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HIV testing behaviour and associated factors in men who have sex with men by level of urbanisation: a cross-sectional study in the Netherlands

Jeanine Leenen ,[1,2] Juliën N A P Wijers,[1,2] Chantal Den Daas ,[3,4] John de Wit,[5,6] Christian J P A Hoebe,[1,7] Nicole H T M Dukers-Muijrers[1,8]

ABSTRACT

Objectives Regular HIV testing in men who have sex with men (MSM) enables timely entry into care and reduces the likelihood of HIV transmission. We aimed to assess HIV-testing behaviour and associated factors in MSM by urbanisation of place of residence.

Design Data were derived from online survey ('Men & Sexuality') in the Netherlands, which was mainly advertised on social media (Facebook and Instagram), dating websites, apps for MSM (Grindr and PlanetRomeo) and gay media.

Primary and secondary outcome measures HIV testing was defined as recent (<1 year), not recent (≥1 year) or never. Using multinominal regression analyses, factors associated with not recent testing and never testing, compared with recent testing, were assessed among MSM living in highly (>2500 residences/km^2) or non-highly (≤2500 residences/km^2) urbanised areas.

Participants The study sample included 3815 MSM, currently living in the Netherlands. The mean age was 36 years (SD 14.7), and 67.6% were highly educated.

Results In highly urbanised areas, 11.8% was never and 19.8% was not recently HIV-tested. In non-highly urbanised areas, this was 25.2% and 19.6%. Among MSM living in highly urbanised areas, independently associated with never and not recent testing were younger age, self-identification as bisexual, fewer sex partners, never notified of HIV and no recent condomless anal intercourse. Among MSM living in non-highly urbanised areas, lower perceived HIV severity, higher perceived HIV risk and a lower proportion gay friends were associated with never and not recent testing. Among never tested MSM, those in non-highly urbanised areas preferred self-sampling/self-testing over facility-based testing; those in highly urbanised areas preferred testing at healthcare facilities.

Conclusions The proportion of never tested MSM was high (25%) in non-highly urbanised areas in the Netherlands. MSM living in non-highly urbanised areas may possibly be reached with targeted approaches to increase HIV testing uptake such as self-testing/self-sampling strategies.

Strengths and limitations of this study

► This study, with data from many men who have sex with men (MSM) (n=3815) living in the Netherlands, provided insight into HIV testing among Dutch MSM living in different urbanised areas.

► The collection of a wide range of sociodemographic, sexual risk behaviour and social environment factors enabled comprehensive explorative data analyses, with adjustment for confounding factors.

► Some bias might also be introduced because of a probable over-representation of MSM with a high educational level, which occurs in most internet surveys.

► This study provides insight into HIV testing behaviour among Dutch MSM and might be similar for other countries, and could provide insight into testing behaviour in a large portion of the European population.

► Other parts of the world may have different living addresses per square kilometre values for the classification of highly and non-highly urbanised areas.

epidemic. In Europe, most countries prioritise MSM as a key population in their HIV response. In the Netherlands, more than 20 000 people are living with HIV, with 482 new HIV diagnoses in the year 2019, of which the majority (64%) were MSM.[1] Regular HIV testing of people at risk of HIV enables early initiation of antiretroviral drug treatment and is associated with virological, immunological and clinical benefits.[2] People with later-stage HIV infections have a higher risk of progressing to AIDS or death and have higher direct medical treatment expenditures.[3]

Universal and frequent HIV testing, in combination with timely treatment, has the potential to eliminate HIV.[4] With effective treatment, the viral load of HIV can become undetectable and sexual transmission does not occur when the partner with HIV has an undetectable viral load,[5 6] enhancing the

INTRODUCTION

Men who have sex with men (MSM) have been disproportionately affected by the HIV

importance of frequent HIV testing and rapid linkage to HIV care. Further efforts to expand testing services and to increase accessibility and availability to key populations must be undertaken to reduce the number of people who are living with undiagnosed HIV or in whom HIV is diagnosed late.

