

Internet-based cohort study of HIV testing over 1 year among men who have sex with men living in England and exposed to a social marketing intervention promoting testing

Ford Hickson,¹ Keith Tomlin,¹ James Hargreaves,¹ Chris Bonell,² David Reid,¹ Peter Weatherburn¹

► Additional material is published online only. To view please visit the journal online (<http://dx.doi.org/10.1136/sextrans-2014-051598>).

¹London School of Hygiene & Tropical Medicine, London, UK
²Institute of Education, London, UK

Correspondence to

Dr Ford Hickson, Sigma Research, Department of Social & Environmental Health Research, London School of Hygiene & Tropical Medicine, 15-17 Tavistock Place, London WC1H 9SH, UK; ford.hickson@lshtm.ac.uk

Received 21 March 2014
Revised 7 July 2014
Accepted 8 September 2014
Published Online First
30 September 2014

ABSTRACT

Objectives Increasing HIV testing among men who have sex with men (MSM) is a major policy goal in the UK. Social marketing is a common intervention to increase testing uptake. We used an online panel of MSM to examine rates of HIV testing behaviour and the impact of a social marketing intervention on them.

Method MSM in England were recruited to a longitudinal internet panel through community websites and a previous survey. Following an enrolment survey, respondents were invited to self-complete 13 surveys at monthly intervals throughout 2011. A unique alphanumeric code linked surveys for individuals. Rates of HIV testing were compared relative to prompted recognition of a multi-part media campaign aiming to normalise HIV testing.

Results Of 3386 unique enrolments, 2047 respondents were included in the analysis, between them submitting 15 353 monthly surveys (equivalent to 1279 years of follow-up), and recording 1517 HIV tests taken, giving an annual rate of tests per participant of 1.19 (95% CI 1.13 to 1.25). Tests were highly clustered in individuals (61% reported no test during the study). Testing rates were higher in London, single men and those aged 25–34 years. Only 7.6% recognised the intervention when prompted. After controlling for sociodemographic characteristics and exposure to other health promotion campaigns, intervention recognition was not associated with increased likelihood of testing. Higher rates of testing were strongly associated with higher number of casual sexual partners and how recently men had HIV tested before study enrolment.

Conclusions This social marketing intervention was not associated with increased rates of HIV testing. More effective promotion of HIV testing is needed among MSM in England to reduce the average duration of undiagnosed infection.

INTRODUCTION

Increasing HIV testing in at-risk populations is a major policy goal in England. Late diagnosis is the major cause of HIV mortality, while early diagnosis and treatment also reduces infectiousness. Knowledge and discussion of HIV statuses can inform couples' sexual decision-making, and aggregate sexual risk-taking declines among HIV-positive people following HIV diagnosis.¹

The UK has a high prevalence of HIV among men who have sex with men (MSM),² and approximately one-third of HIV diagnosed among MSM in the UK is late.³ Over many years, England has had various national HIV health promotion media interventions targeting MSM about HIV/sexually transmitted infections testing (*Think, Talk, Time to Test?*, 1997; *See To It*, 1998; *Promoting Testing*, 2009) and undiagnosed HIV infection (*Assume Nothing*, 1997; *What's on Your Mind*, 1998; *Better off Knowing*, 1999; *Think Again*, 2003; *Undiagnosed Infection*, 2008). Evidence for the behavioural impact of media campaigns on HIV testing among MSM is weak.⁴ UK policy now recommends all MSM HIV-test at least annually and more frequently if having unprotected anal intercourse with multiple partners.³ Healthcare providers are recommended to routinely offer HIV testing to all MSM at least annually or more frequently if clinical symptoms are suggestive of HIV seroconversion or they have ongoing high-risk exposure.⁵

We undertook a longitudinal observational study of MSM using monthly internet-based surveys over 1 year. We examined patterns of HIV testing and assessed whether testing was associated with individual exposure to an intervention designed to increase HIV testing and whether rates of testing were higher during periods when the intervention was delivered. Our sample, like nearly all research with MSM, involves convenience samples because there is no overall sampling frame for this population. MSM recruited via the internet engage in higher sexual risk than MSM overall,⁶ but appear more demographically representative than community or clinic samples.^{7 8}

METHODS

We recruited MSM via the internet. An enrolment survey (month 0) was followed by 13 monthly secure online surveys (months 1–13) hosted by Demographix. Enrolment was open for 8 weeks (20 December 2010–2014 February 2011). No sample size calculation was performed as this was an exploratory study using a method not previously used. Inclusion criteria were: male; England resident; aged 16 years or above; sexually attracted to/had sex with men; can supply an email address.

