BMJ Open

THE IMPACT OF MEETING LOCATIONS FOR MEN HAVING SEX WITH MEN ON THE RISK FOR BACTERIAL SEXUALLY TRANSMITTED INFECTIONS – ANALYSES FROM A CROSS-SECTIONAL ONLINE SURVEY

Journal:	*BMJ Open*
Manuscript ID:	bmjopen-2015-009107
Article Type:	Research
Date Submitted by the Author:	16-Jun-2015
Complete List of Authors:	Marcus, Ulrich; Robert Koch-Institut, Infectious Diseases Epidemiology an der Heiden, Matthias; Robert Koch-Institut, Infectious Diseases Epidemiology Gassowski, Martyna; Robert Koch-Institut, Infectious Diseases Epidemiology Kruspe, Martin; Free University, Public Health Drewes, Jochen; Free University, Public Health
Primary Subject Heading:	Sexual health
Secondary Subject Heading:	Infectious diseases, Public health, Epidemiology
Keywords:	Public health < INFECTIOUS DISEASES, GENITOURINARY MEDICINE, SEXUAL MEDICINE

THE IMPACT OF MEETING LOCATIONS FOR MEN HAVING SEX WITH MEN ON THE RISK FOR BACTERIAL SEXUALLY TRANSMITTED INFECTIONS – ANALYSES FROM A CROSS-SECTIONAL ONLINE SURVEY

Marcus U[1], an der Heiden M[1], Gassowski M[1], Kruspe M[2], Drewes J[2]

[1] Department for Infectious Disease Epidemiology, Robert Koch-Institut, Berlin, Germany

[2] Free University - Public Health, Berlin, Germany

Email addresses of the authors

MarcusU@rki.de

anderHeidenM@rki.de

GassowskiM@rki.de

mkruspe@zedat.fu-berlin.de

jochen.drewes@fu-berlin.de

BMJ open research paper: word count 3420 (including Key messages)

Abstract 279

Corresponding author:

Ulrich Marcus, Department of Infectious Disease Epidemiology, Robert Koch-Institute, P.O. Box 650261, 13302 Berlin, Germany

ABSTRACT

Objectives

Opportunities for men having sex with men (MSM) to meet each other have very much improved by new communication technologies. Meeting venue-based characteristics can impact how many partners are met and how much sexual risk is taken. We analysed the association between physical and virtual venues and the risk for bacterial sexually transmitted infections (bSTI) among participants in an MSM online survey.

Methods

Data were collected during 2013/14 with a survey targeting MSM living in Germany. The impact of meeting place with the last non-steady anal sex partner on diagnosis with bSTI in the previous year was analysed using bi- and multivariate regression analysis, taking into account self-reported HIV status, serostatus communication, condom use, partner number, age, and city size.

Results

The study sample consisted of 8,878 respondents (7,799 not diagnosed with HIV; 1,079 diagnosed with HIV). Meeting partners online was most frequent, followed by sex venues. Other venues were each reported by 2-6% of the respondents. Venue-dependent proportions reporting bSTI in the recent year were 2-4fold higher among men diagnosed with HIV. In multivariate analysis, HIV status was the strongest predictor for bSTI (OR=5.0). Compared with meeting partners online, sex (OR 1.6; 95%CI 1.0-2.5) and social venues (OR 1.9; 95%CI 1.4-2.6) were associated with increased bSTI risk for men not diagnosed with HIV, but the risk when meeting partners by smartphone apps was only of borderline significance (OR 1.5; 95%CI 0.9-2.3). For men diagnosed with HIV bSTI risk increased for sex venues (OR 1.5; 95%CI 1.1-2.1), and was lower for non-gay/other venues (OR 0.2; 95%CI 0.1-0.5).

Conclusions

Venues are connected to social-behavioural facets of corresponding sexual encounters, and may be important arenas for differential HIV and STI education, treatment, and prevention.

ARTICLE SUMMARY

- Outbreaks and increasing numbers of diagnoses of sexually transmitted infections (STI) among men having sex with men are often attributed to new tools for partner finding. Smartphone applications helping to localize and communicate with potential partners are hypothesized to contribute to this because they may help to increase partner numbers.

Strengths of this study

- We intend to test this hypothesis by analysing data from a large online survey. Our data cover a broad range of physical and virtual meeting venues and our sample is not restricted to large cities.

Limitations of this study

- Large differences regarding STI diagnosis rates between men diagnosed and not diagnosed with HIV are partly explained by different access to routine STI screening: while for men diagnosed with HIV in Germany STI testing can be reimbursed as part of regular HIV treatment monitoring, considerable reimbursement barriers for STI screening for men not diagnosed with HIV exist. It is likely that by using self-reported diagnosis rates a high proportion of undiagnosed asymptomatic bacterial STI (bSTI) among MSM not diagnosed with HIV is missed.
- The online survey was not adapted for smartphones, thus smartphone users were likely underrepresented in the study sample and attrition of survey participants was high, possibly introducing self-selection biases.
- When analysing the associations between bSTI diagnosis and behaviours during the last episode of anal intercourse with a non-steady partner we assume these behaviours are representative for the period of STI acquisition on a population level and neglect that STI could also have been transmitted during another occasion and from a steady partner.

INTRODUCTION

In all societies men having sex with men (MSM) represent a minority of the population. Compared to non-sexual-minority individuals, MSM have limited opportunities to meet other (recognizable) MSM. In the last two decades, these opportunities have very much improved by new communication technologies (internet; mobile internet access devices, aka smartphones) becoming available that were adapted quickly by MSM to seek sexual partners.

Several authors have previously looked into the association between study participant recruitment place or sex partner meeting place with sexual risk behaviour, primarily with condom use for anal sex, HIV serostatus disclosure, and personal responsibility beliefs. Common findings were that MSM frequenting different venues often differ with regards to demographic characteristics, HIV and syphilis infection rates, and risky sexual behaviours [1]. For example, men meeting new partners in gay bars/clubs are usually younger and more likely to be single than men visiting saunas or men meeting new partners online [2, 3, 4]. Conversations around condom use and HIV are often difficult in gay venues, and more feasible and convenient using online media [5]. HIV status disclosure is lowest among men who meet their partner in a park, outdoors, or in another public place and highest among men who meet their partner online [6]. A consequence may be less condom use with partners met online. Venue-based characteristics can impact how MSM negotiate sex and HIV-associated risk behaviour. However, in a previous multivariate model of men reporting anal sex during their last encounter, venue where partner was met was not significantly associated with unprotected anal intercourse (UAI) [7, 8].

There has been less research into the association of physical and virtual venues and risk for bacterial sexually transmitted infections (bSTI), and not much has been published on these issues among European MSM. A recent analysis of factors associated with STI and HIV diagnosis among clients of a German community based voluntary counselling and testing site for MSM indicated slight differences in the association of specific meeting places with the risk of new diagnosis of a bSTI or of HIV [9].

The expanding opportunities to communicate online make it easier for MSM, particularly those not living in large cities with an array of established gay venues, to find and meet new partners [10]. A shift from using less effective to more effective means of partner seeking (e.g. by using GPS-based smartphone applications for dating casual sex partners) may contribute to increasing numbers of partners and consequently to an increase of new diagnoses of STI and HIV among MSM.

In this analysis we focus on the impact of meeting locations on the probability of being diagnosed with a bSTI in the previous 12 months.

METHODS

Survey procedures

Data for this analysis were collected with an online survey targeting MSM living in Germany; the survey was online from 11/2013 through 01/2014. For a detailed description of the survey and the survey procedures see the Supplemental file.

The online survey protocol was evaluated and approved by the ethical review board of the Charité University Clinic in Berlin (EA1/266/13).

Measures

The main outcome of interest in our analysis is self-reported diagnosis of a bSTI (syphilis, gonorrhoea, chlamydia) within the previous 12 months.

Measures used as independent variables in this analysis are: (1) Place where the last non-steady anal sex partner (within the previous 12 months) was met (for categories, see Table 1; for multivariate analyses, response options 'not explicitly gay place' and 'another place' were merged); (2) HIV serostatus disclosure and condom use with the last non-steady anal sex partner. The last sexual encounter with a non-steady sex partner was classified as HIV sero-concordant if the reported HIV serostatus of the partner was the same as the serostatus reported by the respondent, as sero-discordant if the respondents reported a different HIV serostatus than his partner, and as non-concordant for any other combination of known and unknown HIV test results; (3) Self-reported HIV status (dichotomised); (4) Size of city of residence (three categories); (5) Number of sex partners in the previous 12 months (five categories); (6) Age group (four categories).

Statistical analysis

In bivariate analysis we first looked – stratified by HIV status - at distribution by venues where the last anal intercourse (AI) partner was met, taking meeting partners online as reference group.

Then we looked - by HIV status and place of meeting the last non-steady sex partner – at: Diagnosis of a bSTI ; median number of sex partners in the previous 12 months; age group; size of the place of residence; HIV serostatus communication; and condom use at last anal intercourse with a non-steady sex partner.

Since all variables interacted with meeting place, we constructed two different multivariate logistic regression models with diagnosis of a bSTI in the previous 12 months as outcome variable:

Model 1 assumes that the distinct distribution patterns of the variables we looked at are intrinsic characteristics associated with meeting venues; e.g. sex venues and social venues for MSM are generally localized in larger cities; sex venues are predominantly frequented by men engaging in sex

with multiple partners, and serostatus disclosure is uncommon; meeting partners online or on smartphone apps allows relatively anonymous discussion of HIV serostatus, serostatus concordance, and condom use before having sexual intercourse; private sex parties are often organized based on HIV serostatus concordance of participants. Model 1 consequently included only meeting venue, age group, and HIV status as additional variables. Since in Germany HIV status has a large impact on the access to and frequency of STI testing, and because we hypothesized that the impact of HIV status would be different by meeting place between respondents diagnosed and not diagnosed with HIV, we constructed a model which contained HIV status as a control variable and meeting places differentiated by HIV status, using meeting the last non-steady partner online as the common reference group. In other words, the primary reference group are HIV-undiagnosed MSM aged 20-29 years who met their last non-steady anal sex partner online. The effect of HIV status is analysed by comparing with HIV-diagnosed MSM aged 20-29 years meeting their last non-steady anal sex partner online. Effects of meeting places and age are then analysed by comparison with the meeting-partners-online reference groups.

Model 2 included additional variables (number of partners in the previous 12 months (reference: 2-5); HIV concordance at last AI (reference: unknown); condom use at last AI; city size (reference: 100,000-500,000)). Due to these additional variables interactions between meeting place and HIV status declined, while interactions between HIV status and partner numbers as well as condom use became more important.

RESULTS

The online questionnaire was completed by 16,734 MSM living in Germany. A previous diagnosis of HIV was reported by 1,427 respondents; a previous negative HIV test result by 9,886, and 5,341 respondents did not report a previous HIV test. Differences between untested men and men who tested negative for HIV compared to men with an HIV diagnosis were minor in most behavioural parameters analysed, with untested men usually reporting less risky behaviours than men who tested negative. Therefore, we dichotomised HIV status into 'Diagnosed with HIV' and 'Not diagnosed with HIV' for this analysis.

The questions on diagnosis of a bSTI in the previous 12 months and the last anal intercourse event were answered by 7,799 respondents who were not diagnosed with HIV and 1,079 respondents diagnosed with HIV. These 8,878 respondents form the final study sample for our analysis.

In our online sample, meeting the last non-steady anal sex partner online was the most frequent mode of meeting non-steady partners, followed by gay sex venues. Other venues were each reported

by 2-6% of the respondents. Sex-focused venues such as sex venues, cruising places, and private gay sex parties were mentioned more frequently by respondents diagnosed with HIV (see Table 1).

Table 1: History of bSTI diagnosis, and demographic and behavioural characteristics of survey respondents, by HIV status and place of meeting the last non-steady anal sex partner, German MSM online survey 2013

		Place meeting the last non-steady anal sex partner								
		Online	Smartphone app	Gay sex venue	Social venue	Cruising place	Private sex party	Non-gay venue	Other places	Total
Proportion meeting the last non-steady sex partner at the respective location	Not diagnosed with HIV	4841 62%	369 4.7%	866 11%	387 4.9%	257 3.3%	124 1.6%	471 6.0%	484 6.2%	7799
	Diagnosed with HIV	548 51%	42 3.9%	268 25%	38 3.5%	56 5.2%	53 4.9%	25 2.3%	49 4.5%	1079
Proportion diagnosed with HIV compared with ref. group online		ref	ns	**	ns	**	**	°°	ns	
Proportion diagnosed with a bacterial STI in recent 12 months	Not diagnosed with HIV	5.0%	7.5%	7.4%	7.2%	4.6%	3.1%	3.8%	3.9%	327 (4.2%)
	Diagnosed with HIV	**20.3%	**23.3%	**27.2%	*18.4%	*10.5%	**26.4%	(0.0%)	6.1%	**225 (20.9%)
Median partner number category (previous 12 months)	Not diagnosed with HIV	4-5 p.	6-7	8-10	4-5	8-10	8-10	4-5	4-5	
	Diagnosed with HIV	8-10	11-20	21-30	6-7	11-20	11-20	6-7	8-10	
Median age	Not diagnosed with HIV	36	31	44	32	45	43	29	36	36
	Diagnosed with HIV	44	39	46	43.5	44	45	42	44	44
Proportion living in a place with less than 100,000 inhabitants	Not diagnosed with HIV	48.8%	40.7%	41.5%	34.1%	54.1%	52.4%	47.6%	51.4%	47.2%
	Diagnosed with HIV	°°33.2%	°21.4%	°°23.5%	°10.5%	(°)41.1%	°34.0%	°16.0%	°°22.4%	°°29.1%
Proportion reporting HIV seroconcordance with last non-steady anal sex partner[1]	Not diagnosed with HIV	32.6%	29.4%	13.4%	30.6%	19.4%	34.1%	36.4%	37.3%	30.3%
	Diagnosed with HIV	**38.2%	*37.2%	**21.0%	28.9%	17.5%	*54.7%	*36.0%	25.0%	**32.6%
Proportion reporting not having used a condom for anal intercourse[1]	Not diagnosed with HIV	29.6%	24.2%	28.4%	26.6%	33.9%	39.2%	30.8%	35.4%	29.8%
	Diagnosed with HIV	**63.5%	*51.2%	**73.7%	48.6%	64.3%	**86.5%	*54.2%	*45.7%	**65.2%

** = proportion significantly higher; °°=significantly lower (p<0.001 for all comparisons). *=significantly higher (p<0.04); °=significantly lower (p<0.025). (°) p=0.064

[1] Information on HIV serostatus communication and condom use with the last non-steady anal sex partner was based on the following series of questions: What did you tell your partner about your own HIV test result? What did you know or think about the HIV test result of your partner? How did you know or why did you think that? Did you have anal intercourse? (specifying whether anal intercourse was receptive or insertive). Did he use a condom? Did you use a condom?

Differences by HIV status

Respondents diagnosed with HIV were older than respondents not diagnosed with HIV, independent of venue (p<0.001). Respondents using smartphone apps had the lowest median age independent of HIV serostatus. Participants with HIV diagnosis more often lived in cities with more than 100,000 inhabitants.

The partner number categories reported by respondents diagnosed with HIV were consistently one to two categories higher. HIV serostatus communication was reported slightly more often by respondents diagnosed with HIV.

The proportion reporting diagnosis of a bSTI in the recent 12 months was two to fourfold higher among men diagnosed with HIV, except for non-gay venues, for which the number of HIV-diagnosed men meeting their last non-steady partner was small (see Table 1).

Differences by meeting venue

Serostatus was relatively frequently communicated at private sex parties, in non-gay settings, and online. It was relatively rarely communicated in gay sex venues and at cruising sites.

Condom use was in general much lower for respondents diagnosed with HIV positive compared those not diagnosed with HIV, and for both it was lowest at private sex parties. Otherwise, the condom use pattern was different for respondents diagnosed and not diagnosed with HIV: at venues with a low perceived personal responsibility to disclose HIV status (sex venues, cruising sites) low condom use was reported by respondents diagnosed, high condom use by respondents not diagnosed with HIV. For respondents not diagnosed with HIV, meeting venues less associated with the gay subculture (non-gay venues, other places) were associated with relatively low condom use. Notable was the low level of condom use associated with cruising places (see Table 1).

In general, mutual serostatus knowledge was associated with lower condom use, independent of serostatus concordance or discordance (see Supplemental Figure). Also, condom use decreased with increasing knowledge of the non-steady partner (see Fig.1).

Results of multivariate analysis

In model 1, HIV status was the strongest predictor for diagnosis of a bSTI. For men not diagnosed with HIV meeting the last non-steady anal sex partner in a gay sex venue or a gay social venue compared with online was associated with an increased risk for STI diagnosis. Meeting the last partner on a smartphone app was associated with an increased risk (OR 1.48; 95%CI 0.94-2.34) which fell short of statistical significance. Men 45 years and older had a significantly lower risk than men aged 20-29 years.

For men diagnosed with HIV risk was increased when the last non-steady anal sex partner was met in a gay sex venue, and it was significantly lower when the partner was met at a non-gay or other venue (see Table 2).