In the Netherlands, options for HIV testing are widespread and available, and sexual health facilities are in place. However, an estimated 15%–20% of all MSM living with HIV were undiagnosed in 2010–2015.[7 8] In 2018, an estimated 1000 MSM (800–1300) with HIV were still undiagnosed, and an estimated 92% of people living with HIV have been diagnosed and linked to care in the Netherlands.[1] Among MSM who attend Dutch sexually transmitted infection (STI) clinics, a minority (19%) test regularly, that is, every 6 months, as suggested by the national testing guidelines. Other testing facilities include the general practitioner (GP) and self-testing options. In the Netherlands, Australia and the UK, the estimated overall proportion of MSM testing at least once per year ranged between 33% and 36%.[9]

A range of factors have previously been found to be associated with HIV testing; of the socioeconomic factors, urbanisation level is a well-known factor.[10] Differences in health between people living in low and highly urbanised areas represent worldwide challenges. The proportion of MSM who had not (recently) tested or MSM who were diagnosed at a later stage and entered care at later stages of infection was found to be higher in less urbanised areas.[10–12] People living in low urbanised areas may face geographical barriers and may have lower access to health information sources.[13 14]

Knowledge on HIV testing and associated factors in MSM by levels of urbanisation can be used to enhance the HIV-testing strategies tailored to the urbanisation setting. Therefore, this study aimed to assess the factors associated with the never tested and not recently tested MSM living in different urbanised areas in the Netherlands, using an internet survey.

METHODS

Between February and June 2018, the open online survey 'Men & Sexuality' was conducted in the Netherlands and is reported elsewhere in greater detail.[15] In short, the cross-sectional survey was designed to assess health, well-being and sexuality among MSM. Inclusion criteria were being male, aged 16 years or older, currently living in the Netherlands, and one of the following: (1) ever had sex with men, (2) attracted to men or (3) expected to have sex with men in the future. This voluntary online survey reached MSM from all over the Netherlands, as it was mainly advertised on social media (Facebook and Instagram), dating websites, apps for MSM (Grindr and PlanetRomeo) and gay media (Attitude, Winq.nl and GayNews). Participating MSM gave their informed consent before the start of the questionnaire. Participants

who completed the questionnaire could participate in a raffle of 10 €50 gift cards.

Patient and public involvement

During the design of the study and the development of the questionnaire, we engaged with the public, targeting young people in particular. The Dutch non-governmental organisation STI Aids Netherlands works extensively with the target audience of MSM. They have explored the suggested topic the questionnaire was going to include, both informally and through focus group discussions, and have reviewed and critiqued the survey questions and suggested items. The order of questions in the concept survey was changed based on this input. Young MSM preferred the survey started with the more factual HIV questions and then went on to STI and risks, ended with the psychological determinants, including health goals and stigma. Additionally, the public involvement groups, in addition to the core research group and members of the consortium, were welcome to suggest topic to be assessed. The core research group made the final decision on all proposed inclusions. People from the public involvement group were not directly involved in the recruitment to and conduct of the study, but did advise on the pictures and text used for the recruitment. All study participants had access to the published report.

Sample

In total, 6205 MSM were eligible (and consented). Because this study focused on HIV-testing behaviour among MSM at risk for HIV, HIV-positive MSM (n=360) were excluded from the analysis dataset. MSM with incomplete data (n=2030) on sociodemographic, sexual practices and social environmental factors were further excluded from the dataset. Excluded versus included respondents were compared using χ^2 analyses. Excluded respondents were more often non-Dutch and self-identified as bisexual (online supplemental file 1). The total sample in the data analyses was 3815 MSM.

Measures and coding

The questionnaire included reported HIV testing, sociodemographics, sexual risk behaviour, social network characteristics and behavioural constructs. The outcome variable for this study was HIV testing. This was defined as (1) not recently tested (longer than 1 year ago), (2) never tested and (3) recently tested (within the last year), which was the reference group. We defined <1 year as recent to allow some lenience in MSM test behaviour to the stricter recommendation of <6 months as recent testing, and to have a more meaningful comparison by the 'not recent' testing group. We explored the following factors as covariates in the univariate and multinomial analyses:
1. General sociodemographics, such as urbanisation. Urbanisation was categorised into highly urban (>2500 living addresses/km^2) and non-highly urban (≤2500 living addresses/km^2) based on the four-digit postal code of where the MSM were living and data from Statistics

Netherlands (https://www.cbs.nl/en-gb). The non-highly urban category included middle–highly urban (1500–2500 living addresses/km^2), middle urban (1000–1500 living addresses/km^2), middle–low urban (500–1000 living addresses/km^2) and low urban (>500 living addresses/km^2). Cut-off values for urbanisation levels were based on use from Statistic Netherlands. General sociodemographic factors further include other factors, such as education level (low or medium/high), ethnicity (Dutch, Western or non-Western) and age (<25 years, between 25 and 42 years, or >42 years). Cut-off values for age were based on equal distribution of participants in three groups.