Invitations to enrol were sent to men who had completed an earlier 2010 survey⁹ and to users of



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To cite: Hickson F, Tomlin K, Hargreaves J, et al. *Sex Transm Infect* 2015;**91**:24–30.

two gay-dating websites, ManHunt and Gaydar. Advertising was carried by Gaydar and in email bulletins by NAM and the Lesbian and Gay Foundation.

Potential participants were informed at enrolment of the survey aims and methods and asked to consent to provide online data, including that relating to sexual activity and HIV testing. Participants provided an email address which was linked to a unique alphanumeric code. Emails were stored separately from data. Names, addresses and post codes were not requested. Before analysis, email addresses were examined for uniqueness and where duplicate submissions were made, the second submission was deleted.

Enrolment questions covered sociodemographic data (age, ethnicity, sexual identity, local authority of residence, education level, employment, income, household composition, relationship status). Local authority of residence was grouped into corresponding Strategic Health Authorities (SHA).

Enrolment was followed by 13 surveys sent on the first day of each month covering events in the previous calendar month.

In two surveys, we collected data on recognition of three HIV health promotion interventions delivered in England over the study period. 'I Did It' was delivered by Terrence Higgins Trust (THT) with the aim of increasing HIV testing by making MSM aware of its ease and convenience. It comprised three image/text media advertisements, a short radio advertisement and a website implemented from December 2010 to April 2011. Because the website was aimed both at men who had already tested and those who might, its use is not examined here.

Two other media interventions, 'Clever Dick/Smart Arse' and 'Count Me In', delivered respectively by THT and GMFA, were used to assess men's propensity for exposure to HIV health promotion, hypothesised as a potential confounder. 'Clever Dick/Smart Arse' aimed to promote condom use (November 2011–February 2012), 'Count Me In' encouraged men to commit to a five-step action plan including, but not limited to HIV testing. We regarded potential exposure to this longer-term intervention to be constant throughout the study period. Recognition of 'I Did It' was assessed in month 7 (August 2011) and of 'Clever Dick/Smart Arse' and 'Count Me In' in month 13 (January 2012).

Data on lifetime sexual partnerships and most recent prestudy HIV test were collected at month 1. Each month, participants were asked if they had tested for HIV in the previous month and, if so, the result. Participants already diagnosed as HIV-positive on entry were excluded from analyses, as were those providing no or inconsistent HIV test results.

After assessing cohort recruitment and retention at each month, we described participants' sociodemographic characteristics, prior HIV testing, sexual behaviour and exposure to the interventions among participants who completed months 1, 7 and 13. We then calculated rates of HIV testing. Each completed questionnaire represented a month of follow-up (ie, each calendar month was treated as a period of exposure in which a test could have happened). Only survey points in which the HIV testing question had been answered were included in analysis. No data were imputed as no assumptions were made about panel members' HIV testing activity in the months they did not report. Where a questionnaire was not completed for a given month, that month was censored, not contributing to total follow-up time. Participants joining the study as HIV-negative or untested and diagnosed as HIV-positive during the study period did not contribute follow-up time after reporting their diagnosis, with the month of the positive result contributing 2 weeks' follow-up. Participants reporting HIV-negative results continued to have their follow-up time included. For untested participants,

their last month reporting this and all prior follow-up time was included in the analysis. We calculated HIV testing rates, CIs and unadjusted rate ratios using Poisson regression adjusted for individual-level random effects to account for multiple follow-ups. We next examined HIV testing rates and rate ratios across demographic subgroups. Then, we assessed whether individual exposure to the 'I Did It' intervention was associated with HIV testing after adjusting for potential confounders. We used random effects Poisson regression to adjust the rate ratio for exposure to the 'I Did It' press advertisement. We adjusted for other exposures separately, and those exposures which seemed potential confounders were included in three models: the first included awareness of the 'I Did It' intervention and sociodemographic variables associated with rates of testing; the second added numbers of sexual partnerships and previous HIV testing and the third added awareness of the other interventions.

Finally, we divided the study duration into three 'exposure periods': period 1 (1 January 2011–30 April 2011) when 'I Did It' was active; period 2 (1 May 2011–30 September 2011) when neither 'I Did It' nor 'Clever Dick/Smart Arse' were active and period 3 (1 October 2011–31 January 2012) when 'Clever Dick/Smart Arse' were implemented. Potential exposure to 'Count Me In' was regarded as constant throughout.

A fuller description of the methods (online supplementary file 1) and the survey tools (online supplementary files 2, 3 and 4) relevant to this paper are supplied as web-only files.

The study was approved by London School of Hygiene and Tropical Medicine Ethics Committee (reference 5834).