Table 2: Age-adjusted logistic regression analysis of association of last meeting place with bSTI diagnosis in recent 12 months, German MSM online survey 2013 – model 1

	Not diagnosed with HIV	OR	95%CI	Diagnosed with HIV	OR	95%CI
HIV status					**4.93**	**2.80 - 8.66**
Meeting place	**Online**	**reference**				
	Social venue-neg	**1.60**	1.03 -2.48	Social venue-pos	.863	.37 - 2.02
	Sex venue-neg	**1.88**	1.37 - 2.57	**Sex venue-pos**	**1.52**	**1.07 - 2.14**
	Private setting-neg	.93	.34 - 2.55	Private setting-pos	1.46	.76 - 2.79
	Cruising place-neg	1.14	.59 - 2.19	Cruising place-pos	.45	.19 -1.09
	Smart phone app-neg	1.48	.94 - 2.34	Smart phone app-pos	1.07	.51 - 2.25
	Other-neg	.73	.48 - 1.11	**Other-pos**	**.16**	**.05 - .52**
Age group	**20-29**	**reference**				
	<20-neg	.62	.35 - 1.09	<20-pos	1.18	.12 -11.81
	30-44-neg	1.07	.82 - 1.39	30-44-pos	1.55	.90 - 2.68
	>44-neg	**.50**	**.36 -.70**	>44-pos	.82	.47 - 1.44

Bold = statistically significant associations (p<0.05)

When we included partner numbers, size of the place of residence, and HIV status disclosure in model 2 and tested for the various interactions between the included variables by stepwise inclusion, the effect of venues mostly disappeared. HIV status remained the strongest predictor for bSTI diagnosis. The effect of age was the same as in model 1. HIV status disclosure was associated with increased odds for bSTI diagnosis, regardless whether status was concordant or discordant. Increasing partner numbers increased the odds for a bSTI diagnosis, more so for men not diagnosed with HIV than for men diagnosed with HIV. Condom use at last anal intercourse had no significant effect on bSTI diagnosis among HIV-undiagnosed men, but for HIV-diagnosed men condoms significantly lowered the risk. With increasing city size also the odds for bSTI diagnosis increased.

Only two meeting venues remained in the model, both associated with a significantly lower risk for bSTI diagnosis : cruising places and non-gay/other venues. Meeting the last non-steady anal sex partner in a gay social or sex venue was still associated with an increased odds of having been diagnosed with a bSTI, but this fell short of being statistically significant (see Table 3).

Table 3: Logistic regression analysis of association of last meeting place with bSTI diagnosis in recent 12 months, German MSM online survey 2013 – model 2 (condom use and partner numbers controlled for HIV status [-neg/ -pos])

		OR	95%CI		OR	95%CI
HIV status	**positive**				**7.02**	**4.13 – 11.93**
Meeting place	**online**	**reference**				
	Social venue	1.36	.91 - 2.05			
	Sex venue	1.18	.92 - 1.53			
	private setting	.92	.53 - 1.58			
	Cruising place	**.55**	**.31 – 0.98**			
	Smart phone app	1.15	.76 – 1.74			
	Other	**.64**	**.43 – 0.97**			
Age group	**20-29**	**reference**				
	<20	.84	.48 - 1.49			
	30-44	1.04	.81 - 1.33			
	>44	**.55**	**.42 - .73**			
City size	100,000-500,000	reference				
	<100,000	.84	.64 - 1.12			
	500,000-1 Million	**1.48**	**1.07 - 2.04**			
	>1 Million	**1.42**	**1.08 - 1.86**			
Partner number	2 to 5	reference				
	One-neg	.75	.32 - 1.74	One-pos	.47	.06 – 3.71

	6 to 10-neg	**2.07**	**1.45 – 2.95**	6 to 10-pos	1.46	0.85 – 2.50
	11 to 50-neg	**4.94**	**3.64 – 6.70**	**11 to 50-pos**	**2.00**	**1.24 – 3.24**
	More than 50-neg	**7.49**	**4.76 – 11.79**	**More than 50-pos**	**4.88**	**2.85 – 8.33**
Serostatus communication	Non-concordant	reference				
	HIV concordant	**1.28**	**1.03 - 1.58**			
	HIV discordant	**2.03**	**1.30 - 3.15**			
Condom	Condom use-neg	.88	.69 – 1.13	**Condom use-pos**	**.55**	**.38 - .82**

Bold = statistically significant associations (p<0.05)

DISCUSSION

The type of physical and virtual meeting place with the last non-steady sex partner was strongly associated with the median number of new sex partners in the previous 12 months. This suggests that certain venues facilitate meeting multiple sex partners more than others (e.g. sex venues, private sex parties), and/or that such venues are visited preferentially by men interested in having multiple sex partners.

HIV status also has an impact on partner numbers: HIV positive respondents consistently reported higher partner numbers than respondents not diagnosed with HIV, which has also been reported from other studies [11]. The higher partner numbers of men diagnosed with HIV may have several, non-exclusive reasons:

1) Higher partner numbers may be one of the risk factors that contributed to HIV infection.

2) Restricting partner numbers may be one important strategy to reduce the risk for HIV infection. The diagnosis of HIV removes this necessity.

3) HIV diagnosis may result in disinhibition regarding partner numbers in some and withdrawing from the gay subculture in others. Recruiting survey participants on websites designed primarily to find new partners may introduce a selection bias towards the first group.

Unfortunately, because we have only cross-sectional and no longitudinal data spanning the time of seroconversion and HIV diagnosis, we cannot determine the relative importance of these three reasons.

The partner number categories were two categories higher in venues/settings where either serostatus communication/ HIV serosorting was frequent (online, smartphone) or where perceived personal responsibility for serostatus disclosure was low (sex venues)[12].

Cruising places seemed to be the meeting venues which combine the lowest levels of serostatus disclosure and thus probably a relatively high mixing of men diagnosed and not diagnosed with HIV with a relatively low level of condom use. However, risk management in cruising places may operate mainly by avoiding anal intercourse in this venue, since only a small proportion of respondents (3% not diagnosed with HIV, 5% HIV diagnosed with HIV) met their last non-steady anal sex partner there.

The probability of being diagnosed with bSTI was much higher among MSM diagnosed with HIV. This is very likely partly explained by higher STI screening frequencies among men diagnosed with HIV and in continuous medical care [13]. On the other hand, in model 1 the probability of being diagnosed with bSTI was higher in MSM visiting sex venues, gay social venues (HIV-neg.), and private sex parties (HIV-pos.). Higher bSTI risk was associated with higher median partner numbers when meeting the last non-steady sex partner in the respective venue. Serosorting, or preferentially seeking sex partners also infected with HIV to avoid rejection and allow condomless sex without risking HIV transmission, also contributes to a higher risk for STI [14]. In addition, also known HIV discordance increased bSTI risk in our sample, suggesting selective, HIV-specific precautions. Serostatus disclosure was much more frequent when meeting partners online, on a smartphone app or at a private sex party. Therefore it is not surprising that that the effect of venues largely disappeared when controlling for partner numbers and serostatus disclosure.

Higher partner numbers and an increased odds for being diagnosed with bSTI for smartphone app users compared with men finding their partners online (HIV-undiagnosed) in model 1 may be a consequence of more sexually active men switching to the new tool of smartphone apps preferentially, similar to the early years when internet became available as a new tool for partner seeking [15, 16]. Higher partner numbers and higher prevalence of ever being diagnosed with an STI have also been reported in a recent publication comparing health outcomes of a smaller sample of 110 MSM who use smartphone apps compared to MSM who meet partners in other ways [17]. Another aspect possibly playing a role is the preferential use of smartphone apps in areas with higher population and MSM density, which are also areas with higher density of sex venues and higher STI prevalence among MSM. The higher proportion of smartphone app users using a condom for last

anal intercourse compared with men finding their partners online may be explained by more intense and explicit online communication compared with smartphone app communication, making men communicating with their potential partners online more confident in being able to determine HIV infection risks associated with their partners.

New technologies like GPS-based smartphone apps seem to improve opportunities to find new sex partners compared with seeking partners on gay websites (particularly for younger men and men living in densely populated areas).

Limitations

There are several limitations to consider when interpreting the results of our analysis. A common limitation for almost all studies among MSM is the lack of a representative sampling frame. Our sample is an online convenience sample, and we cannot claim that our findings are representative for the whole MSM population. Self-selection biases common to online surveys among MSM such as higher education levels compared with the general adult male population probably have been accentuated in this survey by a relatively high attrition rate (see also Supplemental file 1). An analysis of survey participants who did not complete the survey showed a higher probability of being younger, not gay identified, and having lower education levels. Further, the online survey was not adapted for smartphones, thus smartphone users were likely underrepresented in the study sample, possibly introducing further self-selection biases.

Another limitation is the reliance on self-reported STI diagnoses. The large differences regarding STI diagnosis rates between men diagnosed and not diagnosed with HIV are partly explained by different access to routine STI screening: while for men diagnosed with HIV STI testing can be reimbursed as part of regular HIV treatment monitoring, considerable reimbursement barriers for STI screening for men not diagnosed with HIV exist. Due to the resulting low adequate STI screening frequencies among men without HIV diagnosis it is likely that by using self-reported STI diagnosis rates a high proportion of undiagnosed asymptomatic bSTI among these men is missed [13].

When analysing the associations between bSTI diagnosis and behaviours during the last episode of anal intercourse with a non-steady partner we assume these behaviours are representative for the period of STI acquisition on a population level and neglect that STI could also have been transmitted during other occasions, and from a steady partner. Finally, recall and social desirability biases have to be expected, since data on diagnoses and behaviours were self-reported.

CONCLUSIONS

While behaviour patterns associated with STI risk differ according to HIV status and venues visited, this relationship is mediated by factors that contextualize men's encounters (e.g., partner numbers, attitudes toward HIV status disclosure, perceptions about condom use, and anonymous sex). Although not directly associated with STIs, venues are connected to social-behavioural facets of corresponding sexual encounters, and may be important arenas for differential HIV and STI education, treatment, and prevention. Consequently, outreach prevention work in gay venues has long been an important component of HIV prevention for MSM. During the last two decades advances in communication technology have affected networking patterns, thereby influencing the dynamics of sex partnerships. Close and coordinated cooperation between HIV/STI prevention workers and gay website and smartphone app owners to optimize the technical and design-related opportunities for supporting protective and minimizing risk-enhancing behaviours of their customers when seeking new partners should be established and further developed.

Both the venue and individual characteristics must be considered when generating and disseminating STI prevention messaging [18]. Outreach providers should consider these contextualizing aspects when planning interventions in physical and virtual venues.

COMPETING INTERESTS

The authors declare that they have no competing interests.

ACKNOWLEDGEMENTS

This work was supported by the German Federal Centre for Health Education (BZgA) [Grant number 25.5.2.4/13], and by the German Ministry of Health [Grant number IIA5-2014-2514AUK340]. The funders had no influence on the design of the study, the collection, analysis and interpretation of data, the writing of the manuscript, and the decision to submit the manuscript for publication.

The authors would like to acknowledge the work of Michael Bochow who designed and conducted several previous German MSM surveys since the late 1980ies and who contributed to this survey with his advice and support. The authors also thank all survey participants who contributed their time to fill in the questionnaire.

AUTHOR'S CONTRIBUTIONS

The survey was designed and executed by JD and MK with contributions by UM and MG. The paper was conceived and the manuscript was drafted by UM. Statistical analysis was conducted by UM and MadH. All authors contributed writing to second draft. All authors approved the final manuscript.

DATA SHARING

No additional data available.

REFERENCES

1. Zhao J, Chen L, Cai WD, et al. HIV infection and sexual behaviors among non-commercial men who have sex with men at different venues. Arch Sex Behav 2014;43(4):801-9. doi: 10.1007/s10508-013-0167-0. Epub 2013 Aug 27.
2. Vial AC, Starks TJ, Parsons JT. Finding and recruiting the highest risk HIV-negative men who have sex with men. AIDS Educ Prev 2014;26(1):56-67. doi: 10.1521/aeap.2014.26.1.56.
3. Voetsch AC, Lansky A, Drake AJ, et al. Comparison of demographic and behavioral characteristics of men who have sex with men by enrollment venue type in the National HIV Behavioral Surveillance System. Sex Transm Dis 2012;39(3):229-35. doi: 10.1097/OLQ.0b013e31823d2b24.
4. Grov C. HIV risk and substance use in men who have sex with men surveyed in bathhouses, bars/clubs, and on Craigslist.org: venue of recruitment matters. AIDS Behav 2012;16(4):807-17. doi: 10.1007/s10461-011-9999-6.
5. Grov C, Agyemang L, Ventuneac A, et al. Navigating condom use and HIV status disclosure with partners met online: a qualitative pilot study with gay and bisexual men from Craigslist.org. AIDS Educ Prev 2013;25(1):72-85. doi: 10.1521/aeap.2013.25.1.72.
6. Grov C, Hirshfield S, Remien RH, et al. Exploring the venue's role in risky sexual behavior among gay and bisexual men: an event-level analysis from a national online survey in the U.S. Arch Sex Behav 2013;42(2):291-302. doi: 10.1007/s10508-011-9854-x. Epub 2011 Oct 20.
7. Grov C, Crow T. Attitudes about and HIV risk related to the "most common place" MSM meet their sex partners: comparing men from bathhouses, bars/clubs, and Craigslist.org. AIDS Educ Prev 2012;24(2):102-16. doi: 10.1521/aeap.2012.24.2.102.
8. Rönn M, White PJ, Hughes G, et al. Developing a conceptual framework of seroadaptive behaviors in HIV-diagnosed men who have sex with men. J Inf Dis 2014;210(Suppl 2):S586-S593.
9. Marcus U, Ort J, Grenz M, et al. Risk factors for HIV and STI diagnosis in a community-based HIV/STI testing and counselling site for men having sex with men (MSM) in a large German city in 2011–2012. BMC Inf Dis 2015;15:14 doi: 10.1186/s12879-014-0738-2.
10. Bolding G, Davis M, Hart G, et al. Where young MSM meet their first sexual partner: the role of the Internet. AIDS Behav. 2007;11(4):522-6.
11. Rosenberg ES, Sullivan PS, Dinenno EA, et al. Number of casual male sexual partners and associated factors among men who have sex with men: results from the National HIV Behavioral Surveillance system. BMC Public Health 2011;11:189. doi: 10.1186/1471-2458-11-189.

12. O'Leary A, Horvath KJ, Rosser SBR. Associations between partner-venue specific personal responsibility beliefs and transmission risk behavior by HIV-positive men who have sex with men (MSM). AIDS Behav 2013;17(5):1855-61. doi: 10.1007/s10461-012-0291-1.
13. Schmidt AJ, Hickson F, Weatherburn P, et al. Comparison of the performance of STI Screening Services for gay and bisexual men across 40 European cities: results from the European MSM Internet Survey. Sex Transm Infect 2013;89(7):575-582 doi:10.1136/sextrans-2012-050973.
14. Marcus U, Schmidt AJ, Hamouda O. HIV serosorting among HIV-positive men who have sex with men is associated with increased self-reported incidence of bacterial sexually transmissible infections. Sexual Health 2011;8:184–193.
15. Bolding G, Davis M, Hart G, et al. Gay men who look for sex on the Internet: is there more HIV/STI risk with online partners? AIDS 2005;19:961-968.
16. Downing MJ Jr. Using the internet in pursuit of public sexual encounters: is frequency of use associated with risk behavior among MSM? Am J Mens Health 2012;6(1):18-27. doi: 10.1177/1557988311407906. Epub 2011 Jun 9.
17. Lehmiller JJ, Ioerger M. Social networking smartphone applications and sexual health outcomes among men who have sex with men. PLoS One 2014;9(1):e86603. doi: 10.1371/journal.pone.0086603.
18. Kingdon MJ, Storholm ED, Halkitis PN, et al. Targeting HIV prevention messaging to a new generation of gay, bisexual, and other young men who have sex with men. J Health Commun 2013;18(3):325-42. doi: 10.1080/10810730.2012.727953. Epub 2013 Jan 15.

Fig. 1: Condom use during last anal intercourse with a non-steady partner and partner knowledge, German MSM online survey 2013

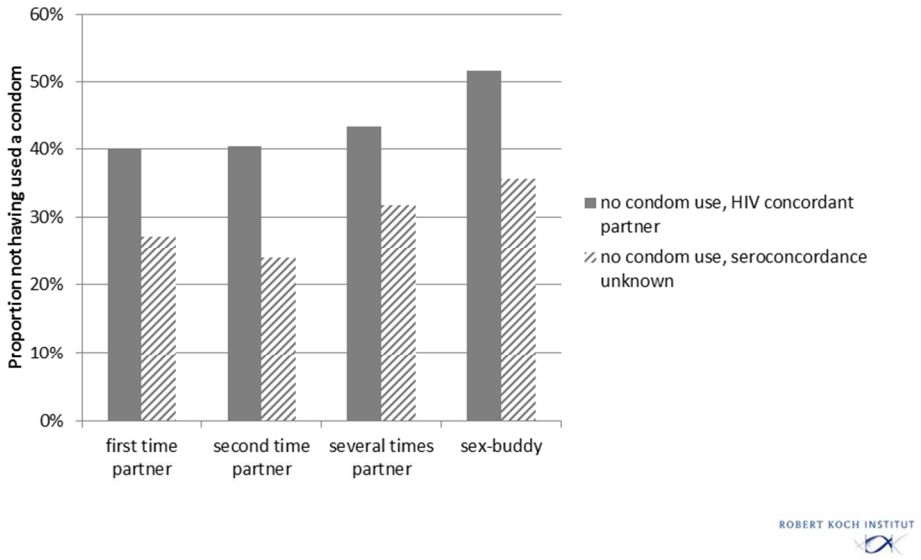
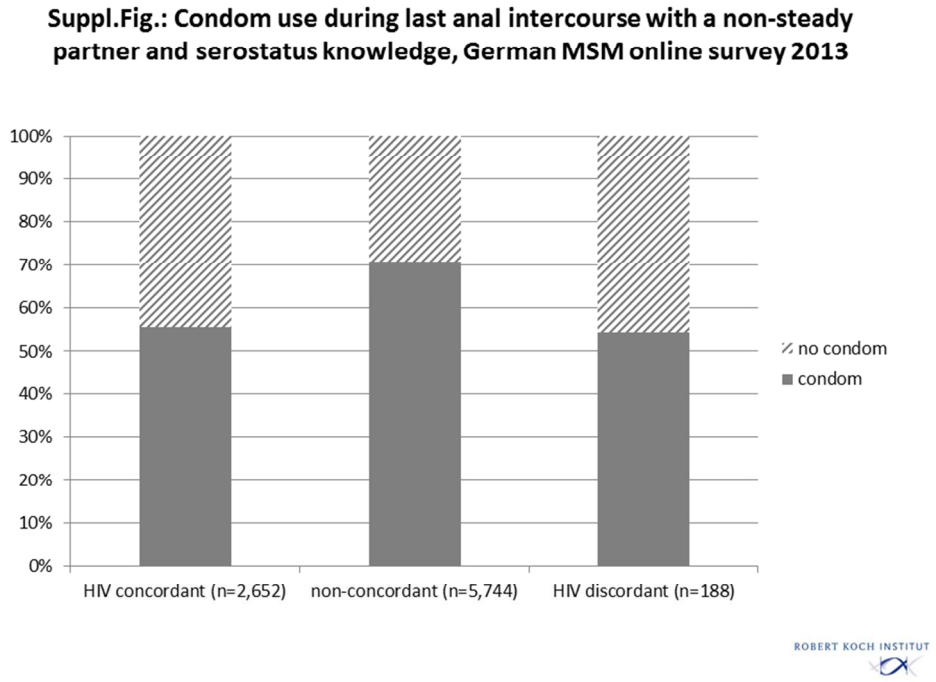


Fig.1: Condom use during last anal intercourse with a non-steady partner and partner knowledge, German MSM online survey 2013
254x190mm (96 x 96 DPI)



Suppl.Fig.: Condom use during last anal intercourse with a non-steady partner and HIV serostatus knowldge, German MSM online survey 2013
254x190mm (96 x 96 DPI)

Supplemental file

CHERRIES criteria for German MSM online survey 2013 (SMA 2013)

Design

The survey was designed as a nationwide, anonymous online-survey targeting MSM. Participants were recruited for the survey through private messages and banners on several social networking and dating sites for gay men. Private messages were sent to all site members having a profile in German language and residing in Germany. Thus the resulting sample was a convenience sample.