2. Sexual risk-related factors, such as self-identification (homosexual and bisexual), condomless anal intercourse (yes or no), number of sex partners in the last 6 months (0–1, 2–5 or >5) and ever being notified by a sex partner or a healthcare provider that they may have been exposed to HIV by a recent sexual partner who tested HIV positive: ever being notified for HIV (yes or no).

3. Social network characteristics, such as the share of gay friends in their social network, time spent with gay people and sense of belonging to a gay community. Items on risk perception of getting HIV infected and perception of HIV severity were also included. All the items were measured on a 5-point Likert scale (very low to very high). In the analyses, we categorised these into a binary factor: high (very high or high) and moderate–low (moderate, low or very low).

The questionnaire further included a question on the preferred method of HIV testing. For analyses, we categorised this into the self-(sampling) test (including self-sampling and self-testing), GP, STI clinic, and Testlab (both sampling and testing at a laboratory of an STI clinic, without consulting the STI clinic staff) and no preference. Finally, the questionnaire included an open response question on the reason for not testing (in MSM who never tested). In the analyses, we grouped these into no perceived HIV risk, having no HIV-related symptoms, expected stigma (afraid of test or the results, afraid of meeting people at the test location, the association of HIV testing with homosexuality or unspecified), had the intention to test but had not had the test, did not know where to test and cost/logistics (long waiting times or too expensive).

Statistical analysis

Descriptive analyses were performed to determine the testing proportions and description of characteristics of MSM living in highly urbanised and non-highly urbanised areas. We assessed differences in HIV-testing behaviour by level or urbanisation using χ^2 tests and univariate and multinominal logistic regressions (adjusting for confounders, ie, the factors found to be associated with not (recent) testing in subsequent analyses). By evaluating the effect modification between urbanisation level and the other previously mentioned factors, various

effect-modification terms were found to be statistically significant (p<0.05). Therefore, the analyses were stratified according to urbanisation level. We assessed the sociodemographics, sexual risk practices and social environment factors for their association with HIV testing in univariable models, separately for MSM in highly and non-highly urbanised areas. The statistically significant (p<0.05) factors obtained from the univariate analyses were included in backward multivariable multinomial logistic regression models to assess the independent associations with recent HIV testing. Finally, we compared the preferred method of HIV testing of MSM living in highly and non-highly urbanised areas and reasons for not testing for HIV (for MSM who have never tested) using χ^2 testing. All analyses were performed using SPSS V.25.0. P values less than 0.05 were considered statistically significant.

RESULTS

Of all the MSM in the analyses, 45.0% (1718/3815) lived in a highly urbanised area, and 55.0% (2097/3815) lived in a non-highly urbanised area. The mean age was 36 years (SD 14.7), and 67.6% were highly educated.

HIV testing by level of urbanisation

Of all MSM, 19.7% (752/3815) were tested but not recently; 19.3% (737/3815) were never tested; and 61.0% (2326/3815) were recently tested within 1 year. The proportion never tested was higher for MSM living in non-highly urbanised areas (25%) than in highly urbanised areas (12%) (p<0.001) (table 1). The proportion recently tested was higher in MSM in highly urbanised areas than in MSM in non-highly urbanised areas. The level of urbanisation was independently associated with recently tested and never tested. The proportion never tested was higher in MSM in non-highly urbanised areas than in MSM in highly urbanised areas. The proportion not recently tested did not differ by level of urbanisation.

MSM living in highly urbanised area

Results of the univariate analyses are presented in table 2. In the multivariable analyses, factors for not *recent testing* (vs recent testing) were having 0–1 (OR 11.93, 95% CI 8.29 to 17.17) or 2–5 (OR 3.10, 95% CI 2.13 to 4.50) sex partners in the past 6 months (vs >5), ever being notified for HIV (OR 1.36, 95% CI 1.04 to 1.78), and being inversely associated with age <25 (OR 0.29, 95% CI 0.19 to 0.42) and between 25 and 42 (OR 0.58, 95% CI 0.43 to 0.79) (vs above 42) (online supplemental file 2).