RESULTS

Following removal of 30 non-qualifying submissions and 103 duplicate submissions, there were 3386 enrolments of whom 45% had previously taken part in the European MSM Internet Survey. Over the 13 months of the survey, a monthly mean of 53.6% of enrollees opened the invitation and a mean of 88.4% of those who opened the survey submitted it. No subsequent surveys were completed by 827 (24.4%); 57 (1.7%) completed a subsequent survey but gave no or inconsistent HIV status data and 455 (13.4%) were HIV-positive on joining the survey. These groups were excluded from subsequent analyses, giving a main analysis sample of 2047 participants (see figure 1, a flow-chart of the procedure provided as a web-only file).

In the main sample, 1966 participants gave answers to all the sociodemographic characteristics. Table 1 displays these. Over half were aged below 45 years and most defined themselves as ethnically white and as gay or bisexual. The largest proportions lived in London (31.2%), the smallest proportions in the North East (3.4%). Almost half had higher education and most were employed. Differences in the profile of non-responders and responders were similar for declining to supply an email address during enrolment and for not returning surveys once enrolled. Compared with men who submitted the first survey, enrollees who did not submit month 1 survey data were younger, less highly educated, less likely to be out about their homosexuality and more likely to be bisexual, members of ethnic minorities and living in the North of England (data not shown).

Subgroup 1 comprised 1122 individuals who submitted the month 7 survey and thereby answered the question relating to 'I Did It'. In subgroup 1, 86 participants (7.6%) reported that they recognised or had read the 'I Did It' print advertisement and 1036 (91.9%) reported that they did not recognise the advertisement (table 1).

Table 1 Rates of HIV testing, and unadjusted and adjusted rate ratios, by sociodemographic exposure

	No of men (n)	No of men (%)	No of HIV tests	Person/years	Rate of HIV testing	Unadjusted rate ratio (95% CI)*	Adjusted rate ratio (95% CI) n = 1966
All participants	2047	100.0	1517	1279.4	1.19	–	–
Age group (years)						p=0.003	p=0.06
<25	175	8.6	103	96.1	1.07	Ref	Ref
25–34	449	21.9	373	248.6	1.50	1.36 (1.01 to 1.82)	1.42 (1.02 to 1.97)
35–44	555	27.1	432	348.8	1.24	1.13 (0.85 to 1.51)	1.18 (0.84 to 1.66)
45–54	526	25.7	385	348.1	1.11	1.01 (0.75 to 1.35)	1.16 (0.82 to 1.64)
55+	332	16.2	221	234.2	0.94	0.88 (0.64 to 1.20)	1.02 (0.69 to 1.50)
Missing	10	0.5	3	3.6	0.84	–	–
Ethnic group						p=0.0003	p=0.19
White British	1,672	81.7	1142		1.09	Ref	Ref
White other	254	12.4	242	160.6	1.51	1.40 (1.14 to 1.71)	1.20 (0.97 to 1.47)
Black	26	1.3	29	15.1	1.92	1.67 (0.95 to 2.93)	1.39 (0.80 to 2.43)
Asian	50	2.4	54	29.5	1.83	1.61 (1.06 to 2.43)	1.21 (0.79 to 1.86)
Other	27	1.3	36	17.3	2.08	1.79 (1.06 to 3.03)	1.50 (0.89 to 2.53)
Missing	18	0.9	14	9.4	1.49	–	–
Sexual identity						p=0.47	
Gay/homosexual	1,709	83.5	1275		1.19	Ref	Not included
Bisexual	171	8.3	118	106.1	1.11	0.89 (0.69 to 1.15)	in multivariate
Other	149	7.3	119	90.4	1.32	1.11 (0.85 to 1.45)	Model
Missing	18	0.9	5	9.3	0.56	–	–
SHA of residence						p=0.0001	p=0.01
London	638	31.2	605	404.3	1.50	Ref	Ref
South West	183	8.9	131	117.9	1.11	0.75 (0.58 to 0.97)	0.84 (0.65 to 1.10)
South Central	138	6.8	97	93.0	1.04	0.71 (0.53 to 0.95)	0.79 (0.58 to 1.06)
South East coast	187	9.1	108	119.2	0.91	0.60 (0.45 to 0.78)	0.66 (0.50 to 0.87)
East of England	152	7.4	107	93.3	1.15	0.75 (0.57 to 1.00)	0.83 (0.63 to 1.11)
East Midlands	129	6.3	63	80.5	0.78	0.52 (0.37 to 0.72)	0.56 (0.40 to 0.78)
West Midlands	135	6.6	74	83.5	0.89	0.62 (0.45 to 0.86)	0.68 (0.49 to 0.93)
Yorkshire & Humber	145	7.1	91	86.3	1.05	0.68 (0.51 to 0.92)	0.70 (0.51 to 0.95)
North West	219	10.7	165	129.0	1.28	0.82 (0.64 to 1.04)	0.89 (0.69 to 1.14)
North East	70	3.4	39	40.5	0.96	0.66 (0.43 to 1.01)	0.77 (0.50 to 1.18)
Missing	51	2.5	37	31.9	1.16	–	–
Highest educational qualification						p=0.87	
Left education <16 years	350	17.1	225	197.1	1.14	Ref	Not included
Completed secondary education	679	33.2	465	402.2	1.16	0.99 (0.79 to 1.23)	in multivariate
Higher education	1,001	48.9	820	672.1	1.23	1.03 (0.84 to 1.26)	Model
Missing	17	0.8	7	7.9	0.88	–	–
Occupation						p=0.11	p=0.83
Employed full/part-time	1,588	77.6	1185	987.9	1.20	Ref	Ref
Unemployed	99	4.9	76	60.1	1.26	1.10 (0.79 to 1.52)	1.01 (0.69 to 1.47)
Student	107	5.2	94	62.5	1.50	1.24 (0.92 to 1.69)	1.16 (0.80 to 1.68)
Other	236	11.5	152	161.7	0.94	0.81 (0.65 to 1.02)	0.94 (0.73 to 1.22)
Missing	17	0.8	10	7.3	1.38	–	–
Gross income per year (£)						p=0.10	p=0.16
<10 000	262	12.8	207	160.9	1.29	Ref	Ref
10 000–39 999	1,179	57.6	800	725.2	1.10	0.83 (0.67 to 1.03)	0.82 (0.62 to 1.07)
≥ 40 000	461	22.5	400	304.3	1.31	1.00 (0.79 to 1.27)	0.97 (0.71 to 1.31)
Unwilling to answer	132	6.5	106	83.9	1.26	0.93 (0.67 to 1.30)	0.92 (0.64 to 1.32)
Missing	13	0.6	4	5.1	0.79	–	–
Household composition						p=0.06	p=0.83
Lives alone	787	38.5	581	493.7	1.18	Ref	Ref
Lives with a partner	692	33.8	481	443.9	1.08	0.90 (0.76 to 1.07)	1.04 (0.82 to 1.32)
Lives with others (not a partner)	551	26.9	448	332.0	1.35	1.12 (0.94 to 1.34)	1.06 (0.88 to 1.29)
Missing	17	0.8	7	9.8	0.72	–	–
Relationship status						p=0.008	p=0.03
Single	1,065	52.0	829	648.0	1.28	Ref	Ref
With one man only	784	38.3	526	499.5	1.05	0.81 (0.70 to 0.94)	0.81 (0.65 to 1.01)