IRB (Institutional Review Board) approval and informed consent process

The online survey protocol was evaluated and approved by the ethical review board of the Charité University Clinic in Berlin (EA1/266/13).

Informed consent

The survey's entry site contained information about who the investigator was, the goals and contents of the survey, terms of participation, data privacy, and approximate length of time of the survey. By clicking on a button "I have read and understood the information above" the participant gave his informed consent and was referred to the online questionnaire (for the information included on the entry site see Annex I).

Data protection

We did not collect any personal data which would allow the identification of participants. Several suggestions by the data protection office of the federal state of Berlin to improve data protection for survey participants were implemented.

Development and pre-testing

The questionnaire was developed by using items of former German surveys with this population. The questionnaire used questions from the 2010 European MSM Internet survey (www.emis-project.eu) as much as possible. Several new questions and scales were included. Experts and stakeholders of the target group were asked to evaluate the questionnaire. The survey was informally pretested for technical functionality, usability and wording with members of the target population.

Recruitment process and description of the sample having access to the questionnaire

Advertising the survey

The survey was announced on several homepages (dating sites and news sites) directed at the target population. On most homepages a banner or texts were provided with a link to the questionnaire. One large dating site for MSM (planetromeo.com; number of active profiles in Germany as of March 18, 2015: 433,781. More than one profile per person is possible. Estimated number of MSM aged 15-64 years living in Germany as of 2010: approximately 656,000 [Marcus U, et al. Estimating the size of the MSM populations for 38 European countries by calculating the survey surveillance discrepancies (SSD) between self-reported new HIV diagnoses from the European MSM

internet survey (EMIS) and surveillance reported HIV diagnoses among MSM in 2009. BMC Public Health 2013, 13:919 http://www.biomedcentral.com/1471-2458/13/919]) sent out a message to every German member with a link to the questionnaire asking the members to participate in the survey (for the wording of the message see Annex II). The survey was announced on planetromeo.com in a time-staggered manner (eight batches, ~50,000 profiles each), originally with the intention to prevent excessive demand for free testing at the cooperating testing sites, where free test vouchers offered at the end of the questionnaire could be used. Due to the lower than expected demand this turned out to be unnecessary. However, unexpectedly the capacity of the server of the survey website was not sufficient to manage the demand, so that long waiting times for users resulted and on some of the first days the survey was practically dysfunctional.

The survey was not specifically adapted for smartphone users. The main recruitment website offers traditional online websites as well as a gps-based smartphone app to manage user profiles. Both types of clients were invited to participate in the survey, however, the lack of smartphone-adaptation was mentioned in the invitation mail. Due to the lack of smartphone adaptation and the technical server problems it is very likely that the survey was filled in preferentially with a personal computer online instead by smartphone. Compared with the previous online survey (EMIS 2010) younger age groups (25-35 years) were less well represented among respondents, which may be due to the higher frequency of app-use in this age group.

Survey administration

The survey was a Web-based survey which was filled in online. Responses were automatically captured and directly stored in a database.

Context

See above.

Mandatory/voluntary

Participation in the survey was voluntary.

Incentives

No incentives were offered.

Time/Date

Data were collected between November 2013 and January 2014

Randomization of items or questionnaires

Randomization or alternating of items was not used.

Adaptive questioning

Adaptive questioning was used throughout the questionnaire to reduce number and complexity of the questions. E.g. separate questions were asked to respondents who indicated that they had received an HIV diagnosis and those who didn't.

Number of Items and screens (pages)

The questionnaire included 344 items and 218 questions, presented online on approximately 100 pages. Due to the adaptive design of the questionnaire the actual number of pages that were seen by an average respondent was much less.

Completeness check

No consistency or completeness check was implemented before the questionnaire was submitted. Several questions (e.g. gender, age, HIV test, etc.) were regarded as especially important. In case the respondent didn't answer one of these questions, they were reminded using a pop-up window, to answer this question. If the respondent still was not willing to answer the question he was able to continue the questionnaire.

Review step

Respondents were able to change answers on previous pages using a Back button.

Response rates

Unique site visitors: No IP addresses were stored and no cookies were used.

For every new first page visitor a unique code was generated. The total number of codes generated was 51,277. However, as mentioned above, the survey page was at certain times dysfunctional, which may have resulted in immediate discontinuation and later re-start of the survey. The first survey question was answered by 27,337 respondents; the last set of questions was answered by 14,392 respondents.

Due to the decision not to store IP addresses and not to use cookies, in combination with the technical difficulties during the implementation of the survey it is not possible to give meaningful numbers for the view rate and the participation rate. The completion rate can be calculated as 14,329/ 27,337 = 52%

Preventing multiple entries from the same individual

No technical tools such as cookies were used to prevent multiple entries from the same individual. However, due to the length of the questionnaire, technical capacity problems on the survey website which resulted in longer waiting times between screens further prolonging the time needed to fill in the questionnaire, and the lack of any material incentives, we think it is highly unlikely that individuals filled in the questionnaire more than once. It is however possible that respondents interrupted filling in the questionnaire and decided to restart at a later time point. To prevent using such possible multiple entries from the same individual, the final dataset was restricted to questionnaires in which at least the questions regarding gender, age, country, sexual orientation and HIV testing behaviour were answered. These represent the first approximately 10 page screens, and survey sections which did not include adaptive questions (27,337 respondents answered the first question on gender; 19,630 respondents answered the question on HIV testing).

IP check

No IP addresses of the client computer were used to identify potential duplicate entries from the same user.

Log file analysis

No other techniques to analyze the log file for identification of multiple entries were used.

Analysis

Incomplete questionnaires were also analysed when questions regarding gender, age, country, sexual orientation and HIV testing behaviour were answered.

Questionnaires submitted with an atypical timestamp

Time to fill out the questionnaire was not used as an exclusion criterion.

Statistical correction

No weighting of items or propensity scores have been used to adjust for the non-representative sample.

Annex I: Entry page of the online questionnaire

Subscriber information

Welcome to the survey!

Please take part in this survey if you ...

• are a gay man and / or

• are a man who feels attracted to men and / or

• are a man who has sex with men and

• are at least 16 years old.

We want to know it!

This survey, the study "Gay Men and HIV / AIDS 2013" refers to the sex you have, your knowledge and attitudes to HIV prevention and HIV testing and your life as a gay man, or a man who has sex with men, and how you are dealing with HIV and other sexually transmitted infections.

The questionnaire will take approximately 30 minutes.

Privacy Policy

Participation is anonymous. We guarantee that we will not save your IP address or collect information about you that could enable your identification by third parties.

For notes on the safe use of PCs, please refer to www.bsi.de.

Replying to the questionnaire is voluntary and can be canceled at any time, without any disadvantages for you.

More information about objectives of this study can be found further down on this page.

Here we go!

Start the questionnaire by clicking on the following button:

[Button]

For more information on this study

We are psychologists and health scientists of the Free University Berlin. This study has been financed by the Federal Centre for Health Education (BZgA). For questions, comments or suggestions about the study please contact us at the e-mail address msm@zedat.fu-berlin.de

Goals

The primary objective of this survey is to obtain current information about how gay and other men who have sex with men (MSM) are dealing and living with HIV / AIDS and other sexually transmitted infections (STI). The collected answers will allow an assessment of the extent to which you and the other participants protect themselves, but also what risks you are willing to take. Questions about the use of preventive services, and knowledge about progress in the treatability of HIV, will also allow to assess information needs and to better address these issues in HIV prevention. In addition to these points the general life situation of gay and other men who have sex with men living in Germany is an important part of this survey. In addition to dealing with discrimination against homosexuality, mental well-being is discussed in this survey for the first time. We want to investigate whether and why gay and bisexual men are more frequently affected by psychological stress. Also, the use of psychoactive substances (alcohol and drugs) will be investigated.

What happens to your data?

Taking into account the legal requirements of data protection we will evaluate your information together with that of the other participants to prepare scientific publications for a specialist audience. In this way we create the conditions that your information can be included in the optimization of prevention services for gay men and other men who have sex with men.

The central results of this survey can be expected to become available by autumn 2014, accessible on www.sma2013.de.

This study was reviewed by the ethics committee of the Charité Berlin, which confirmed the ethical acceptability of this study. The Data Protection Officer of the State of Berlin has examined the compliance with data protection and his suggestions for changes have been implemented.

Annex II: Invitation mail for men with a profile on planetromeo.com

Hello,

We would like to invite you to participate in a survey of gay and other men who have sex with men. This survey deals with your life, your sex and your relationships, your knowledge and attitudes to recent developments in HIV / AIDS, and how you are dealing with HIV and other sexually transmitted infections.

This survey is done anonymously and takes about 30 minutes. The survey is not optimized for filling in on smartphones. (Now start with the questionnaire!)

Your participation in this survey can not only help to ensure that you learn something new. Through your participation, you also support the prevention of HIV and other sexually transmitted diseases among gay and other men who have sex with men in Germany. The results of the study are directly feeding into this prevention work. In this way the prevention may take your needs better into consideration.

For more information about this study, please go to the home page of the questionnaire.

Your experiences and your vision are important to us. We would therefore be very happy if you participate in this survey: Click here for the questionnaire!

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

	Item No	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3
Objectives	3	State specific objectives, including any prespecified hypotheses	3
Methods			
Study design	4	Present key elements of study design early in the paper	4/ Suppl.file
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	4/ Suppl.file
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	Suppl.file
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	4
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	4/ 7
Bias	9	Describe any efforts to address potential sources of bias	
Study size	10	Explain how the study size was arrived at	5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	4
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	5
		(*b*) Describe any methods used to examine subgroups and interactions	5
		(*c*) Explain how missing data were addressed	Suppl.file
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	
		(*e*) Describe any sensitivity analyses	
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	5/ Suppl.file
		(b) Give reasons for non-participation at each stage	
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	7
		(b) Indicate number of participants with missing data for each variable of interest	
Outcome data	15*	Report numbers of outcome events or summary measures	7
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear	9-11

		which confounders were adjusted for and why they were included	
		(*b*) Report category boundaries when continuous variables were categorized	
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	
Discussion			
Key results	18	Summarise key results with reference to study objectives	11-12
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	13
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	13
Generalisability	21	Discuss the generalisability (external validity) of the study results	
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	15

*Give information separately for exposed and unexposed groups.

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

BMJ Open

THE IMPACT OF MEETING LOCATIONS FOR MEN HAVING SEX WITH MEN ON THE RISK FOR BACTERIAL SEXUALLY TRANSMITTED INFECTIONS – ANALYSES FROM A CROSS-SECTIONAL ONLINE SURVEY

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2015-009107.R1
Article Type:	Research
Date Submitted by the Author:	22-Jul-2015
Complete List of Authors:	Marcus, Ulrich; Robert Koch-Institut, Infectious Diseases Epidemiology an der Heiden, Matthias; Robert Koch-Institut, Infectious Diseases Epidemiology Gassowski, Martyna; Robert Koch-Institut, Infectious Diseases Epidemiology Kruspe, Martin; Free University, Public Health Drewes, Jochen; Free University, Public Health
Primary Subject Heading:	Sexual health
Secondary Subject Heading:	Infectious diseases, Public health, Epidemiology
Keywords:	Public health < INFECTIOUS DISEASES, GENITOURINARY MEDICINE, SEXUAL MEDICINE

THE IMPACT OF MEETING LOCATIONS FOR MEN HAVING SEX WITH MEN ON THE RISK FOR BACTERIAL SEXUALLY TRANSMITTED INFECTIONS – ANALYSES FROM A CROSS-SECTIONAL ONLINE SURVEY

Marcus U[1], an der Heiden M[1], Gassowski M[1], Kruspe M[2], Drewes J[2]

[1] Department for Infectious Disease Epidemiology, Robert Koch-Institut, Berlin, Germany

[2] Free University - Public Health, Berlin, Germany

Email addresses of the authors

MarcusU@rki.de

anderHeidenM@rki.de

GassowskiM@rki.de

mkruspe@zedat.fu-berlin.de

jochen.drewes@fu-berlin.de

BMJ open research paper: word count 3415 (including Article summary)

Abstract 279

Corresponding author:

Ulrich Marcus, Department of Infectious Disease Epidemiology, Robert Koch-Institute, P.O. Box 650261, 13302 Berlin, Germany

ABSTRACT

Objectives

Opportunities for men having sex with men (MSM) to meet each other have very much improved by new communication technologies. Meeting venue-based characteristics can impact how many partners are met and how much sexual risk is taken. We analysed the association between physical and virtual venues and the risk for bacterial sexually transmitted infections (bSTI) among participants in an MSM online survey.

Methods

Data were collected during 2013/14 with a survey targeting MSM living in Germany. The impact of meeting place with the last non-steady anal sex partner on diagnosis with bSTI in the previous year was analysed using bi- and multivariate regression analysis, taking into account self-reported HIV status, serostatus communication, condom use, partner number, age, and city size.

Results

The study sample consisted of 8,878 respondents (7,799 not diagnosed with HIV; 1,079 diagnosed with HIV). Meeting partners online was most common, followed by sex venues. Other venues were each reported by 2-6% of the respondents. Venue-dependent proportions reporting bSTI in the recent year were 2-4fold higher among men diagnosed with HIV. In multivariate analysis, HIV status was the strongest predictor for bSTI (OR=5.0). Compared with meeting partners online, sex (OR 1.6; 95%CI 1.0-2.5) and social venues (OR 1.9; 95%CI 1.4-2.6) were associated with increased bSTI risk for men not diagnosed with HIV, but the risk when meeting partners by smartphone apps was only of borderline significance (OR 1.5; 95%CI 0.9-2.3). For men diagnosed with HIV bSTI risk increased for sex venues (OR 1.5; 95%CI 1.1-2.1), and was lower for non-gay/other venues (OR 0.2; 95%CI 0.1-0.5).

Conclusions

Venues are connected to social-behavioural facets of corresponding sexual encounters, and may be important arenas for differential HIV and STI education, treatment, and prevention.

ARTICLE SUMMARY

- Outbreaks and increasing numbers of diagnoses of sexually transmitted infections (STI) among men having sex with men are often attributed to new tools for partner finding. Smartphone applications helping to localize and communicate with potential partners are hypothesized to contribute to this because they may help to increase partner numbers.

Strengths of this study

- We intend to test this hypothesis by analysing data from a large online survey. Our data cover a broad range of physical and virtual meeting venues and our sample is not restricted to large cities.

Limitations of this study

- Large differences regarding STI diagnosis rates between men diagnosed and not diagnosed with HIV are partly explained by different access to routine STI screening: while for men diagnosed with HIV in Germany STI testing can be reimbursed as part of regular HIV treatment monitoring, considerable reimbursement barriers for STI screening for men not diagnosed with HIV exist. It is likely that by using self-reported diagnosis rates a high proportion of undiagnosed asymptomatic bacterial STI (bSTI) among MSM not diagnosed with HIV is missed.
- The online survey was not adapted for smartphones, thus smartphone users were likely underrepresented in the study sample and attrition of survey participants was high, possibly introducing self-selection biases.
- The reference group for our comparisons are MSM meeting their last non-steady anal sex partner online. While this was the most common meeting venue in our online sample, this venue didn't exist before 2000. When comparing STI diagnosis rates among MSM during the 1990ies and current diagnosis rates, the possible impact of new communication technologies on sexual networks needs to be considered.
- When analysing the associations between bSTI diagnosis and behaviours during the last episode of anal intercourse with a non-steady partner we assume these behaviours are representative for the period of STI acquisition on a population level and neglect that STI could also have been transmitted during another occasion and from a steady partner.

INTRODUCTION

In all societies men having sex with men (MSM) represent a minority of the population. Compared to non-sexual-minority individuals, MSM have limited opportunities to meet other (recognizable) MSM. In the last two decades, these opportunities have very much improved by new communication technologies (internet; mobile internet access devices, aka smartphones) becoming available that were adapted quickly by MSM to seek sexual partners.

Several authors have previously looked into the association between study participant recruitment place or sex partner meeting place with sexual risk behaviour, primarily with condom use for anal sex, HIV serostatus disclosure, and personal responsibility beliefs. Common findings were that MSM frequenting different venues often differ with regards to demographic characteristics, HIV and syphilis infection rates, and risky sexual behaviours [1]. For example, men meeting new partners in gay bars/clubs are usually younger and more likely to be single than men visiting saunas or men meeting new partners online [2, 3, 4]. Conversations around condom use and HIV are often difficult in gay venues, and more feasible and convenient using online media [5]. HIV status disclosure is lowest among men who meet their partner in a park, outdoors, or in another public place and highest among men who meet their partner online [6]. A consequence may be less condom use with partners met online. Venue-based characteristics can impact how MSM negotiate sex and HIV-associated risk behaviour. However, in a previous multivariate model of men reporting anal sex during their last encounter, venue where partner was met was not significantly associated with unprotected anal intercourse (UAI) [7, 8].