From the multivariable analyses, factors associated with *never testing* (vs recent testing) were age <25 years (vs age >42 years) (OR 2.54, 95% CI 1.68 to 3.85), self-identification as bisexual (vs homosexual) (OR 1.75, 95% CI 1.14 to 2.69), having 0–1 (OR 8.31, 95% CI 4.79 to 14.40) or 2–5 (OR 4.94, 95% CI 2.87 to 8.50) sex partners in the past 6 months (vs >5), no condomless anal intercourse in the past 6 months (OR 2.50, 95% CI: 1.78 to

Table 1 HIV testing among MSM living in different urban areas in the Netherlands

	Recently tested n (%)	Not recently tested n (%)	Never tested n (%)	Recently tested OR (95% CI)	Recently tested Adjusted OR† (95% CI)	Not recently tested OR (95% CI)	Not recently tested Adjusted OR† (95% CI)	Never tested OR (95% CI)	Never tested Adjusted OR† (95% CI)
Highly urbanised	1175 (68.4)	340 (19.8)	203 (11.8)	1	1	1	1	1	1
Non-highly urbanised	1151 (54.9)‡	412 (19.6)	534 (25.5)‡	**0.56 (0.49 to 0.64)***	**0.75 (0.64 to 0.87)***	0.99 (0.84 to 1.16)	0.87 (0.2 to 1.04)	**2.55 (2.14 to 3.04)***	**1.89 (1.55 to 2.31)***
Middle-high	519 (55.3)	179 (19.1)	240 (25.6)	0.57 (0.49 to 0.67)***	0.74 (0.61 to 0.89)**	0.96 (0.78 to 1.17)	0.86 (0.69 to 1.08)	2.57 (2.09 to 3.16)***	1.94 (1.54 to 2.44)***
Middle	262 (53.6)	105 (21.5)	122 (24.9)	0.53 (0.44 to 0.66)***	0.73 (0.57 to 0.92)**	1.11 (0.87 to 1.42)	0.96 (0.73 to 1.26)	2.48 (1.93 to 3.19)***	1.79 (1.34 to 2.37)***
Middle-low	200 (54.6)	69 (18.9)	97 (26.5)	0.56 (0.44 to 0.70)***	0.76 (0.59 to 0.99)*	0.94 (0.71 to 1.26)	0.83 (0.60 to 1.14)	2.69 (2.045 to 3.54)***	1.88 (1.37 to 2.57)***
Low	170 (55.9)	59 (19.4)	75 (24.7)	0.59 (0.46 to 0.75)***	0.78 (0.59 to 1.04)	0.98 (0.72 to 1.33)	0.78 (0.55 to 1.10)	2.44 (1.81 to 3.30)***	1.92 (1.37 to 2.69)***
Total	2326 (61.0)	752 (19.7)	737 (19.3)						

Bold values are statistically significant (P<0.05).

*P<0.05, **P<0.01, ***P<0.001; in univariate and multivariable logistic regression analyses.

†Models included age, education, migration background, self-identification, number of sex partners, condomless anal intercourse, notified for HIV, HIV severity, HIV risk perception, number of gay friends, time spent with gay friends, sense of belonging to a gay community.

‡Proportion statistically significantly different from proportion in MSM in highly urbanised areas, using χ^2 test; p<0.001.

MSM, men who have sex with men.

3.50), ever being notified for HIV (OR 1.73, 95% CI 1.24 to 2.42), and being inversely associated with age between 25 and 42 years (vs age >42 years) (OR 0.57, 95% CI 0.34 to 0.93).

MSM living in non-highly urbanised area

Results of the univariate analyses are presented in table 3. From the multivariable analyses, factors associated with not recent testing (vs recent testing) were having 0–1 (OR 8.72, 95% CI 6.10 to 12.46) or 2–5 (OR 2.45, 95% CI 1.73 to 3.54) sex partners in the past 6 months (vs >5), ever being notified for HIV (OR 1.44, 95% CI 1.12 to 1.85), high HIV severity perception (OR 1.72, 95% CI 1.19 to 2.47) and reporting a lower share of gay people among friends (OR 1.6), and being inversely associated was age <25 years (OR 0.16, 95% CI 0.11 to 0.23) and between 25 and 42 years (OR 0.64, 95% CI 0.48 to 0.85) (vs age >42 years).