Continued

Table 1 Continued

	No of men (n)	No of men (%)	No of HIV tests	Person/years	Rate of HIV testing	Unadjusted rate ratio (95% CI)*	Adjusted rate ratio (95% CI) n = 1966
With 2+ men but no women	64	3.2	73	46.4	1.57	1.26 (0.88 to 1.82)	1.36 (0.93 to 1.99)
With one or more women	117	5.7	78	76.4	1.02	0.76 (0.56 to 1.05)	0.89 (0.60 to 1.31)
Missing	17	0.8	11	9.0	1.22	–	–

*Population excludes those with missing data within each exposure. SHA, Strategic Health Authorities.

Subgroup 2 included 879 participants who also submitted the month 1 survey and, thereby, gave answers to questions about the lifetime number of sexual partners and the most recent HIV test prior to joining the survey. In subgroup 2, 291 participants (32.8%) reported an average of fewer than one casual sexual partner per month, while 236 (26.6%) reported more than two casual partners per month. The median number of lifetime sexual partners was 90 (IQR 25–300). Being tested in the

month before enrolment was reported by 109 participants (12.3%), while 232 (26.2%) had last tested more than 12 months before enrolment. Of those who submitted the month 1 survey, 158 (17.8%) had never had an HIV test.

Finally, subgroup 3 included 719 participants who also submitted the month 13 survey and, thereby, answered questions about awareness of the 'Clever Dick/Smart Arse' and 'Count Me In' interventions. In subgroup 3, 246 participants (34.2%) had

Table 2 Rates of HIV testing and unadjusted rate ratios for exposures measured in each subgroup