There has been less research into the association of physical and virtual venues and risk for bacterial sexually transmitted infections (bSTI), and not much has been published on these issues among European MSM. A recent analysis of factors associated with STI and HIV diagnosis among clients of a German community based voluntary counselling and testing site for MSM indicated slight differences in the association of specific meeting places with the risk of new diagnosis of a bSTI or of HIV [9].

The expanding opportunities to communicate online make it easier for MSM, particularly those not living in large cities with an array of established gay venues, to find and meet new partners [10]. A shift from using less effective to more effective means of partner seeking (e.g. by using GPS-based smartphone applications for dating casual sex partners) may contribute to increasing numbers of partners and consequently to an increase of new diagnoses of STI and HIV among MSM.

In this analysis we focus on the impact of meeting locations on the probability of being diagnosed with a bSTI in the previous 12 months.

METHODS

Survey procedures

Data for this analysis were collected with an online survey targeting MSM living in Germany; the survey was online from 11/2013 through 01/2014. For a detailed description of the survey and the survey procedures see the Supplemental file.

The online survey protocol was evaluated and approved by the ethical review board of the Charité University Clinic in Berlin (EA1/266/13).

Measures

The main outcome of interest in our analysis is self-reported diagnosis of a bSTI (syphilis, gonorrhoea, chlamydia) within the previous 12 months.

Measures used as independent variables in this analysis are: (1) Place where the last non-steady anal sex partner (within the previous 12 months) was met (for categories, see Table 1; for multivariate analyses, response options 'not explicitly gay place' and 'another place' were merged); (2) HIV serostatus disclosure and condom use with the last non-steady anal sex partner. The last sexual encounter with a non-steady sex partner was classified as HIV sero-concordant if the reported HIV serostatus of the partner was the same as the serostatus reported by the respondent, as sero-discordant if the respondents reported a different HIV serostatus than his partner, and as non-concordant for any other combination of known and unknown HIV test results; (3) Self-reported HIV status (dichotomised); (4) Size of city of residence (three categories); (5) Number of sex partners in the previous 12 months (five categories); (6) Age group (four categories).

Statistical analysis

In bivariate analysis we first looked – stratified by HIV status - at distribution by venues where the last anal intercourse (AI) partner was met, taking meeting partners online as reference group.

Then we looked - by HIV status and place of meeting the last non-steady sex partner – at: Diagnosis of a bSTI ; median number of sex partners in the previous 12 months; age group; size of the place of residence; HIV serostatus communication; and condom use at last anal intercourse with a non-steady sex partner.

Since all variables interacted with meeting place, we constructed two different multivariate logistic regression models with diagnosis of a bSTI in the previous 12 months as outcome variable:

Model 1 assumes that the distinct distribution patterns of the explanatory variables we looked at are intrinsic characteristics associated with meeting venues; e.g. sex venues and social venues for MSM are generally localized in larger cities; sex venues are predominantly frequented by men engaging in

sex with multiple partners, and serostatus disclosure is uncommon; meeting partners online or on smartphone apps allows relatively anonymous discussion of HIV serostatus, serostatus concordance, and condom use before having sexual intercourse; private sex parties are often organized based on HIV serostatus concordance of participants.

To focus on the effect of meeting venue, Model 1 consequently included only age group and HIV status as additional variables. We distinguished between respondents diagnosed and not diagnosed with HIV in each venue, because we hypothesized that the impact of HIV status would be different by meeting place. The reference category of Model 1 are HIV-undiagnosed MSM aged 20-29 years who met their last non-steady anal sex partner online.

Model 2 included additional variables (number of partners in the previous 12 months (reference: 2-5); HIV concordance at last AI (reference: HIV status unknown); condom use at last AI; city size (reference: 100,000-500,000)). Due to these additional variables interactions between meeting place and HIV status declined, while interactions between HIV status and partner numbers as well as condom use became more important.

RESULTS

The online questionnaire was completed by 16,734 MSM living in Germany. A previous diagnosis of HIV was reported by 1,427 respondents; a previous negative HIV test result by 9,886, and 5,341 respondents did not report a previous HIV test. Differences between untested men and men who tested negative for HIV compared to men with an HIV diagnosis were minor in most behavioural parameters analysed, with untested men usually reporting less risky behaviours than men who tested negative. Therefore, we dichotomised HIV status into 'Diagnosed with HIV' and 'Not diagnosed with HIV' for this analysis.

The questions on diagnosis of a bSTI in the previous 12 months and the last anal intercourse event were answered by 7,799 respondents who were not diagnosed with HIV and 1,079 respondents diagnosed with HIV. These 8,878 respondents form the final study sample for our analysis.

In our online sample, meeting the last non-steady anal sex partner online was the most frequent mode of meeting non-steady partners, followed by gay sex venues. Other venues were each reported by 2-6% of the respondents. Sex-focused venues such as sex venues, cruising places, and private gay sex parties were mentioned more frequently by respondents diagnosed with HIV (see Table 1).

Table 1: History of bSTI diagnosis, and demographic and behavioural characteristics of survey respondents, by HIV status and place of meeting the last non-steady anal sex partner, German MSM online survey 2013

		Place meeting the last non-steady anal sex partner								
		Online	Smartphone app	Gay sex venue	Social venue	Cruising place	Private sex party	Non-gay venue	Other places	Total
Proportion meeting the last non-steady sex partner at the respective location	Not diagnosed with HIV	4841 62%	369 4.7%	866 11%	387 4.9%	257 3.3%	124 1.6%	471 6.0%	484 6.2%	7799
	Diagnosed with HIV	548 51%	42 3.9%	268 25%	38 3.5%	56 5.2%	53 4.9%	25 2.3%	49 4.5%	1079
Proportion diagnosed with HIV compared with ref. group online		ref	ns	**	ns	**	**	°°	ns	
Proportion diagnosed with a bacterial STI in recent 12 months	Not diagnosed with HIV	5.0%	7.5%	7.4%	7.2%	4.6%	3.1%	3.8%	3.9%	327 (4.2%)
	Diagnosed with HIV	**20.3%	**23.3%	**27.2%	*18.4%	*10.5%	**26.4%	(0.0%)	6.1%	**225 (20.9%)
Median partner number category (previous 12 months)	Not diagnosed with HIV	4-5 p.	6-7	8-10	4-5	8-10	8-10	4-5	4-5	
	Diagnosed with HIV	8-10	11-20	21-30	6-7	11-20	11-20	6-7	8-10	
Median age	Not diagnosed with HIV	36	31	44	32	45	43	29	36	36
	Diagnosed with HIV	44	39	46	43.5	44	45	42	44	44
Proportion living in a place with less than 100,000 inhabitants	Not diagnosed with HIV	48.8%	40.7%	41.5%	34.1%	54.1%	52.4%	47.6%	51.4%	47.2%
	Diagnosed with HIV	°°33.2%	°21.4%	°°23.5%	°10.5%	(°)41.1%	°34.0%	°16.0%	°°22.4%	°°29.1%
Proportion reporting HIV seroconcordance with last non-steady anal sex partner[1]	Not diagnosed with HIV	32.6%	29.4%	13.4%	30.6%	19.4%	34.1%	36.4%	37.3%	30.3%
	Diagnosed with HIV	**38.2%	*37.2%	**21.0%	28.9%	17.5%	*54.7%	*36.0%	25.0%	**32.6%
Proportion reporting not having used a condom for anal intercourse[1]	Not diagnosed with HIV	29.6%	24.2%	28.4%	26.6%	33.9%	39.2%	30.8%	35.4%	29.8%
	Diagnosed with HIV	**63.5%	*51.2%	**73.7%	48.6%	64.3%	**86.5%	*54.2%	*45.7%	**65.2%

** = proportion significantly higher; °°=significantly lower (p<0.001 for all comparisons). *=significantly higher (p<0.04); °=significantly lower (p<0.025). (°) p=0.064

[1] Information on HIV serostatus communication and condom use with the last non-steady anal sex partner was based on the following series of questions: What did you tell your partner about your own HIV test result? What did you know or think about the HIV test result of your partner? How did you know or why did you think that? Did you have anal intercourse? (specifying whether anal intercourse was receptive or insertive). Did he use a condom? Did you use a condom?

Differences by HIV status

Respondents diagnosed with HIV were older than respondents not diagnosed with HIV, independent of venue. Respondents using smartphone apps had the lowest median age independent of HIV serostatus. Participants with HIV diagnosis more often lived in cities with more than 100,000 inhabitants.

The partner number categories reported by respondents diagnosed with HIV were consistently one to two categories higher. HIV serostatus communication was reported slightly more often by respondents diagnosed with HIV.

The proportion reporting diagnosis of a bSTI in the recent 12 months was two to fourfold higher among men diagnosed with HIV, except for non-gay venues, for which the number of HIV-diagnosed men meeting their last non-steady partner was small (see Table 1).

Differences by meeting venue

Serostatus was relatively frequently communicated at private sex parties, in non-gay settings, and online. It was relatively rarely communicated in gay sex venues and at cruising sites.

Condom use was in general much lower for respondents diagnosed with HIV positive compared those not diagnosed with HIV, and for both it was lowest at private sex parties. Otherwise, the condom use pattern was different for respondents diagnosed and not diagnosed with HIV: at venues with a low perceived personal responsibility to disclose HIV status (sex venues, cruising sites) low condom use was reported by respondents diagnosed, high condom use by respondents not diagnosed with HIV. For respondents not diagnosed with HIV, meeting venues less associated with the gay subculture (non-gay venues, other places) were associated with relatively low condom use. Notable was the low level of condom use associated with cruising places (see Table 1).

In general, mutual serostatus knowledge was associated with lower condom use, independent of serostatus concordance or discordance (see Supplemental Figure). Also, condom use decreased with increasing knowledge of the non-steady partner (see Fig.1).

Results of multivariate analysis

In model 1, HIV status was the strongest predictor for diagnosis of a bSTI. For men not diagnosed with HIV meeting the last non-steady anal sex partner in a gay sex venue or a gay social venue compared with online was associated with an increased risk for STI diagnosis. Meeting the last partner on a smartphone app was associated with an increased risk (OR 1.48; 95%CI 0.94-2.34) which fell short of statistical significance. Men 45 years and older had a significantly lower risk than men aged 20-29 years.

For men diagnosed with HIV risk was increased when the last non-steady anal sex partner was met in a gay sex venue, and it was significantly lower when the partner was met at a non-gay or other venue (see Table 2).

Table 2: Age-adjusted logistic regression analysis of association of last meeting place with bSTI diagnosis in recent 12 months, German MSM online survey 2013 – model 1

	Not diagnosed with HIV	OR	95%CI	Diagnosed with HIV	OR	95%CI
HIV status					**4.93**	**2.80 - 8.66**
Meeting place	Online	reference				
	Social venue-neg	**1.60**	1.03 -2.48	Social venue-pos	.863	.37 - 2.02
	Sex venue-neg	**1.88**	1.37 - 2.57	**Sex venue-pos**	**1.52**	**1.07 - 2.14**
	Private setting-neg	.93	.34 - 2.55	Private setting-pos	1.46	.76 - 2.79
	Cruising place-neg	1.14	.59 - 2.19	Cruising place-pos	.45	.19 -1.09
	Smart phone app-neg	1.48	.94 - 2.34	Smart phone app-pos	1.07	.51 - 2.25
	Other-neg	.73	.48 - 1.11	**Other-pos**	**.16**	**.05 - .52**
Age group	20-29	reference				
	<20-neg	.62	.35 - 1.09	<20-pos	1.18	.12 -11.81
	30-44-neg	1.07	.82 - 1.39	30-44-pos	1.55	.90 - 2.68
	>44-neg	**.50**	**.36 -.70**	>44-pos	.82	.47 - 1.44

Bold = statistically significant associations (p<0.05)

Example how to read the table: The odds for an MSM diagnosed with HIV who met his last non-steady anal sex partner online to have received an bSTI diagnosis in the recent 12 months is 4.93 compared to an MSM not diagnosed with HIV. The odds for a man not diagnosed with HIV who met his non-steady anal sex partner in a gay sex venue were 1.88 compared to a man meeting his last non-steady anal sex partner online. The odds for a man diagnosed with HIV who met his last non-staedy anal sex partner in a gay sex venue were 1.52 compared to a man diagnosed with HIV and meeting his last partner online, and 1.52*4.93= 7.49 compared to a man not diagnosed with HIV meeting his last partner online.

When we included partner numbers, size of the place of residence, and HIV status disclosure in model 2 and tested for the various interactions between the included variables by stepwise inclusion, the effect of venues mostly disappeared. HIV status remained the strongest predictor for bSTI diagnosis. The effect of age was the same as in model 1. HIV status disclosure was associated with increased odds for bSTI diagnosis, regardless whether status was concordant or discordant.

Increasing partner numbers increased the odds for a bSTI diagnosis, more so for men not diagnosed with HIV than for men diagnosed with HIV. Condom use at last anal intercourse had no significant effect on bSTI diagnosis among HIV-undiagnosed men, but for HIV-diagnosed men condoms significantly lowered the risk. With increasing size of the place of residence also the odds for bSTI diagnosis increased.

Only two meeting venues remained in the model, both associated with a significantly lower risk for bSTI diagnosis : cruising places and non-gay/other venues. Meeting the last non-steady anal sex partner in a gay social or sex venue was still associated with an increased odds of having been diagnosed with a bSTI, but this fell short of being statistically significant (see Table 3).

Table 3: Logistic regression analysis of association of last meeting place with bSTI diagnosis in recent 12 months, German MSM online survey 2013 – model 2 (condom use and partner numbers controlled for HIV status [-neg/ -pos])

		OR	95%CI	OR	95%CI
HIV status	**positive**			**7.02**	**4.13 – 11.93**
Meeting place	online	reference			
	Social venue	1.36	.91 - 2.05		
	Sex venue	1.18	.92 - 1.53		
	private setting	.92	.53 - 1.58		
	Cruising place	**.55**	**.31 – 0.98**		
	Smart phone app	1.15	.76 – 1.74		
	Other	**.64**	**.43 – 0.97**		
Age group	20-29	reference			
	<20	.84	.48 - 1.49		
	30-44	1.04	.81 - 1.33		
	>44	**.55**	**.42 - .73**		
City size	100,000-500,000	reference			
	<100,000	.84	.64 - 1.12		

	500,000-1 Million	**1.48**	**1.07 - 2.04**			
	>1 Million	**1.42**	**1.08 - 1.86**			
Partner number	2 to 5	reference				
	One-neg	.75	.32 - 1.74	One-pos	.47	.06 – 3.71
	6 to 10-neg	**2.07**	**1.45 – 2.95**	6 to 10-pos	1.46	0.85 – 2.50
	11 to 50-neg	**4.94**	**3.64 – 6.70**	**11 to 50-pos**	**2.00**	**1.24 – 3.24**
	More than 50-neg	**7.49**	**4.76 – 11.79**	**More than 50-pos**	**4.88**	**2.85 – 8.33**
Serostatus communication	Non-concordant	reference				
	HIV concordant	**1.28**	**1.03 - 1.58**			
	HIV discordant	**2.03**	**1.30 - 3.15**			
Condom	Condom use-neg	.88	.69 – 1.13	**Condom use-pos**	**.55**	**.38 - .82**

Bold = statistically significant associations (p<0.05)

DISCUSSION

The type of physical and virtual meeting place with the last non-steady sex partner was strongly associated with the median number of new sex partners in the previous 12 months. This suggests that certain venues facilitate meeting multiple sex partners more than others (e.g. sex venues, private sex parties), and/or that such venues are visited preferentially by men interested in having multiple sex partners.

HIV status also has an impact on partner numbers: HIV positive respondents consistently reported higher partner numbers than respondents not diagnosed with HIV, which has also been reported from other studies [11]. The higher partner numbers of men diagnosed with HIV may have several, non-exclusive reasons:

1) Higher partner numbers may be one of the risk factors that contributed to HIV infection.

2) Restricting partner numbers may be one important strategy to reduce the risk for HIV infection. The diagnosis of HIV removes this necessity.

3) HIV diagnosis may result in disinhibition regarding partner numbers in some and withdrawing from the gay subculture in others. Recruiting survey participants on websites designed primarily to find new partners may introduce a selection bias towards the first group.

Unfortunately, because we have only cross-sectional and no longitudinal data spanning the time of seroconversion and HIV diagnosis, we cannot determine the relative importance of these three reasons.

The reported partner numbers were higher in venues/settings where either serostatus communication/ HIV serosorting was frequent (online, smartphone) or where perceived personal responsibility for serostatus disclosure was low (sex venues)[12].

Cruising places seemed to be the meeting venues which combine the lowest levels of serostatus disclosure and thus probably a relatively high mixing of men diagnosed and not diagnosed with HIV with a relatively low level of condom use. However, risk management in cruising places may operate mainly by avoiding anal intercourse in this venue, since only a small proportion of respondents (3% not diagnosed with HIV, 5% HIV diagnosed with HIV) met their last non-steady anal sex partner there.

The probability of being diagnosed with bSTI was much higher among MSM diagnosed with HIV. This is very likely partly explained by higher STI screening frequencies among men diagnosed with HIV and in continuous medical care [13]. On the other hand, in model 1 the probability of being diagnosed with bSTI was higher in MSM visiting sex venues, gay social venues (HIV-neg.), and private sex parties (HIV-pos.). Higher bSTI risk was associated with higher median partner numbers when meeting the last non-steady sex partner in the respective venue. Serosorting, or preferentially seeking sex partners also infected with HIV to avoid rejection and allow condomless sex without risking HIV transmission, also contributes to a higher risk for STI [14]. In addition, also known HIV discordance increased bSTI risk in our sample, suggesting selective, HIV-specific precautions. Serostatus disclosure was much more frequent when meeting partners online, on a smartphone app or at a private sex party (see reported seroconcordance, Table 1). Therefore it is not surprising that the effect of venues largely disappeared when controlling for partner numbers and serostatus disclosure in Model 2.