From the multivariable analyses, factors associated with never testing (vs recent testing) were age <25 years (vs age >42 years) (OR 1.96, 95% CI 1.47 to 2.62), self-identification as bisexual (vs homosexual) (OR 1.70, 95% CI 1.34 to 2.17), having 0–1 (OR 7.02, 95% CI 4.86 to 10.16) or 2–5 (OR 2.60, 95% CI 1.80 to 3.76) sex partners in the past 6 months (vs >5), no condomless anal intercourse in the past 6 months (OR 1.70, 95% CI 1.34 to 2.17), ever being notified for HIV (OR 1.69, 95% CI 1.34 to 2.17), a lower HIV risk perception (OR 2.08, 95% CI 1.08 to 4.00) and reporting a lower share of gay people among friends (OR 2.03, 95% CI 1.50 to 2.74), and being inversely associated was age between 25 and 42 years (vs age >42 years) (OR 0.60, 95% CI 0.42 to 0.85).

Preferred method of HIV testing

In both highly urbanised and non-highly urbanised areas, MSM who recently or not recently tested preferred testing at the STI clinic (figure 1). Of the MSM who never tested, the proportion who would prefer self-sampling or a self-test was 40.4% in non-highly urbanised areas and 35.0% in highly urbanised areas. Of the MSM who never tested, the proportion who would prefer testing at the STI clinic was 32.0% in non-highly urbanised areas and 42.9% in highly urbanised areas.

DISCUSSION

This study assessed the HIV-testing behaviour of MSM living in highly and non-highly urbanised areas in the Netherlands in 2018. Even though The Netherlands has achieved much in the prevention of HIV in the past years, such as reaching the 90–90–90 goals in HIV prevention, we here demonstrate large variations within the country.

The proportion of MSM who never tested was higher (25%) in non-highly urbanised areas than in highly urbanised areas (12%). Other international studies in MSM outside major cities observed similar high proportions.[16 17] Examining non-highly urbanised areas in more detail, we found that more rural areas and mixed urban–rural areas

Table 2 Factors associated with HIV testing for MSM living in highly urbanised areas from the multinominal regression analysis