	No of men (n)	No of men (%)	No of HIV tests	Person/years	Rate of HIV testing	Unadjusted rate ratio (95% CI)*
<i>Subgroup 1 (n=1127) completed month 7 (incl. 'I Did It' measures)</i>						
'I Did It' press advertisement						
Not seen advertisement	1036	91.9	1044	874.8	1.19	Ref
Recognised, or had seen and read, advertisement	86	7.6	125	74.9	1.67	1.37 (1.03 to 1.81)
Missing	5	0.5	9	3.3	2.73	–
<i>Subgroup 2 (n=887). Also completed month 1 (incl. sexual partners and prepanel HIV testing)</i>						
Lifetime sexual partners						
≤20	193	21.8	177	172.5	1.03	Ref
21–50	171	19.3	171	150.5	1.14	1.08 (0.81 to 1.44)
51–100	141	15.9	157	125.6	1.25	1.21 (0.90 to 1.62)
101–250	130	14.7	166	113.6	1.46	1.41 (1.04 to 1.90)
251–500	119	13.4	136	107.7	1.26	1.22 (0.89 to 1.66)
500+	128	14.4	175	114.7	1.52	1.48 (1.10 to 1.99)
Missing	5	0.6	7	4.9	1.42	–
Monthly average casual sexual partners						
<1	291	32.8	199	259.0	0.77	Ref
1–2	360	40.6	410	320.1	1.28	1.67 (1.34 to 2.07)
>2	236	26.6	380	210.3	1.81	2.32 (1.85 to 2.92)
Missing	0	0	0	0	0	–
Last HIV test before survey enrolment						
Never tested	158	17.8	58	156.8	0.37	Ref
>12 months before enrolment	232	26.2	109	198.4	0.55	1.48 (1.06 to 2.07)
6–12 months before enrolment	122	13.8	126	109.4	1.15	3.12 (2.24 to 4.35)
1–6 months before enrolment	263	29.7	370	225.7	1.64	4.42 (3.30 to 5.92)
<1 month before enrolment	109	12.3	323	97.0	3.33	9.01 (6.65 to 12.20)
Missing	3	0.3	3	1.9	1.57	–
<i>Subgroup 3 (n=719). Also completed month 13 (incl. 'Clever Dick' and 'Count Me In' measures)</i>						
'Clever Dick/Smart Arse' press advertisements						
No awareness of advertisements	473	65.8	531	446.6	1.19	Ref
Any awareness of advertisements	246	34.2	329	233.7	1.41	1.18 (0.96 to 1.44)
'Count Me In' intervention						
No awareness of intervention	500	69.5	532	475.8	1.12	Ref
Any awareness of intervention	219	30.5	328	204.5	1.60	1.43 (1.17 to 1.75)
Time period of testing						
1 January 2011–30 April 2011	719	100.0	283	223.1	1.27	Ref
1 May 2011–30 September 2011	719	100.0	274	236.1	1.16	0.93 (0.79 to 1.10)
1 October 2011–31 January 2013	719	100.0	303	211.1	1.37	1.08 (0.92 to 1.27)

*Population excludes those with missing data within each exposure.

some awareness of the THT 'Clever Dick/Smart Arse' print campaign to promote condom use and 219 (30.5%) had some awareness of 'Count Me In'.

The 2047 participants in the main sample submitted a total of 15 353 monthly surveys (range 1–13 per participant), with a total follow-up time of 1279.4 person-years (mean of 0.63 years per participant). Participants reported 1517 HIV tests giving an annual rate of 1.19 tests per participant (95% CI 1.13 to 1.25). The number of tests per participant ranged from zero to 10. Testing was strongly clustered: 1246 participants (60.9%) reported no tests during the study, while 39 participants reported having 5–10 tests during follow-up; 1647 participants (80.5%) had already received a negative HIV test result prior to joining the survey, while 400 (19.5%) had never been tested. Among those who joined as untested, 382 submitted at least one further survey, of whom 78 (20.0%) reported having their first test. Eighteen participants reported testing HIV-positive during the course of the survey (0.88% of enrollers, an annual diagnosis incidence of 1.4%).

At the univariate level age, ethnicity, SHA of residence and relationship status were strongly associated with HIV testing (table 2) status which remained significant ($p=0.01$, $p=0.03$, respectively) after adjustment. Men living in Yorkshire & Humber, East Midlands, West Midlands and the South East Coast had the lowest rates of testing. Men in a relationship with one other man were less likely to test than single men (rate ratio 0.81, 95% CI 0.65 to 1.01).

The rate of testing among those who recognised or had read the 'I Did It' press advertisement was 1.67, compared with 1.19 in those who did not recognise the advertisement, giving an unadjusted rate ratio of 1.37 (95% CI 1.03 to 1.81, $p=0.03$, table 2). However, after adjusting for age-group, SHA of residence and relationship status, the association between awareness of the 'I Did It' advertisement and testing was weakened (rate ratio 1.29, 95% CI 0.97 to 1.70, $p=0.08$, table 3).