Higher partner numbers and an increased odds for being diagnosed with bSTI for smartphone app users compared with men finding their partners online (HIV-undiagnosed) in model 1 may be a consequence of more sexually active men switching to the new tool of smartphone apps preferentially, similar to the early years when internet became available as a new tool for partner seeking [15, 16]. Higher partner numbers and higher prevalence of ever being diagnosed with an STI have also been reported in a recent publication comparing health outcomes of a smaller sample of 110 MSM who use smartphone apps compared to MSM who meet partners in other ways [17].

Another aspect possibly playing a role is the preferential use of smartphone apps in areas with higher population and MSM density, which are also areas with higher density of sex venues and higher STI prevalence among MSM. The higher proportion of smartphone app users using a condom for last anal intercourse compared with men finding their partners online may be explained by more intense and explicit online communication compared with smartphone app communication, making men communicating with their potential partners online more confident in being able to determine HIV infection risks associated with their partners.

New technologies like GPS-based smartphone apps seem to improve opportunities to find new sex partners compared with seeking partners on gay websites (particularly for younger men and men living in densely populated areas).

Limitations

There are several limitations to consider when interpreting the results of our analysis. A common limitation for almost all studies among MSM is the lack of a representative sampling frame. Our sample is an online convenience sample, and we cannot claim that our findings are representative for the whole MSM population. Self-selection biases common to online surveys among MSM such as higher education levels compared with the general adult male population probably have been accentuated in this survey by a relatively high attrition rate (see also Supplemental file 1). An analysis of survey participants who did not complete the survey showed a higher probability of being younger, not gay identified, and having lower education levels. In addition, the online survey was not adapted for smartphones, thus smartphone users were likely underrepresented in the study sample, possibly introducing further self-selection biases.

Another limitation is the reliance on self-reported STI diagnoses. The large differences regarding STI diagnosis rates between men diagnosed and not diagnosed with HIV are partly explained by different access to routine STI screening: while for men diagnosed with HIV STI testing can be reimbursed as part of regular HIV treatment monitoring, considerable reimbursement barriers for STI screening for men not diagnosed with HIV exist. Due to the resulting low adequate STI screening frequencies among men without HIV diagnosis it is likely that by using self-reported STI diagnosis rates a high proportion of undiagnosed asymptomatic bSTI among these men is missed [13].

When analysing the associations between bSTI diagnosis and behaviours during the last episode of anal intercourse with a non-steady partner we assume these behaviours are representative for the period of STI acquisition on a population level and neglect that STI could also have been transmitted during other occasions, and from a steady partner. Finally, recall and social desirability biases have to be expected, since data on diagnoses and behaviours were self-reported.

CONCLUSIONS

While behaviour patterns associated with STI risk differ according to HIV status and venues visited, this relationship is mediated by factors that contextualize men's encounters (e.g., partner numbers, attitudes toward HIV status disclosure, perceptions about condom use, and anonymous sex). Although not directly associated with STIs, venues are connected to social-behavioural facets of corresponding sexual encounters, and may be important arenas for differential HIV and STI education, treatment, and prevention. Consequently, outreach prevention work in gay venues has long been an important component of HIV prevention for MSM. During the last two decades advances in communication technology have affected networking patterns, thereby influencing the dynamics of sex partnerships. Close and coordinated cooperation between HIV/STI prevention workers and gay website and smartphone app owners to optimize the technical and design-related opportunities for supporting protective and minimizing risk-enhancing behaviours of their customers when seeking new partners should be established and further developed.

Both the venue and individual characteristics must be considered when generating and disseminating STI prevention messaging [18]. Outreach providers should consider these contextualizing aspects when planning interventions in physical and virtual venues.

COMPETING INTERESTS

The authors declare that they have no competing interests.

ACKNOWLEDGEMENTS

This work was supported by the German Federal Centre for Health Education (BZgA) [Grant number 25.5.2.4/13], and by the German Ministry of Health [Grant number IIA5-2014-2514AUK340]. The funders had no influence on the design of the study, the collection, analysis and interpretation of data, the writing of the manuscript, and the decision to submit the manuscript for publication.

The authors would like to acknowledge the work of Michael Bochow who designed and conducted several previous German MSM surveys since the late 1980ies and who contributed to this survey with his advice and support. The authors also thank all survey participants who contributed their time to fill in the questionnaire.

AUTHOR'S CONTRIBUTIONS

The survey was designed and executed by JD and MK with contributions by UM and MG. The paper was conceived and the manuscript was drafted by UM. Statistical analysis was conducted by UM and MadH. All authors contributed writing to second draft. All authors approved the final manuscript.

DATA SHARING

No additional data available.

FIGURES

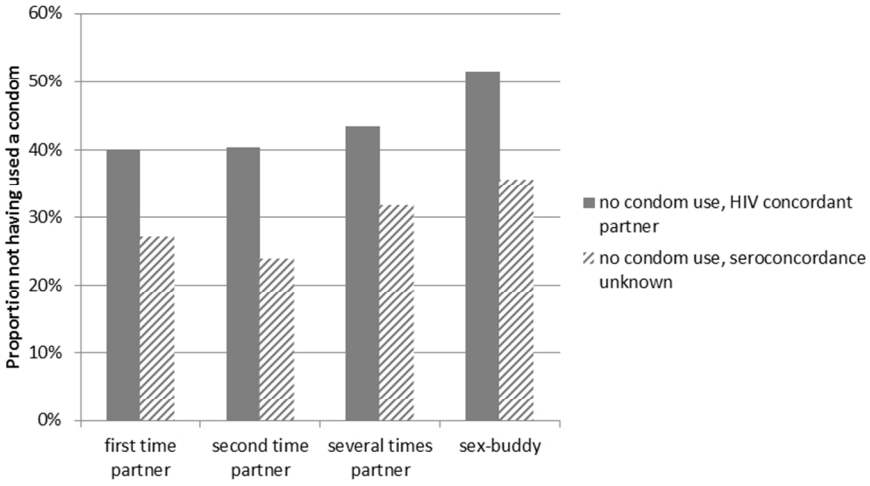
Fig.1: Proportion of survey participants reporting no condom use during last anal intercourse with a non-steady partner by partner knowledge and reported HIV seroconcordance*, German MSM online survey 2013

*HIV concordant = respondent reported the same HIV serostatus as his non-steady partner; HIV seroconcordance unknown = either the respondent has never been tested for HIV or the HIV serostatus of his non-steady partner was not known or HIV serostatus was not disclosed

REFERENCES

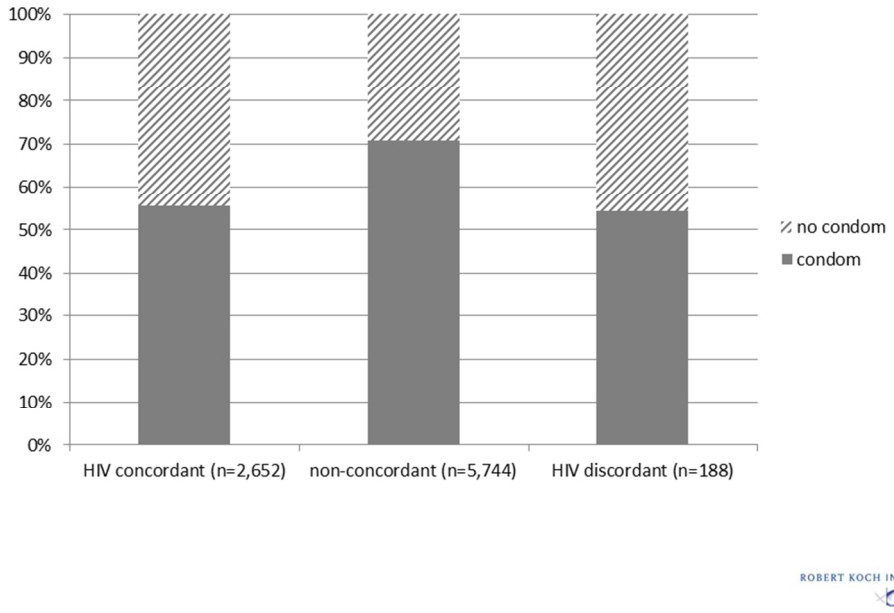
1. Zhao J, Chen L, Cai WD, et al. HIV infection and sexual behaviors among non-commercial men who have sex with men at different venues. Arch Sex Behav 2014;43(4):801-9. doi: 10.1007/s10508-013-0167-0. Epub 2013 Aug 27.
2. Vial AC, Starks TJ, Parsons JT. Finding and recruiting the highest risk HIV-negative men who have sex with men. AIDS Educ Prev 2014;26(1):56-67. doi: 10.1521/aeap.2014.26.1.56.
3. Voetsch AC, Lansky A, Drake AJ, et al. Comparison of demographic and behavioral characteristics of men who have sex with men by enrollment venue type in the National HIV Behavioral Surveillance System. Sex Transm Dis 2012;39(3):229-35. doi: 10.1097/OLQ.0b013e31823d2b24.
4. Grov C. HIV risk and substance use in men who have sex with men surveyed in bathhouses, bars/clubs, and on Craigslist.org: venue of recruitment matters. AIDS Behav 2012;16(4):807-17. doi: 10.1007/s10461-011-9999-6.
5. Grov C, Agyemang L, Ventuneac A, et al. Navigating condom use and HIV status disclosure with partners met online: a qualitative pilot study with gay and bisexual men from Craigslist.org. AIDS Educ Prev 2013;25(1):72-85. doi: 10.1521/aeap.2013.25.1.72.
6. Grov C, Hirshfield S, Remien RH, et al. Exploring the venue's role in risky sexual behavior among gay and bisexual men: an event-level analysis from a national online survey in the U.S. Arch Sex Behav 2013;42(2):291-302. doi: 10.1007/s10508-011-9854-x. Epub 2011 Oct 20.
7. Grov C, Crow T. Attitudes about and HIV risk related to the "most common place" MSM meet their sex partners: comparing men from bathhouses, bars/clubs, and Craigslist.org. AIDS Educ Prev 2012;24(2):102-16. doi: 10.1521/aeap.2012.24.2.102.
8. Rönn M, White PJ, Hughes G, et al. Developing a conceptual framework of seroadaptive behaviors in HIV-diagnosed men who have sex with men. J Inf Dis 2014;210(Suppl 2):S586-S593.
9. Marcus U, Ort J, Grenz M, et al. Risk factors for HIV and STI diagnosis in a community-based HIV/STI testing and counselling site for men having sex with men (MSM) in a large German city in 2011–2012. BMC Inf Dis 2015;15:14 doi: 10.1186/s12879-014-0738-2.
10. Bolding G, Davis M, Hart G, et al. Where young MSM meet their first sexual partner: the role of the Internet. AIDS Behav. 2007;11(4):522-6.
11. Rosenberg ES, Sullivan PS, Dinenno EA, et al. Number of casual male sexual partners and associated factors among men who have sex with men: results from the National HIV Behavioral Surveillance system. BMC Public Health 2011;11:189. doi: 10.1186/1471-2458-11-189.

12. O'Leary A, Horvath KJ, Rosser SBR. Associations between partner-venue specific personal responsibility beliefs and transmission risk behavior by HIV-positive men who have sex with men (MSM). AIDS Behav 2013;17(5):1855-61. doi: 10.1007/s10461-012-0291-1.
13. Schmidt AJ, Hickson F, Weatherburn P, et al. Comparison of the performance of STI Screening Services for gay and bisexual men across 40 European cities: results from the European MSM Internet Survey. Sex Transm Infect 2013;89(7):575-582 doi:10.1136/sextrans-2012-050973.
14. Marcus U, Schmidt AJ, Hamouda O. HIV serosorting among HIV-positive men who have sex with men is associated with increased self-reported incidence of bacterial sexually transmissible infections. Sexual Health 2011;8:184–193.
15. Bolding G, Davis M, Hart G, et al. Gay men who look for sex on the Internet: is there more HIV/STI risk with online partners? AIDS 2005;19:961-968.
16. Downing MJ Jr. Using the internet in pursuit of public sexual encounters: is frequency of use associated with risk behavior among MSM? Am J Mens Health 2012;6(1):18-27. doi: 10.1177/1557988311407906. Epub 2011 Jun 9.
17. Lehmiller JJ, Ioerger M. Social networking smartphone applications and sexual health outcomes among men who have sex with men. PLoS One 2014;9(1):e86603. doi: 10.1371/journal.pone.0086603.
18. Kingdon MJ, Storholm ED, Halkitis PN, et al. Targeting HIV prevention messaging to a new generation of gay, bisexual, and other young men who have sex with men. J Health Commun 2013;18(3):325-42. doi: 10.1080/10810730.2012.727953. Epub 2013 Jan 15.



Proportion of survey participants reporting no condom use during last anal intercourse with a non-steady partner by partner knowledge and reported HIV seroconcordance*, German MSM online survey 2013

*HIV concordant = respondent reported the same HIV serostatus as his non-steady partner; HIV seroconcordance unknown = either the respondent has never been tested for HIV or the HIV serostatus of his non-steady partner was not known or no disclosure of HIV serostatus occurred
254x190mm (96 x 96 DPI)



Condom use during last anal intercourse with a non-steady partner and HIV serostatus knowledge*, German MSM online survey 2013

* HIV concordant = respondent reported the same HIV serostatus as his non-steady partner; HIV discordant = respondent reported HIV serostatus to be different from his non-steady partners serostatus; HIV non-concordant = HIV status of one or both unknown or no HIV serostatus disclosure

254x190mm (96 x 96 DPI)

Supplemental file

CHERRIES criteria for German MSM online survey 2013 (SMA 2013)

Design

The survey was designed as a nationwide, anonymous online-survey targeting MSM. Participants were recruited for the survey through private messages and banners on several social networking and dating sites for gay men. Private messages were sent to all site members having a profile in German language and residing in Germany. Thus the resulting sample was a convenience sample.

IRB (Institutional Review Board) approval and informed consent process

The online survey protocol was evaluated and approved by the ethical review board of the Charité University Clinic in Berlin (EA1/266/13).

Informed consent

The survey's entry site contained information about who the investigator was, the goals and contents of the survey, terms of participation, data privacy, and approximate length of time of the survey. By clicking on a button "I have read and understood the information above" the participant gave his informed consent and was referred to the online questionnaire (for the information included on the entry site see Annex I).

Data protection

We did not collect any personal data which would allow the identification of participants. Several suggestions by the data protection office of the federal state of Berlin to improve data protection for survey participants were implemented.

Development and pre-testing

The questionnaire was developed by using items of former German surveys with this population. The questionnaire used questions from the 2010 European MSM Internet survey (www.emis-project.eu) as much as possible. Several new questions and scales were included. Experts and stakeholders of the target group were asked to evaluate the questionnaire. The survey was informally pretested for technical functionality, usability and wording with members of the target population.

Recruitment process and description of the sample having access to the questionnaire

Advertising the survey

The survey was announced on several homepages (dating sites and news sites) directed at the target population. On most homepages a banner or texts were provided with a link to the questionnaire. One large dating site for MSM (planetromeo.com; number of active profiles in Germany as of March 18, 2015: 433,781. More than one profile per person is possible. Estimated number of MSM aged 15-64 years living in Germany as of 2010: approximately 656,000 [Marcus U, et al. Estimating the size of the MSM populations for 38 European countries by calculating the survey surveillance discrepancies (SSD) between self-reported new HIV diagnoses from the European MSM

internet survey (EMIS) and surveillance reported HIV diagnoses among MSM in 2009. BMC Public Health 2013, 13:919 http://www.biomedcentral.com/1471-2458/13/919]) sent out a message to every German member with a link to the questionnaire asking the members to participate in the survey (for the wording of the message see Annex II). The survey was announced on planetromeo.com in a time-staggered manner (eight batches, ~50,000 profiles each), originally with the intention to prevent excessive demand for free testing at the cooperating testing sites, where free test vouchers offered at the end of the questionnaire could be used. Due to the lower than expected demand this turned out to be unnecessary. However, unexpectedly the capacity of the server of the survey website was not sufficient to manage the demand, so that long waiting times for users resulted and on some of the first days the survey was practically dysfunctional.

The survey was not specifically adapted for smartphone users. The main recruitment website offers traditional online websites as well as a gps-based smartphone app to manage user profiles. Both types of clients were invited to participate in the survey, however, the lack of smartphone-adaptation was mentioned in the invitation mail. Due to the lack of smartphone adaptation and the technical server problems it is very likely that the survey was filled in preferentially with a personal computer online instead by smartphone. Compared with the previous online survey (EMIS 2010) younger age groups (25-35 years) were less well represented among respondents, which may be due to the higher frequency of app-use in this age group.

Survey administration

The survey was a Web-based survey which was filled in online. Responses were automatically captured and directly stored in a database.

Context

See above.

Mandatory/voluntary

Participation in the survey was voluntary.

Incentives

No incentives were offered.

Time/Date

Data were collected between November 2013 and January 2014

Randomization of items or questionnaires

Randomization or alternating of items was not used.

Adaptive questioning

Adaptive questioning was used throughout the questionnaire to reduce number and complexity of the questions. E.g. separate questions were asked to respondents who indicated that they had received an HIV diagnosis and those who didn't.

Number of Items and screens (pages)

The questionnaire included 344 items and 218 questions, presented online on approximately 100 pages. Due to the adaptive design of the questionnaire the actual number of pages that were seen by an average respondent was much less.

Completeness check

No consistency or completeness check was implemented before the questionnaire was submitted. Several questions (e.g. gender, age, HIV test, etc.) were regarded as especially important. In case the respondent didn't answer one of these questions, they were reminded using a pop-up window, to answer this question. If the respondent still was not willing to answer the question he was able to continue the questionnaire.

Review step

Respondents were able to change answers on previous pages using a Back button.

Response rates

Unique site visitors: No IP addresses were stored and no cookies were used.

For every new first page visitor a unique code was generated. The total number of codes generated was 51,277. However, as mentioned above, the survey page was at certain times dysfunctional, which may have resulted in immediate discontinuation and later re-start of the survey. The first survey question was answered by 27,337 respondents; the last set of questions was answered by 14,392 respondents.