	Total	Recent tested (reference group)	Not recently tested			Never tested		
	N	n (%)	n (%)	OR univariate	OR adjusted	n (%)	OR univariate	OR adjusted
Age (years)								
<25	491	308 (62.7)	57 (11.6)	0.47 (0.33 to 0.65)***	0.29 (0.19 to 0.42)***	126 (25.7)	3.51 (2.41 to 5.12)***	2.54 (1.68 to 3.85)***
25–42	668	498 (74.6)	136 (20.4)	0.67 (0.52 to 0.90)***	0.58 (0.43 to 0.79)**	34 (5.1)	0.59 (0.37 to 0.94)*	0.57 (0.34 to 0.93)*
>42	559	369 (66.0)	147 (26.3)	1	1	43 (7.7)	1	1
Education ‡								
Middle–low	339	222 (65.5)	66 (19.5)	1.03 (0.76 to 1.40)		51 (15.0)	1.44 (1.02 to 2.04)	
High	1379	953 (69.1)	274 (19.9)	1		152 (11.0)	1	
Migration background ‡								
Dutch	1307	871 (66.6)	276 (21.1)	1.60 (1.10 to 2.33)*		160 (12.2)	1.47 (0.93 to 2.32)	
Western	157	112 (71.3)	26 (16.6)	1.17 (0.68 to 2.03)		19 (12.1)	1.36 (0.71 to 2.59)	
Non-Western	254	192 (75.6)	38 (15.0)	1		24 (9.4)	1	
Self-identification								
Bisexual/other	187	109 (58.3)	33 (17.6)	1.05 (0.70 to 1.58)	0.83 (0.53 to 1.30)	45 (24.1)	2.79 (1.90 to 4.10)***	1.75 (1.14 to 2.69)*
Homosexual	1531	1066 (69.9)	307 (20.1)	1	1	158 (10.3)	1	1
Number of sex partner for <6 months								
0–1	506	217 (42.9)	192 (37.9)	9.53 (6.77 to 13.42)***	11.93 (8.29 to 17.17)***	97 (19.2)	14.18 (8.37 to 24.01)***	8.31 (4.79 to 14.40)***
2–5	570	387 (67.9)	95 (16.7)	2.65 (1.85 to 3.79)***	3.10 (2.13 to 4.50)***	88 (15.4)	7.21 (4.28 to 12.17)***	4.94 (2.87 to 8.50)***
>5	642	571 (88.9)	53 (8.3)	1	1	18 (2.8)	1	1
Condomless anal intercourse								
No	711	423 (59.5)	156 (21.9)	1.51 (1.18 to 1.92)**	1.08 (0.82 to 1.42)	132 (18.6)	3.31 (2.42 to 4.52)***	2.50 (1.78 to 3.50)***
Yes	1007	752 (74.7)	184 (18.3)	1	1	71 (7.1)	1	1
Notified for HIV								
Yes	686	419 (61.1)	163 (23.8)	1.66 (1.30 to 2.1)***	1.36 (1.04 to 1.78)*	104 (15.2)	1.90 (1.40 to 2.56)***	1.73 (1.24 to 2.42)**
No	1032	756 (73.3)	177 (17.2)	1	1	99 (9.6)	1	1
HIV severity†, ‡								
High	1413	949 (67.2)	287 (20.3)	1.29 (0.93 to 1.79)		177 (12.5)	1.62 (1.05 to 2.51)*	
Moderate–low	305	226 (74.1)	53 (17.4)	1		26 (8.5)	1	
HIV risk perception†, ‡								
Moderate–low	1622	1102 (67.9)	329 (20.3)	1.98 (1.04 to 3.78)*		191 (11.8)	1.05 (0.56 to 1.98)	
High	96	73 (76.0)	11 (11.5)	1		12 (12.5)	1	
Amount of gay friends†, ‡								
Moderate–low	1067	682 (63.9)	221 (20.7)	1.34 (1.04 to 1.73)*		164 (15.4)	3.04 (2.10 to 4.40)***	

Continued

Table 2 Continued

	Total	Recent tested (reference group)			Not recently tested			Never tested		
	N	n (%)	OR univariate	OR adjusted	n (%)	OR univariate	OR adjusted	n (%)	OR univariate	OR adjusted
High	651	493 (75.4)	1		119 (18.3)	1		39 (6.0)	1	
Time spend with gay friends†, ‡										
Moderate–low	1219	789 (64.7)	1		251 (20.6)	**1.38 (1.05 to 1.81)***		179 (14.7)	**3.65 (2.34 to 5.68)*****	
High	499	386 (77.4)	1		89 (17.8)	1		24 (4.8)	1	
Sense of belonging to a gay community†, ‡										
Moderate–low	1088	697 (64.1)	1		231 (21.2)	**1.45 (1.13 to 1.88)****		160 (14.7)	**2.55 (1.78 to 3.64)*****	
High	630	478 (75.9)	1		109 (17.3)	1		43 (6.8)	1	

Bold values are statistically significant (P<0.05).
*P<0.05, **P<0.01, ***P<0.001.
†Measured on a 5-point Likert scale.
‡Not included in the final model.
MSM, men who have sex with men.

showed similar high proportions of MSM who never tested. The proportion of MSM who were tested (but not in the past 12 months) was also similar (20%) between non-highly and highly urbanised areas.

Subsequently, we assessed what typified the testing behaviour in the separate groups of MSM residing in highly urbanised areas and of MSM in non-highly urbanised areas. We observed similar risk factors in both groups, that is, a lower number of sex partners in the past 6 months, no condomless anal intercourse, never being notified for HIV risk, age <25 years and self-identification as bisexual (vs homosexual). While the former three might indicate a possible lower risk of HIV acquisition, the latter two provide important targets for prevention. Also, in the sensitivity analyses, we restricted to 'higher-risk MSM' (ie, reporting >2 partners and unprotected anal intercourse); young age and bisexual both remained independently associated with never testing. Young MSM and MSM who self-identify as bisexual are usually more difficult to reach with conventional care strategies and should be prioritised to reach the last mile in HIV elimination.[9 18]