Participants with a monthly average of two or more casual sexual partners had a higher unadjusted rate of HIV testing than those reporting a monthly average of <1 (rate ratio 2.32, 95% CI 1.85 to 2.92, $p<0.0001$). Participants who had tested in the

month prior to the panel had a rate of testing nine times higher than those who had never tested (rate ratio 9.01, 95% CI 6.65 to 12.20, $p<0.0001$), with a trend between time since the last test and rate of testing during it (p for trend <0.0001). A weaker unadjusted association was present between lifetime number of sexual partners and testing during the survey ($p=0.09$).

Patterns of HIV testing in subgroup 2 were similar to subgroup 1. Further adjustment for sexual partners and testing history weakened the association between awareness of the 'I Did It' advertisement and HIV testing further (rate ratio 1.16, 95% CI 0.92 to 1.46, $p=0.22$). After full adjustment, the average monthly casual partners and the most recent test before the survey both retain a strong association with rate of testing during the survey period, but the associations with age group, SHA of residence and relationship status were weakened ($p=0.02$, 0.32 and 0.38, respectively, table 4).

Awareness of the 'Clever Dick/Smart Arse' advertisement was not associated with rates of testing (rate ratio 1.18, 95% CI 0.96 to 1.44, $p=0.11$). Restricting analysis to the time period when the advertisement was implemented results in a weak unadjusted association (rate ratio 1.28, 95% CI 0.98 to 1.67, $p=0.07$). Participants reporting awareness of 'Count Me In' had an unadjusted rate of HIV testing during the study which was 17%–75% greater than those with no awareness of it (rate ratio 1.43, 95% CI 1.17 to 1.75, $p=0.0006$). The rate of HIV testing did not significantly vary across the three periods of the year examined ($p=0.21$).

The strength of the association between awareness of the 'I Did It' advertisement and rate of testing was further weakened by the addition to the model of these exposures to other health promotion interventions (rate ratio 1.11, 95% CI 0.85 to 1.45, $p=0.45$, table 3). In the fully adjusted model, the associations of rates of testing with 'Clever Dick/Smart Arse' and period of the year were further weakened, as was the association with the 'Count Me In' intervention which ceased to be significant ($p=0.50$, table 4). The associations between age group, SHA of residence and relationship status were also further weakened in this group. However, monthly average sexual partners and most recent HIV test both remained strongly associated with rates of testing during the survey period.

Table 3 Associations between the 'I Did It' print advertisement and rates of HIV testing, adjusted for significant sociodemographic characteristics, and exposures measured at each subgroup

	No men	% men	Unadjusted	Adjusted for significant sociodemographic characteristics* (95% CI)	Adjusted for significant sociodemographic characteristics and those in subgroup 2† (95% CI)	Adjusted for significant sociodemographic characteristics and those in subgroups 2 and 3‡ (95% CI)
Subgroup 1: n=1122§						
Not seen advertisement	1036	92.3	Ref	Ref	–	–
Recognised, or had seen & read advertisement	86	7.7	1.37 (1.03 to 1.81)	1.29(0.97 to 1.70)	–	–
Subgroup 2: n=879§						
Not seen advertisement	806	91.7	Ref	Ref	Ref	–
Recognised, or had seen & read advertisement	73	8.3	1.38 (1.02 to 1.86)	1.24 (0.92 to 1.67)	1.16(0.92 to 1.46)	–
Subgroup 3: n=719						
Not seen advertisement	663	92.2	Ref	Ref	Ref	Ref
Recognised, or had seen & read advertisement	56	7.8	1.48(1.06 to 2.06)	1.33(0.96 to 1.85)	1.16(0.90 to 1.50)	1.11(0.85 to 1.45)

*Age group; SHA of residence; relationship status.

†Average monthly casual sexual partners; lifetime sexual partners; last HIV test before survey.

‡Awareness of 'Clever Dick/Smart Arse' press advertisements and 'Count Me In' campaigns; time period of testing.

§Participants with missing exposure data excluded.

SHA, Strategic Health Authorities.