Due to the decision not to store IP addresses and not to use cookies, in combination with the technical difficulties during the implementation of the survey it is not possible to give meaningful numbers for the view rate and the participation rate. The completion rate can be calculated as 14,329/ 27,337 = 52%

Preventing multiple entries from the same individual

No technical tools such as cookies were used to prevent multiple entries from the same individual. However, due to the length of the questionnaire, technical capacity problems on the survey website which resulted in longer waiting times between screens further prolonging the time needed to fill in the questionnaire, and the lack of any material incentives, we think it is highly unlikely that individuals filled in the questionnaire more than once. It is however possible that respondents interrupted filling in the questionnaire and decided to restart at a later time point. To prevent using such possible multiple entries from the same individual, the final dataset was restricted to questionnaires in which at least the questions regarding gender, age, country, sexual orientation and HIV testing behaviour were answered. These represent the first approximately 10 page screens, and survey sections which did not include adaptive questions (27,337 respondents answered the first question on gender; 19,630 respondents answered the question on HIV testing).

IP check

No IP addresses of the client computer were used to identify potential duplicate entries from the same user.

Log file analysis

No other techniques to analyze the log file for identification of multiple entries were used.

Analysis

Incomplete questionnaires were also analysed when questions regarding gender, age, country, sexual orientation and HIV testing behaviour were answered.

Questionnaires submitted with an atypical timestamp

Time to fill out the questionnaire was not used as an exclusion criterion.

Statistical correction

No weighting of items or propensity scores have been used to adjust for the non-representative sample.

Annex I: Entry page of the online questionnaire

Subscriber information

Welcome to the survey!

Please take part in this survey if you ...

• are a gay man and / or

• are a man who feels attracted to men and / or

• are a man who has sex with men and

• are at least 16 years old.

We want to know it!

This survey, the study "Gay Men and HIV / AIDS 2013" refers to the sex you have, your knowledge and attitudes to HIV prevention and HIV testing and your life as a gay man, or a man who has sex with men, and how you are dealing with HIV and other sexually transmitted infections.

The questionnaire will take approximately 30 minutes.

Privacy Policy

Participation is anonymous. We guarantee that we will not save your IP address or collect information about you that could enable your identification by third parties.

For notes on the safe use of PCs, please refer to www.bsi.de.

Replying to the questionnaire is voluntary and can be canceled at any time, without any disadvantages for you.

More information about objectives of this study can be found further down on this page.

Here we go!

Start the questionnaire by clicking on the following button:

[Button]

For more information on this study

We are psychologists and health scientists of the Free University Berlin. This study has been financed by the Federal Centre for Health Education (BZgA). For questions, comments or suggestions about the study please contact us at the e-mail address msm@zedat.fu-berlin.de

Goals

The primary objective of this survey is to obtain current information about how gay and other men who have sex with men (MSM) are dealing and living with HIV / AIDS and other sexually transmitted infections (STI). The collected answers will allow an assessment of the extent to which you and the other participants protect themselves, but also what risks you are willing to take. Questions about the use of preventive services, and knowledge about progress in the treatability of HIV, will also allow to assess information needs and to better address these issues in HIV prevention. In addition to these points the general life situation of gay and other men who have sex with men living in Germany is an important part of this survey. In addition to dealing with discrimination against homosexuality, mental well-being is discussed in this survey for the first time. We want to investigate whether and why gay and bisexual men are more frequently affected by psychological stress. Also, the use of psychoactive substances (alcohol and drugs) will be investigated.

What happens to your data?

Taking into account the legal requirements of data protection we will evaluate your information together with that of the other participants to prepare scientific publications for a specialist audience. In this way we create the conditions that your information can be included in the optimization of prevention services for gay men and other men who have sex with men.

The central results of this survey can be expected to become available by autumn 2014, accessible on www.sma2013.de.

This study was reviewed by the ethics committee of the Charité Berlin, which confirmed the ethical acceptability of this study. The Data Protection Officer of the State of Berlin has examined the compliance with data protection and his suggestions for changes have been implemented.

Annex II: Invitation mail for men with a profile on planetromeo.com

Hello,

We would like to invite you to participate in a survey of gay and other men who have sex with men. This survey deals with your life, your sex and your relationships, your knowledge and attitudes to recent developments in HIV / AIDS, and how you are dealing with HIV and other sexually transmitted infections.

This survey is done anonymously and takes about 30 minutes. The survey is not optimized for filling in on smartphones. (Now start with the questionnaire!)

Your participation in this survey can not only help to ensure that you learn something new. Through your participation, you also support the prevention of HIV and other sexually transmitted diseases among gay and other men who have sex with men in Germany. The results of the study are directly feeding into this prevention work. In this way the prevention may take your needs better into consideration.

For more information about this study, please go to the home page of the questionnaire.

Your experiences and your vision are important to us. We would therefore be very happy if you participate in this survey: Click here for the questionnaire!

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

	Item No	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	5/ Suppl.file
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5/ Suppl.file
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	Suppl.file
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	5
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	5/ 7
Bias	9	Describe any efforts to address potential sources of bias	
Study size	10	Explain how the study size was arrived at	5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	5
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	6
		(*b*) Describe any methods used to examine subgroups and interactions	6
		(*c*) Explain how missing data were addressed	Suppl.file
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	
		(*e*) Describe any sensitivity analyses	
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	6/ Suppl.file
		(b) Give reasons for non-participation at each stage	
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	7
		(b) Indicate number of participants with missing data for each variable of interest	
Outcome data	15*	Report numbers of outcome events or summary measures	7
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear	7-11

		which confounders were adjusted for and why they were included	
		(*b*) Report category boundaries when continuous variables were categorized	
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	
Discussion			
Key results	18	Summarise key results with reference to study objectives	11-13
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	13
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	13
Generalisability	21	Discuss the generalisability (external validity) of the study results	13
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	15

*Give information separately for exposed and unexposed groups.

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

BMJ Open

THE IMPACT OF MEETING LOCATIONS FOR MEN HAVING SEX WITH MEN ON THE RISK FOR BACTERIAL SEXUALLY TRANSMITTED INFECTIONS – ANALYSES FROM A CROSS-SECTIONAL ONLINE SURVEY

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2015-009107.R2
Article Type:	Research
Date Submitted by the Author:	25-Sep-2015
Complete List of Authors:	Marcus, Ulrich; Robert Koch-Institut, Infectious Diseases Epidemiology an der Heiden, Matthias; Robert Koch-Institut, Infectious Diseases Epidemiology Gassowski, Martyna; Robert Koch-Institut, Infectious Diseases Epidemiology Kruspe, Martin; Free University, Public Health Drewes, Jochen; Free University, Public Health
Primary Subject Heading:	Sexual health
Secondary Subject Heading:	Infectious diseases, Public health, Epidemiology
Keywords:	Public health < INFECTIOUS DISEASES, GENITOURINARY MEDICINE, SEXUAL MEDICINE

THE IMPACT OF MEETING LOCATIONS FOR MEN HAVING SEX WITH MEN ON THE RISK FOR BACTERIAL SEXUALLY TRANSMITTED INFECTIONS – ANALYSES FROM A CROSS-SECTIONAL ONLINE SURVEY

Marcus U[1], an der Heiden M[1], Gassowski M[1], Kruspe M[2], Drewes J[2]

[1] Department for Infectious Disease Epidemiology, Robert Koch-Institut, Berlin, Germany

[2] Free University - Public Health, Berlin, Germany

Email addresses of the authors

MarcusU@rki.de

anderHeidenM@rki.de

GassowskiM@rki.de

mkruspe@zedat.fu-berlin.de

jochen.drewes@fu-berlin.de

Corresponding author:

Ulrich Marcus, Department of Infectious Disease Epidemiology, Robert Koch-Institute, P.O. Box 650261, 13302 Berlin, Germany

ABSTRACT

Objectives

Opportunities for men having sex with men (MSM) to meet each other have very much improved by new communication technologies. Meeting venue-based characteristics can impact how many partners are met and how much sexual risk is taken. We analysed the association between physical and virtual venues and the risk for bacterial sexually transmitted infections (bSTI) among participants in an MSM online survey.

Methods

Data were collected during 2013/14 with a survey targeting MSM living in Germany. The impact of meeting place with the last non-steady anal sex partner on diagnosis with bSTI in the previous year was analysed using bi- and multivariate regression analysis, taking into account self-reported HIV status, serostatus communication, condom use, partner number, age, and city size.

Results

The study sample consisted of 8,878 respondents (7,799 not diagnosed with HIV; 1,079 diagnosed with HIV). Meeting partners online was most common (62% HIV-/51% HIV+), followed by sex venues (11% HIV-/25% HIV+); other venues were each reported by 2-6% of the respondents. Venue-dependent proportions reporting bSTI in the recent year were 2-4 folds higher among men diagnosed with HIV. In multivariate analysis, HIV status was the strongest predictor for bSTI (OR=5.0; 95%CI 2.8-8.7). Compared with meeting partners online, sex (OR 1.6; 95%CI 1.0-2.5) and social venues (OR 1.9; 95%CI 1.4-2.6) were associated with increased bSTI risk for men not diagnosed with HIV, but the risk when meeting partners by smartphone apps was only of borderline significance (OR 1.5; 95%CI 0.9-2.3). For men diagnosed with HIV bSTI risk increased for sex venues (OR 1.5; 95%CI 1.1-2.1), and was lower for non-gay/other venues (OR 0.2; 95%CI 0.1-0.5).

Conclusions

Venues are connected to social-behavioural facets of corresponding sexual encounters, and may be important arenas for differential HIV and STI education, treatment, and prevention.

ARTICLE SUMMARY

- Outbreaks and increasing numbers of diagnoses of sexually transmitted infections (STI) among men having sex with men are often attributed to new tools for partner finding. Smartphone applications helping to localize and communicate with potential partners are hypothesized to contribute to this because they may help to increase partner numbers.

Strengths of this study

- We intend to test this hypothesis by analysing data from a large online survey. Our data cover a broad range of physical and virtual meeting venues and our sample is not restricted to large cities.

Limitations of this study

- Large differences regarding STI diagnosis rates between men diagnosed and not diagnosed with HIV are partly explained by different access to routine STI screening: while for men diagnosed with HIV in Germany STI testing can be reimbursed as part of regular HIV treatment monitoring, considerable reimbursement barriers for STI screening for men not diagnosed with HIV exist. It is likely that by using self-reported diagnosis rates a high proportion of undiagnosed asymptomatic bacterial STI (bSTI) among MSM not diagnosed with HIV is missed.
- The online survey was not adapted for smartphones, thus smartphone users were likely underrepresented in the study sample and attrition of survey participants was high, possibly introducing self-selection biases.
- The reference group for our comparisons are MSM meeting their last non-steady anal sex partner online. While this was the most common meeting venue in our online sample, this venue didn't exist before 2000. When comparing STI diagnosis rates among MSM during the 1990ies and current diagnosis rates, the possible impact of new communication technologies on sexual networks needs to be considered.
- When analysing the associations between bSTI diagnosis and behaviours during the last episode of anal intercourse with a non-steady partner we assume these behaviours are representative for the period of STI acquisition on a population level and neglect that STI could also have been transmitted during another occasion and from a steady partner.

INTRODUCTION

In all societies men having sex with men (MSM) represent a minority of the population. Compared to non-sexual-minority individuals, MSM have limited opportunities to meet other (recognizable) MSM. In the last two decades, these opportunities have very much improved by new communication technologies (internet; mobile internet access devices, aka smartphones) becoming available that were adapted quickly by MSM to seek sexual partners.

Several authors have previously looked into the association between study participant recruitment place or sex partner meeting place with sexual risk behaviour, primarily with condom use for anal sex, HIV serostatus disclosure, and personal responsibility beliefs. Common findings were that MSM frequenting different venues often differ with regards to demographic characteristics, HIV and syphilis infection rates, and risky sexual behaviours [1]. For example, men meeting new partners in gay bars/clubs are usually younger and more likely to be single than men visiting saunas or men meeting new partners online [2, 3, 4]. Conversations around condom use and HIV are often difficult in gay venues, and more feasible and convenient using online media [5]. HIV status disclosure is lowest among men who meet their partner in a park, outdoors, or in another public place and highest among men who meet their partner online [6]. A consequence may be less condom use with partners met online due to a higher level of serostatus disclosure. Venue-based characteristics can impact how MSM negotiate sex and HIV-associated risk behaviour. However, in a previous multivariate model of men reporting anal sex during their last encounter, venue where partner was met was not significantly associated with unprotected anal intercourse (UAI) [7, 8].

There has been less research into the association of physical and virtual venues and risk for bacterial sexually transmitted infections (bSTI), and not much has been published on these issues among European MSM. A recent analysis of factors associated with STI and HIV diagnosis among clients of a German community based voluntary counselling and testing site for MSM indicated slight differences in the association of specific meeting places with the risk of new diagnosis of a bSTI or of HIV [9].

The expanding opportunities to communicate online make it easier for MSM, particularly those not living in large cities with an array of established gay venues, to find and meet new partners [10]. A shift from using less effective to more effective means of partner seeking (e.g. by using GPS-based smartphone applications for dating casual sex partners) may contribute to increasing numbers of partners and consequently to an increase of new diagnoses of STI and HIV among MSM.

In this analysis we focus on the impact of meeting locations on the probability of being diagnosed with a bSTI in the previous 12 months.

METHODS

Survey procedures

Data for this analysis were collected with an online survey targeting MSM living in Germany; the survey was online from 11/2013 through 01/2014. For a detailed description of the survey and the survey procedures see the Supplemental file.

The online survey protocol was evaluated and approved by the ethical review board of the Charité University Clinic in Berlin (EA1/266/13).

Measures

The main outcome of interest in our analysis is self-reported diagnosis of a bSTI (syphilis, gonorrhoea, chlamydia) within the previous 12 months.

Measures used as independent variables in this analysis are: (1) Place where the last non-steady anal sex partner (within the previous 12 months) was met (for categories, see Table 1; for multivariate analyses, response options 'not explicitly gay place' and 'another place' were merged); (2) HIV serostatus disclosure and condom use with the last non-steady anal sex partner. The last sexual encounter with a non-steady sex partner was classified as HIV sero-concordant if the reported HIV serostatus of the partner was the same as the serostatus reported by the respondent, as sero-discordant if the respondents reported a different HIV serostatus than his partner, and as non-concordant for any other combination of known and unknown HIV test results; (3) Self-reported HIV status (dichotomised); (4) Size of city of residence (three categories); (5) Number of sex partners in the previous 12 months (five categories); (6) Age group (four categories).

Statistical analysis

In bivariate analysis we first looked – stratified by HIV status - at distribution by venues where the last anal intercourse (AI) partner was met, taking meeting partners online as reference group.

Then we looked - by HIV status and place of meeting the last non-steady sex partner – at: Diagnosis of a bSTI ; median number of sex partners in the previous 12 months; age group; size of the place of residence; HIV serostatus communication; and condom use at last anal intercourse with a non-steady sex partner.

We constructed two different multivariate logistic regression models with diagnosis of a bSTI in the previous 12 months as the outcome variable:

Model 1 assumes that the distinct distribution patterns of the explanatory variables we looked at are intrinsic characteristics associated with meeting venues; e.g. sex venues and social venues for MSM are generally localized in larger cities; sex venues are predominantly frequented by men engaging in

sex with multiple partners, and serostatus disclosure is uncommon; meeting partners online or on smartphone apps allows relatively anonymous discussion of HIV serostatus, serostatus concordance, and condom use before having sexual intercourse; private sex parties are often organized based on HIV serostatus concordance of participants.

To focus on the effect of meeting venue, Model 1 consequently included only age group and HIV status as additional variables. We distinguished between respondents diagnosed and not diagnosed with HIV in each venue, because we hypothesized that the impact of HIV status would be different by meeting place. The reference category of Model 1 are HIV-undiagnosed MSM aged 20-29 years who met their last non-steady anal sex partner online.

Model 2 included additional variables (number of partners in the previous 12 months (reference: 2-5); HIV concordance at last AI (reference: HIV status unknown); condom use at last AI; city size (reference: 100,000-500,000)).

RESULTS

The online questionnaire was completed by 16,734 MSM living in Germany. A previous diagnosis of HIV was reported by 1,427 respondents; a previous negative HIV test result by 9,886, and 5,341 respondents did not report a previous HIV test. Differences between untested men and men who tested negative for HIV compared to men with an HIV diagnosis were minor in most behavioural parameters analysed, with untested men usually reporting less risky behaviours than men who tested negative. Therefore, we dichotomised HIV status into 'Diagnosed with HIV' and 'Not diagnosed with HIV' for this analysis.

The questions on diagnosis of a bSTI in the previous 12 months and the last anal intercourse event were answered by 7,799 respondents who were not diagnosed with HIV and 1,079 respondents diagnosed with HIV. These 8,878 respondents form the final study sample for our analysis.

In our online sample, meeting the last non-steady anal sex partner online was the most frequent mode of meeting non-steady partners, followed by gay sex venues. Other venues were each reported by 2-6% of the respondents. Sex-focused venues such as sex venues, cruising places, and private gay sex parties were mentioned more frequently by respondents diagnosed with HIV (see Table 1).

