<.01
Subjective norms regarding STI testing	3.66	3.11	3.48	3.79	4.20	15.24	<.001	11.23	<.05
Perceived behavioral control regarding STI testing	4.47	3.91	4.38	4.72	4.85	20.65	<.001	6.82	<.10
Fears and worries about STI testing	2.84	3.36	2.93	2.55	2.55	10.63	<.001	5.87	ns
Perceived STI stigma	2.77	2.90	2.77	2.70	2.73	1.08	ns		

[a] STI knowledge range 0–10; all other psychosocial variables range 1–5

As the promotion of *regular* HIV and STI testing amongst MSM gains prominence in expert guidelines [15–17], it is encouraging that around half of men have moderate or strong HIV and/or STI testing routines, suggesting nevertheless that there is substantial room for improvement. While HIV and STI testing routines are associated with corresponding differences in frequency and recency of testing, future research should further examine the properties and application of our indicators of testing routines. Notably, these summary indicators of regular HIV and STI testing capture an experiential component of having established a sexual health routine, which may reflect individuals' appraisal of the adequacy of their current practices and any perceived need for improvement, potentially attenuating the influence of interventions. Indicators of testing routines may also provide a proxy measure of the extent to which strong HIV and STI testing routines of MSM have become habitual. Habits exert a strong influence on health behaviors [48], and the promotion of 'healthy habits' is the explicit or implicit aim of many health promotion interventions.

The present study extends the current evidence base by providing a comprehensive, theory-informed, correlational assessment of potential barriers to HIV and STI testing, adding to the few studies to date that inform understanding of social-cognitive factors associated with HIV/STI testing among MSM [49, 50]. Supporting the proposition that social-cognitive factors are proximal determinants of behavior that mediate the influence of more distal personal, social and structural factors [41–43], we found that socio-demographic and behavioral factors were generally no longer associated with HIV and STI testing routines when taking social-cognitive factors into account. Extending previous research reporting associations between older age

and having *ever* tested for HIV [18, 51], our findings show that older age is also associated with having developed stronger HIV testing routines. Of note, while some studies found that *recent* testing is more likely among younger men [51, 52], this may reflect the initiation of testing rather than routine testing. In addition to an association with age, STI testing was more likely among MSM who lived in Sydney or Canberra, which may reflect better access to appropriate services [53].

Analyses further show that our comprehensive assessment of socio-demographic, behavioral and social-demographic covariates results in robust multivariate models that explain more than half of the variance in the HIV and STI testing practices of MSM. An earlier study of socio-demographic, behavioral and social-cognitive correlates of HIV testing in gay, lesbian and bisexual youth explained almost half (42 %) of the variance in testing. This compares favorably to social-cognitive models of other health behaviors, which are found to explain between 19 and 38 % of the variance in behavior [54]. Studies that only assess socio-demographic and/or behavioral covariates of HIV and STI testing typically do not report the proportion of variance explained or other indicators of (multivariate) effect size. Multivariate models further show that each specific covariate makes a limited contribution to the explained variance in HIV and STI testing, illustrating the notion of 'causal density' [38], which entails that many factors play a role. This cautions that relying on research addressing only one or few factors potential associated with HIV/STI testing may result in pursuing intervention strategies to promote testing that have limited impact.

Independent associations were found between HIV as well as STI testing routines and knowledge, perceived pros (but not perceived cons) of testing and attitudes regarding testing, illustrating the continued need for health information, education and communication for MSM to ensure awareness of the importance and benefits of regular testing for HIV and STI. Perceived benefits of testing were also found to be associated with HIV testing behaviors in a recent study with MSM in Scotland [33]. We previously noted the important, albeit under-researched, role of perceived benefits of testing [30], and cautioned that perceived benefits of testing that are important for lay people may differ from those of medical experts. For instance, our review of published research did not find evidence that the timely initiation of treatment when testing HIV positive, a clear medical benefit, would be persuasive in promoting HIV testing [30]. Social-cognitive theories of health behavior underscore the importance of assessing the salient beliefs of affected individuals and communities to inform health communication [41, 55]. Items included in our assessment suggest that important beliefs in particular reflect the role of testing as a prevention strategy, including that testing is important as a way of knowing how good one's sexual health is, helps one to look after one's sexual health, gives peace of mind and helps to put new relationships on the right track.

We also found that subjective norms were associated with STI testing routines and that perceived behavioral control was associated with HIV testing routines. This underscores the importance of promoting supportive norms regarding STI testing and ensuring that HIV testing is accessible and convenient. Making testing normative, accessible and convenient is the objective of current policies, programs and services for MSM. This approach is broadly supported by our data, in particular when combined with communication approaches highlighting why it is beneficial to test regularly. Conceptually, associations between participants' testing routines and their attitudes, subjective norms and perceived behavioral control regarding testing supports previous research illustrating the usefulness of the Theory of Planned Behavior in understanding HIV and STI testing among MSM [50]. Departing from earlier research informed by the Health Belief Model [49], perceived susceptibility to HIV and STI was not associated with testing routines, nor was perceived severity of HIV and STI. These findings suggest that risk communication and fear appeals are unlikely to contribute to the promotion of regular testing for HIV and/or STI among MSM in Australia.

Contrary to previous research [33, 50] and reviews [30–32], the present study found no association between fears and worries and HIV testing routines. While this is consistent with the observation that the association between fears and worries and HIV testing has diminished in recent years [33], this lack of association may alternatively reflect that the influence of fears and worries on HIV testing overlaps with or is mediated by theory-informed social-cognitive variables. We did find that MSM who had never tested for STI experienced more fears and worries regarding STI (including fears of medical procedures) than MSM with strong STI testing routines. Furthermore, while previous research has found associations between stigma and testing for HIV and gonorrhea [44], and between STI testing and shame and fear of homophobic reactions [56], we did not observe overall associations between STI-related stigma and STI testing routines. This may reflect more favorable community and/or health care provider norms or better access to appropriate health services, but can also reflect mediation by theory-informed social-cognitive variable. Importantly, we did find that non-routine HIV testers reported more HIV-related stigma than MSM who routinely tested for HIV. Future research should continue to monitor associations between HIV and STI testing practices among MSM and fears and worries and stigma to gauge whether factors of influence change as testing becomes more normalized.

The joint assessment of covariates of HIV and STI testing routines mostly finds similarities in factors associated with HIV and STI testing; factors associated with specific HIV testing routines were also largely similar. Several differences were observed in factors associated with specific STI testing routines, such that men who had not tested for STI differed in more respects from men who had strong STI testing routines than men who had tested for STI but had no testing routines, who differed in more respects from men with strong STI testing routines than men with moderately strong STI testing routines. Sociodemographic and behavioral characteristics also were largely similar across men with specific HIV testing routines, while they differed between MSM with specific STI testing routines.

While limitations of the study should be noted, including the cross-sectional design, participant self-selection, the small sample size, compounded by randomization to two arms, and a focus on client-related factors, the present study provides a uniquely comprehensive, theory-informed studies of correlates of HIV and STI testing. The study in particular highlights the role of social-cognitive factors in increasing understanding of barriers to regular HIV and STI testing among MSM. Individually, various social-cognitive factors play a limited role in HIV and STI testing, while together they explain much of the variance in testing routines. Findings illustrate that, to successfully promote regular HIV and STI testing in MSM, prevention programs face the challenge of having to address multiple hurdles rather than a few obstacles, requiring a combination intervention approach.

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