Table 4 Adjusted rate ratios for all included exposures, for each sub-group

Exposure	Main sample (n=1966)	Subgroup 1 (n=1122)	Subgroup 2 (n=879)	Subgroup 3 (n=719)
Age group (years)	p=0.06	p=0.005	p=0.02	p=0.13
<25	Ref	Ref	Ref	Ref
25–34	1.42 (1.02 to 1.97)	1.21 (0.85 to 1.72)	1.07 (0.77 to 1.50)	1.05 (0.70 to 1.55)
35–44	1.18 (0.84 to 1.66)	0.95 (0.67 to 1.33)	0.89 (0.63 to 1.24)	0.86 (0.58 to 1.27)
45–54	1.16 (0.82 to 1.64)	0.87 (0.62 to 1.23)	0.82 (0.58 to 1.14)	0.83 (0.56 to 1.22)
55+	1.02 (0.69 to 1.50)	0.73 (0.50 to 1.05)	0.71 (0.49 to 1.02)	0.73 (0.48 to 1.12)
SHA of residence	p=0.01	p=0.0009	p=0.32	p=0.45
London	Ref	Ref	Ref	Ref
South West	0.84 (0.65 to 1.10)	0.82 (0.61 to 1.09)	0.92 (0.71 to 1.20)	0.91 (0.68 to 1.22)
South Central	0.79 (0.58 to 1.06)	0.62 (0.44 to 0.86)	0.84 (0.61 to 1.16)	0.91 (0.66 to 1.27)
South East Coast	0.66 (0.50 to 0.87)	0.70 (0.52 to 0.95)	0.83 (0.63 to 1.09)	0.82 (0.61 to 1.10)
East of England	0.83 (0.63 to 1.11)	0.92 (0.67 to 1.25)	1.22 (0.93 to 1.59)	1.26 (0.92 to 1.74)
East Midlands	0.56 (0.40 to 0.78)	0.50 (0.34 to 0.73)	0.88 (0.62 to 1.25)	0.89 (0.60 to 1.32)
West Midlands	0.68 (0.49 to 0.93)	0.57 (0.39 to 0.84)	0.78 (0.54 to 1.11)	0.75 (0.50 to 1.12)
Yorkshire & Humber	0.70 (0.51 to 0.95)	0.72 (0.51 to 1.03)	0.95 (0.67 to 1.36)	0.92 (0.63 to 1.34)
North West	0.89 (0.69 to 1.14)	0.96 (0.74 to 1.26)	1.14 (0.89 to 1.46)	1.12 (0.86 to 1.47)
North East	0.77 (0.50 to 1.18)	0.67 (0.41 to 1.10)	0.89 (0.56 to 1.42)	0.88 (0.52 to 1.47)
Relationship status	p=0.03	p=0.03	p=0.38	p=0.70
Single	Ref	Ref	Ref	Ref
With one man only	0.81 (0.65 to 1.01)	0.79 (0.67 to 0.93)	0.93 (0.79 to 1.08)	0.96 (0.81 to 1.13)
With 2+ men but no women	1.36 (0.93 to 1.99)	1.17 (0.77 to 1.78)	1.04 (0.74 to 1.46)	1.02 (0.70 to 1.47)
With one or more women	0.89 (0.60 to 1.31)	1.02 (0.69 to 1.52)	1.27 (0.88 to 1.84)	1.24 (0.82 to 1.87)
'I Did It' press advertisement		p=0.08	p=0.22	p=0.45
Not seen advertisement	–	Ref	Ref	Ref
Recognised, or had seen & read, advertisement	–	1.29 (0.97 to 1.70)	1.16 (0.92 to 1.46)	1.11 (0.85 to 1.45)
Lifetime sexual partners			p=0.32	p=0.27
≤20	–	–	Ref	Ref
21–50	–	–	0.92 (0.71 to 1.17)	0.84 (0.64 to 1.11)
51–100	–	–	0.85 (0.66 to 1.11)	0.82 (0.62 to 1.10)
101–250	–	–	0.91 (0.69 to 1.19)	0.85 (0.63 to 1.15)
251–500	–	–	0.72 (0.54 to 0.96)	0.68 (0.49 to 0.92)
500+	–	–	0.87 (0.65 to 1.17)	0.83 (0.60 to 1.15)
Monthly average casual sexual partners			p<0.0001	p<0.0001
<1	–	–	Ref	Ref
1–2	–	–	1.40 (1.16 to 1.70)	1.45 (1.17 to 1.80)
>2	–	–	1.77 (1.42 to 2.20)	1.84 (1.44 to 2.34)
Last HIV test before survey enrolment			p<0.0001	p<0.0001
Never tested	–	–	Ref	Ref
>12 months before enrolment	–	–	1.46 (1.04 to 2.05)	1.44 (1.00 to 2.07)
6–12 months before enrolment	–	–	2.84 (2.03 to 3.97)	2.56 (1.77 to 3.68)
1–6 months before enrolment	–	–	3.83 (2.84 to 5.17)	3.71 (2.67 to 5.15)
<1 month before enrolment	–	–	7.75 (5.70 to 10.55)	7.24 (5.17 to 10.15)
'Clever Dick/Smart Arse' press advertisements				p=0.52
No awareness of advertisements	–	–	–	Ref
Any awareness of advertisements	–	–	–	1.06 (0.89 to 1.26)
'Count Me In' intervention				p=0.50
No awareness of intervention	–	–	–	Ref
Any awareness of intervention	–	–	–	1.06 (0.89 to 1.27)
Time period of testing				p=0.25
1 January 2011–30 April 2011	–	–	–	Ref
1 May 2011–30 September 2011	–	–	–	0.94 (0.80 to 1.11)
1 October 2011–31 January 2013	–	–	–	1.08 (0.92 to 1.27)

SHA, strategic health authorities.