Table 1: History of bSTI diagnosis, and demographic and behavioural characteristics of survey respondents, by HIV status and place of meeting the last non-steady anal sex partner, German MSM online survey 2013

		Place meeting the last non-steady anal sex partner								
		Online	Smartphone app	Gay sex venue	Social venue	Cruising place	Private sex party	Non-gay venue	Other places	Total
Proportion meeting the last non-steady sex partner at the respective location	Not diagnosed with HIV	4841 62%	369 4.7%	866 11%	387 4.9%	257 3.3%	124 1.6%	471 6.0%	484 6.2%	7799
	Diagnosed with HIV	548 51%	42 3.9%	268 25%	38 3.5%	56 5.2%	53 4.9%	25 2.3%	49 4.5%	1079
Proportion diagnosed with HIV compared with ref. group online		ref	ns	**	ns	**	**	°°	ns	
Proportion diagnosed with a bacterial STI in recent 12 months	Not diagnosed with HIV	5.0%	7.5%	7.4%	7.2%	4.6%	3.1%	3.8%	3.9%	327 (4.2%)
	Diagnosed with HIV	**20.3%	**23.3%	**27.2%	*18.4%	*10.5%	**26.4%	(0.0%)	6.1%	**225 (20.9%)
Median partner number category (previous 12 months)	Not diagnosed with HIV	4-5 p.	6-7	8-10	4-5	8-10	8-10	4-5	4-5	
	Diagnosed with HIV	8-10	11-20	21-30	6-7	11-20	11-20	6-7	8-10	
Median age	Not diagnosed with HIV	36	31	44	32	45	43	29	36	36
	Diagnosed with HIV	44	39	46	43.5	44	45	42	44	44
Proportion living in a place with less than 100,000 inhabitants	Not diagnosed with HIV	48.8%	40.7%	41.5%	34.1%	54.1%	52.4%	47.6%	51.4%	47.2%
	Diagnosed with HIV	°°33.2%	°21.4%	°°23.5%	°10.5%	(°)41.1%	°34.0%	°16.0%	°°22.4%	°°29.1%
Proportion reporting HIV seroconcordance with last non-steady anal sex partner[1]	Not diagnosed with HIV	32.6%	29.4%	13.4%	30.6%	19.4%	34.1%	36.4%	37.3%	30.3%
	Diagnosed with HIV	**38.2%	*37.2%	**21.0%	28.9%	17.5%	*54.7%	*36.0%	25.0%	**32.6%
Proportion reporting not having used a condom for anal intercourse[1]	Not diagnosed with HIV	29.6%	24.2%	28.4%	26.6%	33.9%	39.2%	30.8%	35.4%	29.8%
	Diagnosed with HIV	**63.5%	*51.2%	**73.7%	48.6%	64.3%	**86.5%	*54.2%	*45.7%	**65.2%

** = proportion significantly higher; °°=significantly lower (p<0.001 for all comparisons). *=significantly higher (p<0.04); °=significantly lower (p<0.025). (°) p=0.064

[1] Information on HIV serostatus communication and condom use with the last non-steady anal sex partner was based on the following series of questions: What did you tell your partner about your own HIV test result? What did you know or think about the HIV test result of your partner? How did you know or why did you think that? Did you have anal intercourse? (specifying whether anal intercourse was receptive or insertive). Did he use a condom? Did you use a condom?

Differences by HIV status

The proportion reporting diagnosis of a bSTI in the recent 12 months was two to fourfold higher among men diagnosed with HIV, except for non-gay venues, for which the number of HIV-diagnosed men meeting their last non-steady partner was small (see Table 1).

The partner number categories reported by respondents diagnosed with HIV were consistently one to two categories higher. HIV serostatus communication was reported slightly more often by respondents diagnosed with HIV across all types of venues, with characteristic patterns in different types of venues.

Respondents diagnosed with HIV were older than respondents not diagnosed with HIV, independent of venue. Respondents using smartphone apps had the lowest median age independent of HIV serostatus. Participants with HIV diagnosis less often lived in cities with less than 100,000 inhabitants.

Differences by meeting venue

Serostatus was relatively frequently communicated at private sex parties, in non-gay settings, and online. It was relatively rarely communicated in gay sex venues and at cruising sites.

Condom use was in general much lower for respondents diagnosed with HIV compared to those not diagnosed with HIV, and for both it was lowest at private sex parties. Otherwise, the condom use pattern was different for respondents diagnosed and not diagnosed with HIV: at venues with a low perceived personal responsibility to disclose HIV status (sex venues, cruising sites) low condom use was reported by respondents diagnosed, high condom use by respondents not diagnosed with HIV. For respondents not diagnosed with HIV, meeting venues less associated with the gay subculture (non-gay venues, other places) were associated with relatively low condom use. Notable was the low level of condom use associated with cruising places (see Table 1).

In general, mutual serostatus knowledge was associated with lower condom use, regardless whether serostatus was concordant or discordant (see Supplemental Figure). Also, condom use decreased with increasing knowledge of the non-steady partner (see Fig.1).

Results of multivariate analysis

In model 1, HIV status was the strongest predictor for diagnosis of a bSTI with individuals diagnosed with HIV reporting a greater proportion of bSTIs than individuals without HIV diagnosis. For men not diagnosed with HIV meeting the last non-steady anal sex partner in a gay sex venue or a gay social venue compared with online was associated with an increased risk for STI diagnosis. Meeting the last partner on a smartphone app was associated with an increased risk (OR 1.48; 95%CI 0.94-2.34) which

fell short of statistical significance. Men 45 years and older had a significantly lower risk than men aged 20-29 years.

For men diagnosed with HIV risk was increased when the last non-steady anal sex partner was met in a gay sex venue, and it was significantly lower when the partner was met at a non-gay or other venue (see Table 2).

Table 2: Age-adjusted logistic regression analysis of association of last meeting place with bSTI diagnosis in recent 12 months, German MSM online survey 2013 – model 1

	Not diagnosed with HIV	OR	95%CI	Diagnosed with HIV	OR	95%CI
HIV status					**4.93**	**2.80 - 8.66**
Meeting place	Online	reference				
	Social venue-neg	**1.60**	1.03 -2.48	Social venue-pos	.863	.37 - 2.02
	Sex venue-neg	**1.88**	1.37 - 2.57	**Sex venue-pos**	**1.52**	**1.07 - 2.14**
	Private setting-neg	.93	.34 - 2.55	Private setting-pos	1.46	.76 - 2.79
	Cruising place-neg	1.14	.59 - 2.19	Cruising place-pos	.45	.19 -1.09
	Smart phone app-neg	1.48	.94 - 2.34	Smart phone app-pos	1.07	.51 - 2.25
	Other-neg	.73	.48 - 1.11	**Other-pos**	**.16**	**.05 - .52**
Age group	20-29	reference				
	<20-neg	.62	.35 - 1.09	<20-pos	1.18	.12 -11.81
	30-44-neg	1.07	.82 - 1.39	30-44-pos	1.55	.90 - 2.68
	>44-neg	**.50**	**.36 -.70**	>44-pos	.82	.47 - 1.44

Bold = statistically significant associations (p<0.05)

Example how to read the table: The odds for an MSM diagnosed with HIV who met his last non-steady anal sex partner online to have received an bSTI diagnosis in the recent 12 months is 4.93 compared to an MSM not diagnosed with HIV. The odds for a man not diagnosed with HIV who met his non-steady anal sex partner in a gay sex venue were 1.88 compared to a man meeting his last non-steady anal sex partner online. The odds for a man diagnosed with HIV who met his last non-staedy anal sex partner in a gay sex venue were 1.52 compared to a man diagnosed with HIV and meeting his last partner online, and 1.52*4.93= 7.49 compared to a man not diagnosed with HIV meeting his last partner online.

When we included partner numbers, size of the place of residence, and HIV status disclosure in model 2 and tested for the various interactions between the included variables by stepwise inclusion, the effect of venues mostly disappeared, while interactions between HIV status and partner numbers

as well as condom use became more important. HIV status remained the strongest predictor for bSTI diagnosis. The effect of age was the same as in model 1. HIV status disclosure was associated with increased odds for bSTI diagnosis, regardless whether status was concordant or discordant. Increasing partner numbers increased the odds for a bSTI diagnosis, more so for men not diagnosed with HIV than for men diagnosed with HIV. Condom use at last anal intercourse had no significant effect on bSTI diagnosis among HIV-undiagnosed men, but for HIV-diagnosed men condoms significantly lowered the risk. With increasing size of the place of residence also the odds for bSTI diagnosis increased.

Only two meeting venues remained in the model, both associated with a significantly lower risk for bSTI diagnosis : cruising places and non-gay/other venues. Meeting the last non-steady anal sex partner in a gay social or sex venue was still associated with an increased odds of having been diagnosed with a bSTI, but this fell short of being statistically significant (see Table 3).

Table 3: Logistic regression analysis of association of last meeting place with bSTI diagnosis in recent 12 months, German MSM online survey 2013 – model 2 (condom use and partner numbers controlled for HIV status [-neg/ -pos])

		OR	95%CI	OR	95%CI
HIV status	**positive**			**7.02**	**4.13 – 11.93**
Meeting place	online	reference			
	Social venue	1.36	.91 - 2.05		
	Sex venue	1.18	.92 - 1.53		
	private setting	.92	.53 - 1.58		
	Cruising place	**.55**	**.31 – 0.98**		
	Smart phone app	1.15	.76 – 1.74		
	Other	**.64**	**.43 – 0.97**		
Age group	20-29	reference			
	<20	.84	.48 - 1.49		
	30-44	1.04	.81 - 1.33		
	>44	**.55**	**.42 - .73**		

City size	100,000-500,000	reference				
	<100,000	.84	.64 - 1.12			
	500,000-1 Million	**1.48**	**1.07 - 2.04**			
	>1 Million	**1.42**	**1.08 - 1.86**			
Partner number	2 to 5	reference				
	One-neg	.75	.32 - 1.74	One-pos	.47	.06 – 3.71
	6 to 10-neg	**2.07**	**1.45 – 2.95**	6 to 10-pos	1.46	0.85 – 2.50
	11 to 50-neg	**4.94**	**3.64 – 6.70**	**11 to 50-pos**	**2.00**	**1.24 – 3.24**
	More than 50-neg	**7.49**	**4.76 – 11.79**	**More than 50-pos**	**4.88**	**2.85 – 8.33**
Serostatus communication	Non-concordant	reference				
	HIV concordant	**1.28**	**1.03 - 1.58**			
	HIV discordant	**2.03**	**1.30 - 3.15**			
Condom	Condom use-neg	.88	.69 – 1.13	**Condom use-pos**	**.55**	**.38 - .82**

Bold = statistically significant associations (p<0.05)

DISCUSSION

The type of physical and virtual meeting place with the last non-steady sex partner was strongly associated with the median number of new sex partners in the previous 12 months. This suggests that certain venues facilitate meeting multiple sex partners more than others (e.g. sex venues, private sex parties), and/or that such venues are visited preferentially by men interested in having multiple sex partners.

HIV status also has an impact on partner numbers: HIV positive respondents consistently reported higher partner numbers than respondents not diagnosed with HIV, which has also been reported from other studies [11]. The higher partner numbers of men diagnosed with HIV may have several, non-exclusive reasons:

1) Higher partner numbers may be one of the risk factors that contributed to HIV infection.

2) Restricting partner numbers may be one important strategy to reduce the risk for HIV infection. The diagnosis of HIV removes this necessity.

3) HIV diagnosis may result in disinhibition regarding partner numbers in some and withdrawing from the gay subculture in others. Recruiting survey participants on websites designed primarily to find new partners may introduce a selection bias towards the first group.

Unfortunately, because we have only cross-sectional and no longitudinal data spanning the time of seroconversion and HIV diagnosis, we cannot determine the relative importance of these three reasons.

The reported partner numbers were higher in venues/settings where either serostatus communication/ HIV serosorting was frequent (online, smartphone) or where perceived personal responsibility for serostatus disclosure was low (sex venues)[12].

Cruising places seemed to be the meeting venues which combine the lowest levels of serostatus disclosure and thus probably a relatively high mixing of men diagnosed and not diagnosed with HIV with a relatively low level of condom use. However, risk management in cruising places may operate mainly by avoiding anal intercourse in this venue, since only a small proportion of respondents (3% not diagnosed with HIV, 5% HIV diagnosed with HIV) met their last non-steady anal sex partner there.

The probability of being diagnosed with bSTI was much higher among MSM diagnosed with HIV. This is very likely partly explained by higher STI screening frequencies among men diagnosed with HIV and in continuous medical care [13]. On the other hand, in model 1 the probability of being diagnosed with bSTI was higher in MSM visiting sex venues, gay social venues (HIV-neg.), and private sex parties (HIV-pos.). Higher bSTI risk was associated with higher median partner numbers when meeting the last non-steady sex partner in the respective venue. Serosorting, or preferentially seeking sex partners also infected with HIV to avoid rejection and allow condomless sex without risking HIV transmission, also contributes to a higher risk for STI [14]. In addition, also known HIV discordance increased bSTI risk in our sample, suggesting selective, HIV-specific precautions. Serostatus disclosure was much more frequent when meeting partners online, on a smartphone app or at a private sex party (see reported seroconcordance, Table 1). Therefore it is not surprising that the effect of venues largely disappeared when controlling for partner numbers and serostatus disclosure in Model 2.

Higher partner numbers and an increased odds for being diagnosed with bSTI for smartphone app users compared with men finding their partners online (HIV-undiagnosed) in model 1 may be a consequence of more sexually active men switching to the new tool of smartphone apps preferentially, similar to the early years when internet became available as a new tool for partner

seeking [15, 16]. Higher partner numbers and higher prevalence of ever being diagnosed with an STI have also been reported in a recent publication comparing health outcomes of a smaller sample of 110 MSM who use smartphone apps compared to MSM who meet partners in other ways [17]. Another aspect possibly playing a role is the preferential use of smartphone apps in areas with higher population and MSM density, which are also areas with higher density of sex venues and higher STI prevalence among MSM. The higher proportion of smartphone app users using a condom for last anal intercourse compared with men finding their partners online may be explained by more intense and explicit online communication compared with smartphone app communication, making men communicating with their potential partners online more confident in being able to determine HIV infection risks associated with their partners.

New technologies like GPS-based smartphone apps seem to improve opportunities to find new sex partners compared with seeking partners on gay websites (particularly for younger men and men living in densely populated areas).

Limitations

There are several limitations to consider when interpreting the results of our analysis. A common limitation for almost all studies among MSM is the lack of a representative sampling frame. Our sample is an online convenience sample, and we cannot claim that our findings are representative for the whole MSM population. Self-selection biases common to online surveys among MSM such as higher education levels compared with the general adult male population probably have been accentuated in this survey by a relatively high attrition rate (see also Supplemental file 1). An analysis of survey participants who did not complete the survey showed a higher probability of being younger, not gay identified, and having lower education levels. In addition, the online survey was not adapted for smartphones, thus smartphone users were likely underrepresented in the study sample, possibly introducing further self-selection biases.

Another limitation is the reliance on self-reported STI diagnoses. The large differences regarding STI diagnosis rates between men diagnosed and not diagnosed with HIV are partly explained by different access to routine STI screening: while for men diagnosed with HIV STI testing can be reimbursed as part of regular HIV treatment monitoring, considerable reimbursement barriers for STI screening for men not diagnosed with HIV exist. Due to the resulting low adequate STI screening frequencies among men without HIV diagnosis it is likely that by using self-reported STI diagnosis rates a high proportion of undiagnosed asymptomatic bSTI among these men is missed [13].

When analysing the associations between bSTI diagnosis and behaviours during the last episode of anal intercourse with a non-steady partner we assume these behaviours are representative for the

period of STI acquisition on a population level and neglect that STI could also have been transmitted during other occasions, and from a steady partner. Finally, recall and social desirability biases have to be expected, since data on diagnoses and behaviours were self-reported.

CONCLUSIONS

While behaviour patterns associated with STI risk differ according to HIV status and venues visited, this relationship is mediated by factors that contextualize men's encounters (e.g., partner numbers, attitudes toward HIV status disclosure, perceptions about condom use, and anonymous sex). Although not directly associated with STIs, venues are connected to social-behavioural facets of corresponding sexual encounters, and may be important arenas for differential HIV and STI education, treatment, and prevention. Consequently, outreach prevention work in gay venues has long been an important component of HIV prevention for MSM. During the last two decades advances in communication technology have affected networking patterns, thereby influencing the dynamics of sex partnerships. Close and coordinated cooperation between HIV/STI prevention workers and gay website and smartphone app owners to optimize the technical and design-related opportunities for supporting protective and minimizing risk-enhancing behaviours of their customers when seeking new partners should be established and further developed.

Both the venue and individual characteristics must be considered when generating and disseminating STI prevention messaging [18]. Outreach providers should consider these contextualizing aspects when planning interventions in physical and virtual venues.

COMPETING INTERESTS

The authors declare that they have no competing interests.

ACKNOWLEDGEMENTS

This work was supported by the German Federal Centre for Health Education (BZgA) [Grant number 25.5.2.4/13], and by the German Ministry of Health [Grant number IIA5-2014-2514AUK340]. The funders had no influence on the design of the study, the collection, analysis and interpretation of data, the writing of the manuscript, and the decision to submit the manuscript for publication.

The authors would like to acknowledge the work of Michael Bochow who designed and conducted several previous German MSM surveys since the late 1980ies and who contributed to this survey with his advice and support. The authors also thank all survey participants who contributed their time to fill in the questionnaire.

AUTHOR'S CONTRIBUTIONS

The survey was designed and executed by JD and MK with contributions by UM and MG. The paper was conceived and the manuscript was drafted by UM. Statistical analysis was conducted by UM and MadH. All authors contributed writing to second draft. All authors approved the final manuscript.

DATA SHARING

No additional data available.