DISCUSSION

Rates of HIV testing among these participants was more than one test per year, higher than the UK national guidelines minimum for HIV testing.⁵ However, HIV testing was strongly

clustered, with some men reporting 10 tests and others none. A recent test prior to the study entry was the strongest predictor of testing. Average monthly casual sex partners was more strongly associated with testing than sociodemographic factors

or lifetime sexual partners. This suggests that men with many partners are more aware of the need to test regularly.

Lower rates of HIV testing were observed among older men, men in relationships and those with fewer sexual partners, patterns seen in other countries including Scotland¹⁰ and Australia.¹¹ In this 2011 survey in England, testing appeared particularly low in the East Midlands.

Recognition of the 'I Did It' intervention was very low and less than the other two interventions, and most other similar previous interventions by the same provider.^{12–14} 'I Did It' had a significant unadjusted association with HIV testing which reduced on adjusting for sociodemographic factors and reduced further on adjusting for casual sexual partners. It is possible that our sample was generally already aware of HIV testing issues and more likely to recognise a testing campaign, but would have tested anyway. There was no overall effect of time period on rates of testing, nor did time period act as an effect modifier in the unadjusted association between 'I Did It' and testing.

There have been few longitudinal studies of HIV testing among MSM in England and these are now very dated.^{15 16} The majority of data on HIV testing among MSM come from cross-sectional surveys using retrospective recall. This is the first UK study that has attempted to reduce recall bias of HIV risk and precautionary behaviours by monthly questioning. It is likely that participation in our study with regular questioning about HIV testing behaviour influenced at least some men's propensity to test. However, 82% of participants had already had at least one test before joining the study, and of the men who were untested at enrolment, 80% remained untested.

Our results should be interpreted with caution for several reasons. First, ours was a non-experimental study: men were not allocated randomly or otherwise to be exposed to interventions, but rather we examined associations between individuals' self-reported recognition of interventions and subsequent testing. It may be that those who recognised the 'I Did It' intervention differed in important, unmeasured ways from those who did not. However, we strove to measure and adjust for potential confounders including self-reported exposure to other HIV health promotion interventions. Through this we showed that 'I Did It' had a significant unadjusted association with HIV testing which disappeared when adjusting for socioeconomic factors and reduced further when adjusting for current sexual behaviour. Second, despite our regular data collection, recall error may have been systematically related to individuals' testing patterns, introducing the possibility of information bias. Finally, our sample was

selective, both by its being an online convenience sample, as discussed in our introduction,⁶ and by the large proportion of study members who were excluded from our analysis because they did not provide sufficient data across key time-points.

Our findings suggest a need for HIV testing promotion interventions to achieve much higher coverage and impact than that investigated in this study. Previous research suggests that this media intervention achieved particularly low recall.

Handling editor Jackie A Cassell

Acknowledgements Our thanks go to Richard Scholey (THT), Matthew Hodson (GMFA), Bobby Pickering (Demographix), David Novak (Online Buddies Inc.) and all the men who took part in the Sigma Panel 2011.

Contributors PW conceived the Sigma panel and its technical specification. FH coordinated the panel study. FH, CB and DR designed the monthly questionnaires. DR and FH were responsible for communications with respondents, the technical implementation of the panel and data management and cleaning. KT, FH, CB and JH planned the data analysis. KT performed the data analysis. FH and KT drafted the paper and PW, JH and CB edited it. All authors contributed to and agreed the final manuscript.

Funding This work was supported by the Department of Health for England through the CHAPS programme.

Competing interests None.

Ethics approval London School of Hygiene and Tropical Medicine Ethics Committee (approval number 5834).

Provenance and peer review Not commissioned; externally peer reviewed.

Data sharing statement No additional unpublished data from this study are currently available as analysis by the investigators is ongoing.

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Key messages

- ▶ Recruitment and retention of men who have sex with men (MSM) to an online panel for monthly surveying is feasible and acceptable.
- ▶ Although, collectively, MSM in this study took more than one test per year per person, testing was highly clustered and most men did not test in the year period.
- ▶ HIV testing is strongly associated with numbers of casual sexual partners, suggesting testing is more common among men at greater risk of HIV/STIs.
- ▶ A national social marketing intervention aimed at increasing testing among MSM was seen by a small proportion of the target group and did not appear to increase testing in those exposed to it.