FIGURES

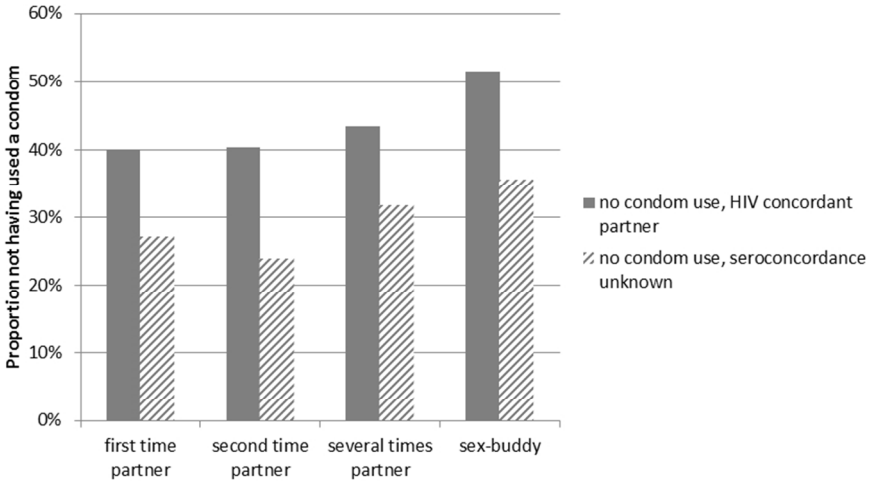
Fig.1: Proportion of survey participants reporting no condom use during last anal intercourse with a non-steady partner by partner knowledge and reported HIV seroconcordance*, German MSM online survey 2013

*HIV concordant = respondent reported the same HIV serostatus as his non-steady partner; HIV seroconcordance unknown = either the respondent has never been tested for HIV or the HIV serostatus of his non-steady partner was not known or HIV serostatus was not disclosed

REFERENCES

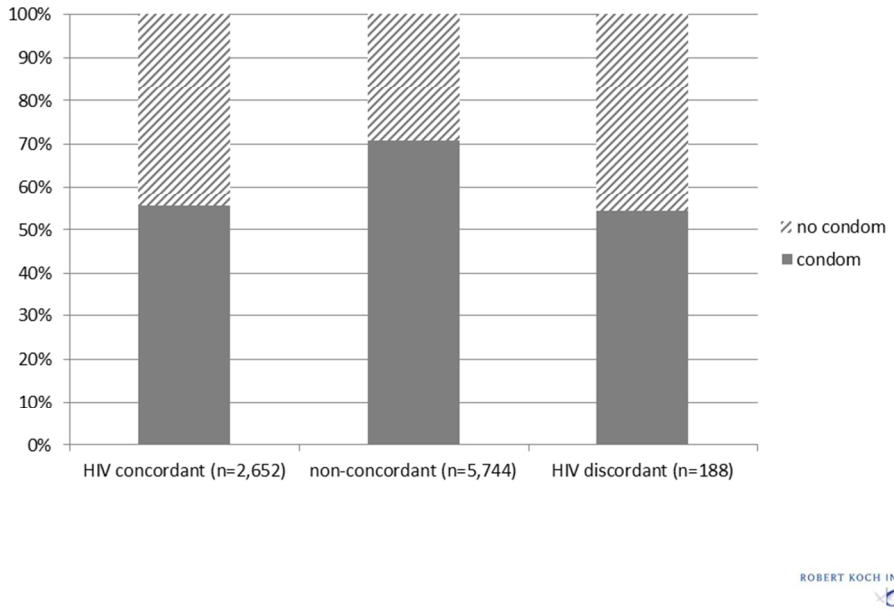
1. Zhao J, Chen L, Cai WD, et al. HIV infection and sexual behaviors among non-commercial men who have sex with men at different venues. Arch Sex Behav 2014;43(4):801-9. doi: 10.1007/s10508-013-0167-0. Epub 2013 Aug 27.
2. Vial AC, Starks TJ, Parsons JT. Finding and recruiting the highest risk HIV-negative men who have sex with men. AIDS Educ Prev 2014;26(1):56-67. doi: 10.1521/aeap.2014.26.1.56.
3. Voetsch AC, Lansky A, Drake AJ, et al. Comparison of demographic and behavioral characteristics of men who have sex with men by enrollment venue type in the National HIV Behavioral Surveillance System. Sex Transm Dis 2012;39(3):229-35. doi: 10.1097/OLQ.0b013e31823d2b24.
4. Grov C. HIV risk and substance use in men who have sex with men surveyed in bathhouses, bars/clubs, and on Craigslist.org: venue of recruitment matters. AIDS Behav 2012;16(4):807-17. doi: 10.1007/s10461-011-9999-6.
5. Grov C, Agyemang L, Ventuneac A, et al. Navigating condom use and HIV status disclosure with partners met online: a qualitative pilot study with gay and bisexual men from Craigslist.org. AIDS Educ Prev 2013;25(1):72-85. doi: 10.1521/aeap.2013.25.1.72.
6. Grov C, Hirshfield S, Remien RH, et al. Exploring the venue's role in risky sexual behavior among gay and bisexual men: an event-level analysis from a national online survey in the U.S. Arch Sex Behav 2013;42(2):291-302. doi: 10.1007/s10508-011-9854-x. Epub 2011 Oct 20.
7. Grov C, Crow T. Attitudes about and HIV risk related to the "most common place" MSM meet their sex partners: comparing men from bathhouses, bars/clubs, and Craigslist.org. AIDS Educ Prev 2012;24(2):102-16. doi: 10.1521/aeap.2012.24.2.102.
8. Rönn M, White PJ, Hughes G, et al. Developing a conceptual framework of seroadaptive behaviors in HIV-diagnosed men who have sex with men. J Inf Dis 2014;210(Suppl 2):S586-S593.
9. Marcus U, Ort J, Grenz M, et al. Risk factors for HIV and STI diagnosis in a community-based HIV/STI testing and counselling site for men having sex with men (MSM) in a large German city in 2011–2012. BMC Inf Dis 2015;15:14 doi: 10.1186/s12879-014-0738-2.
10. Bolding G, Davis M, Hart G, et al. Where young MSM meet their first sexual partner: the role of the Internet. AIDS Behav. 2007;11(4):522-6.
11. Rosenberg ES, Sullivan PS, Dinenno EA, et al. Number of casual male sexual partners and associated factors among men who have sex with men: results from the National HIV Behavioral Surveillance system. BMC Public Health 2011;11:189. doi: 10.1186/1471-2458-11-189.

12. O'Leary A, Horvath KJ, Rosser SBR. Associations between partner-venue specific personal responsibility beliefs and transmission risk behavior by HIV-positive men who have sex with men (MSM). AIDS Behav 2013;17(5):1855-61. doi: 10.1007/s10461-012-0291-1.
13. Schmidt AJ, Hickson F, Weatherburn P, et al. Comparison of the performance of STI Screening Services for gay and bisexual men across 40 European cities: results from the European MSM Internet Survey. Sex Transm Infect 2013;89(7):575-582 doi:10.1136/sextrans-2012-050973.
14. Marcus U, Schmidt AJ, Hamouda O. HIV serosorting among HIV-positive men who have sex with men is associated with increased self-reported incidence of bacterial sexually transmissible infections. Sexual Health 2011;8:184–193.
15. Bolding G, Davis M, Hart G, et al. Gay men who look for sex on the Internet: is there more HIV/STI risk with online partners? AIDS 2005;19:961-968.
16. Downing MJ Jr. Using the internet in pursuit of public sexual encounters: is frequency of use associated with risk behavior among MSM? Am J Mens Health 2012;6(1):18-27. doi: 10.1177/1557988311407906. Epub 2011 Jun 9.
17. Lehmiller JJ, Ioerger M. Social networking smartphone applications and sexual health outcomes among men who have sex with men. PLoS One 2014;9(1):e86603. doi: 10.1371/journal.pone.0086603.
18. Kingdon MJ, Storholm ED, Halkitis PN, et al. Targeting HIV prevention messaging to a new generation of gay, bisexual, and other young men who have sex with men. J Health Commun 2013;18(3):325-42. doi: 10.1080/10810730.2012.727953. Epub 2013 Jan 15.



Proportion of survey participants reporting no condom use during last anal intercourse with a non-steady partner by partner knowledge and reported HIV seroconcordance*, German MSM online survey 2013

*HIV concordant = respondent reported the same HIV serostatus as his non-steady partner; HIV seroconcordance unknown = either the respondent has never been tested for HIV or the HIV serostatus of his non-steady partner was not known or no disclosure of HIV serostatus occurred
254x190mm (96 x 96 DPI)



Condom use during last anal intercourse with a non-steady partner and HIV serostatus knowledge*, German MSM online survey 2013

* HIV concordant = respondent reported the same HIV serostatus as his non-steady partner; HIV discordant = respondent reported HIV serostatus to be different from his non-steady partners serostatus; HIV non-concordant = HIV status of one or both unknown or no HIV serostatus disclosure

254x190mm (96 x 96 DPI)

Supplemental file

CHERRIES criteria for German MSM online survey 2013 (SMA 2013)

Design

The survey was designed as a nationwide, anonymous online-survey targeting MSM. Participants were recruited for the survey through private messages and banners on several social networking and dating sites for gay men. Private messages were sent to all site members having a profile in German language and residing in Germany. Thus the resulting sample was a convenience sample.

IRB (Institutional Review Board) approval and informed consent process

The online survey protocol was evaluated and approved by the ethical review board of the Charité University Clinic in Berlin (EA1/266/13).

Informed consent

The survey's entry site contained information about who the investigator was, the goals and contents of the survey, terms of participation, data privacy, and approximate length of time of the survey. By clicking on a button "I have read and understood the information above" the participant gave his informed consent and was referred to the online questionnaire (for the information included on the entry site see Annex I).

Data protection

We did not collect any personal data which would allow the identification of participants. Several suggestions by the data protection office of the federal state of Berlin to improve data protection for survey participants were implemented.

Development and pre-testing

The questionnaire was developed by using items of former German surveys with this population. The questionnaire used questions from the 2010 European MSM Internet survey (www.emis-project.eu) as much as possible. Several new questions and scales were included. Experts and stakeholders of the target group were asked to evaluate the questionnaire. The survey was informally pretested for technical functionality, usability and wording with members of the target population.

Recruitment process and description of the sample having access to the questionnaire

Advertising the survey

The survey was announced on several homepages (dating sites and news sites) directed at the target population. On most homepages a banner or texts were provided with a link to the questionnaire. One large dating site for MSM (planetromeo.com; number of active profiles in Germany as of March 18, 2015: 433,781. More than one profile per person is possible. Estimated number of MSM aged 15-64 years living in Germany as of 2010: approximately 656,000 [Marcus U, et al. Estimating the size of the MSM populations for 38 European countries by calculating the survey surveillance discrepancies (SSD) between self-reported new HIV diagnoses from the European MSM

internet survey (EMIS) and surveillance reported HIV diagnoses among MSM in 2009. BMC Public Health 2013, 13:919 http://www.biomedcentral.com/1471-2458/13/919]) sent out a message to every German member with a link to the questionnaire asking the members to participate in the survey (for the wording of the message see Annex II). The survey was announced on planetromeo.com in a time-staggered manner (eight batches, ~50,000 profiles each), originally with the intention to prevent excessive demand for free testing at the cooperating testing sites, where free test vouchers offered at the end of the questionnaire could be used. Due to the lower than expected demand this turned out to be unnecessary. However, unexpectedly the capacity of the server of the survey website was not sufficient to manage the demand, so that long waiting times for users resulted and on some of the first days the survey was practically dysfunctional.

The survey was not specifically adapted for smartphone users. The main recruitment website offers traditional online websites as well as a gps-based smartphone app to manage user profiles. Both types of clients were invited to participate in the survey, however, the lack of smartphone-adaptation was mentioned in the invitation mail. Due to the lack of smartphone adaptation and the technical server problems it is very likely that the survey was filled in preferentially with a personal computer online instead by smartphone. Compared with the previous online survey (EMIS 2010) younger age groups (25-35 years) were less well represented among respondents, which may be due to the higher frequency of app-use in this age group.

Survey administration

The survey was a Web-based survey which was filled in online. Responses were automatically captured and directly stored in a database.

Context

See above.

Mandatory/voluntary

Participation in the survey was voluntary.

Incentives

No incentives were offered.

Time/Date

Data were collected between November 2013 and January 2014

Randomization of items or questionnaires

Randomization or alternating of items was not used.

Adaptive questioning

Adaptive questioning was used throughout the questionnaire to reduce number and complexity of the questions. E.g. separate questions were asked to respondents who indicated that they had received an HIV diagnosis and those who didn't.

Number of Items and screens (pages)

The questionnaire included 344 items and 218 questions, presented online on approximately 100 pages. Due to the adaptive design of the questionnaire the actual number of pages that were seen by an average respondent was much less.

Completeness check

No consistency or completeness check was implemented before the questionnaire was submitted. Several questions (e.g. gender, age, HIV test, etc.) were regarded as especially important. In case the respondent didn't answer one of these questions, they were reminded using a pop-up window, to answer this question. If the respondent still was not willing to answer the question he was able to continue the questionnaire.

Review step

Respondents were able to change answers on previous pages using a Back button.

Response rates

Unique site visitors: No IP addresses were stored and no cookies were used.

For every new first page visitor a unique code was generated. The total number of codes generated was 51,277. However, as mentioned above, the survey page was at certain times dysfunctional, which may have resulted in immediate discontinuation and later re-start of the survey. The first survey question was answered by 27,337 respondents; the last set of questions was answered by 14,392 respondents.

Due to the decision not to store IP addresses and not to use cookies, in combination with the technical difficulties during the implementation of the survey it is not possible to give meaningful numbers for the view rate and the participation rate. The completion rate can be calculated as 14,329/ 27,337 = 52%

Preventing multiple entries from the same individual

No technical tools such as cookies were used to prevent multiple entries from the same individual. However, due to the length of the questionnaire, technical capacity problems on the survey website which resulted in longer waiting times between screens further prolonging the time needed to fill in the questionnaire, and the lack of any material incentives, we think it is highly unlikely that individuals filled in the questionnaire more than once. It is however possible that respondents interrupted filling in the questionnaire and decided to restart at a later time point. To prevent using such possible multiple entries from the same individual, the final dataset was restricted to questionnaires in which at least the questions regarding gender, age, country, sexual orientation and HIV testing behaviour were answered. These represent the first approximately 10 page screens, and survey sections which did not include adaptive questions (27,337 respondents answered the first question on gender; 19,630 respondents answered the question on HIV testing).

IP check

No IP addresses of the client computer were used to identify potential duplicate entries from the same user.

Log file analysis

No other techniques to analyze the log file for identification of multiple entries were used.

Analysis

Incomplete questionnaires were also analysed when questions regarding gender, age, country, sexual orientation and HIV testing behaviour were answered.

Questionnaires submitted with an atypical timestamp

Time to fill out the questionnaire was not used as an exclusion criterion.

Statistical correction

No weighting of items or propensity scores have been used to adjust for the non-representative sample.

Annex I: Entry page of the online questionnaire

Subscriber information

Welcome to the survey!

Please take part in this survey if you ...

• are a gay man and / or

• are a man who feels attracted to men and / or

• are a man who has sex with men and

• are at least 16 years old.

We want to know it!

This survey, the study "Gay Men and HIV / AIDS 2013" refers to the sex you have, your knowledge and attitudes to HIV prevention and HIV testing and your life as a gay man, or a man who has sex with men, and how you are dealing with HIV and other sexually transmitted infections.

The questionnaire will take approximately 30 minutes.

Privacy Policy

Participation is anonymous. We guarantee that we will not save your IP address or collect information about you that could enable your identification by third parties.

For notes on the safe use of PCs, please refer to www.bsi.de.

Replying to the questionnaire is voluntary and can be canceled at any time, without any disadvantages for you.

More information about objectives of this study can be found further down on this page.

Here we go!

Start the questionnaire by clicking on the following button:

[Button]

For more information on this study

We are psychologists and health scientists of the Free University Berlin. This study has been financed by the Federal Centre for Health Education (BZgA). For questions, comments or suggestions about the study please contact us at the e-mail address msm@zedat.fu-berlin.de

Goals

The primary objective of this survey is to obtain current information about how gay and other men who have sex with men (MSM) are dealing and living with HIV / AIDS and other sexually transmitted infections (STI). The collected answers will allow an assessment of the extent to which you and the other participants protect themselves, but also what risks you are willing to take. Questions about the use of preventive services, and knowledge about progress in the treatability of HIV, will also allow to assess information needs and to better address these issues in HIV prevention. In addition to these points the general life situation of gay and other men who have sex with men living in Germany is an important part of this survey. In addition to dealing with discrimination against homosexuality, mental well-being is discussed in this survey for the first time. We want to investigate whether and why gay and bisexual men are more frequently affected by psychological stress. Also, the use of psychoactive substances (alcohol and drugs) will be investigated.

What happens to your data?

Taking into account the legal requirements of data protection we will evaluate your information together with that of the other participants to prepare scientific publications for a specialist audience. In this way we create the conditions that your information can be included in the optimization of prevention services for gay men and other men who have sex with men.

The central results of this survey can be expected to become available by autumn 2014, accessible on www.sma2013.de.

This study was reviewed by the ethics committee of the Charité Berlin, which confirmed the ethical acceptability of this study. The Data Protection Officer of the State of Berlin has examined the compliance with data protection and his suggestions for changes have been implemented.

Annex II: Invitation mail for men with a profile on planetromeo.com

Hello,

We would like to invite you to participate in a survey of gay and other men who have sex with men. This survey deals with your life, your sex and your relationships, your knowledge and attitudes to recent developments in HIV / AIDS, and how you are dealing with HIV and other sexually transmitted infections.

This survey is done anonymously and takes about 30 minutes. The survey is not optimized for filling in on smartphones. (Now start with the questionnaire!)

Your participation in this survey can not only help to ensure that you learn something new. Through your participation, you also support the prevention of HIV and other sexually transmitted diseases among gay and other men who have sex with men in Germany. The results of the study are directly feeding into this prevention work. In this way the prevention may take your needs better into consideration.

For more information about this study, please go to the home page of the questionnaire.

Your experiences and your vision are important to us. We would therefore be very happy if you participate in this survey: Click here for the questionnaire!

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

	Item No	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	5/ Suppl.file
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5/ Suppl.file
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	Suppl.file
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	5
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	5/ 7
Bias	9	Describe any efforts to address potential sources of bias	
Study size	10	Explain how the study size was arrived at	5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	5
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	6
		(*b*) Describe any methods used to examine subgroups and interactions	6
		(*c*) Explain how missing data were addressed	Suppl.file
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	
		(*e*) Describe any sensitivity analyses	
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	6/ Suppl.file
		(b) Give reasons for non-participation at each stage	
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	7
		(b) Indicate number of participants with missing data for each variable of interest	
Outcome data	15*	Report numbers of outcome events or summary measures	7
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear	7-11

		which confounders were adjusted for and why they were included	
		(*b*) Report category boundaries when continuous variables were categorized	
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	
Discussion			
Key results	18	Summarise key results with reference to study objectives	11-13
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	13
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	13
Generalisability	21	Discuss the generalisability (external validity) of the study results	13
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	15

*Give information separately for exposed and unexposed groups.

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