Further, additional factors were observed in non-highly urbanised areas. One of these included a low HIV risk perception. Among MSM who never tested for HIV, the main reason for not testing included perceived HIV risk (online supplemental file 3), in concordance with the determinant of 'low-risk perception' observed in table 3 for non-high urban MSM. Several studies among MSM reported low perceived risk as a reason for not being tested for HIV.[19–21] Low-risk perception towards contracting HIV could cause people to feel 'invincible' about contracting the virus.[22] However, perceived risk does not always represent actual risk.[23] Adequate knowledge or talking about HIV/AIDS was found to be lower in some studies in non-high urbanised areas. Therefore, addressing realistic perceptions of behaviour, vulnerability and HIV risk, as well as knowledge on HIV and test options, remains important to reach key populations for HIV testing.

Also, a lower share of gay people among friends was associated with not testing or not recent testing among MSM living in non-highly urbanised areas. The proportion of MSM reported to have a high share of gay friends was 37.9% (651/1067) in highly urbanised areas and lower with 27.5% (576/2097) in non-highly urbanised areas. It is possible that an increased non-heteronormative environment could contribute to HIV testing, with MSM role models who also test, and a positive norm for sharing information and also to reduce stigma-related experiences. Social approval and emotional support can help to overcome perceived fear and stigma related to planning on HIV testing.[22]

Various options are available for MSM to test for HIV in the Netherlands, for example, testing at STI care facilities, GP and using self-testing/self-sampling. In our study, a substantial proportion of MSM in both non-highly and highly urbanised areas preferred the STI clinic for HIV testing, although MSM living in non-highly urbanised areas who never tested showed a slightly higher preference for self-testing/self-sampling. Testing using self-collected

Table 3 Factors associated with HIV testing for MSM living in non-highly urbanised areas

	Total	Recent tested (reference group)	Not recently tested			Never tested		
	N	n (%)	n (%)	OR univariate	OR adjusted	n (%)	OR univariate	OR adjusted
Age (years)								
<25	772	375 (48.6)	55 (7.1)	0.29 (0.21 to 0.40)***	0.16 (0.11 to 0.23)***	342 (44.3)	3.08 (2.39 to 3.96)***	1.96 (1.47 to 2.62)***
25–42	607	378 (62.3)	155 (25.5)	0.81 (0.63 to 1.04)	0.64 (0.48 to 0.85)**	74 (12.2)	0.66 (0.48 to 0.91)*	0.60 (0.42 to 0.85)**
>42	718	398 (55.4)	202 (28.1)	1	1	118 (16.4)	1	1
Education†, ‡								
Middle–low	897	474 (52.8)	176 (19.6)	1.07 (0.85 to 1.34)		247 (27.5)	1.23 (1.00 to 1.51)	
High	1200	677 (56.4)	236 (19.7)	1		287 (23.9)	1	
Migration background†, ‡								
Dutch	1828	986 (53.9)	374 (20.5)	1.75 (1.08 to 2.85)*		468 (25.6)	1.02 (0.71 to 1.48)	
Western	106	68 (64.2)	17 (16.0)	1.16 (0.57 to 2.35)		21 (19.8)	0.67 (0.36 to 1.22)	
Non-Western	163	97 (59.5)	21 (12.9)	1		45 (27.6)	1	
Self-identification								
Bisexual/other	330	146 (44.2)	54 (16.4)	1.04 (0.74 to 1.45)	0.76 (0.53 to 1.10)	130 (39.4)	2.22 (1.70 to 2.88)***	1.70 (1.34 to 2.17)**
Homosexual	1767	1005 (56.9)	358 (20.3)	1	1	404 (22.9)	1	1
Number of sex partner for <6 months								
0–1	815	255 (31.3)	237 (29.1)	7.40 (5.35 to 10.25)***	8.72 (6.10 to 12.46)***	323 (39.6)	12.45 (8.84 to 17.53)***	7.02 (4.86 to 10.16)***
2–5	715	434 (60.7)	117 (16.4)	2.15 (1.53 to 3.01)***	2.45 (1.73 to 3.54)***	164 (22.9)	3.71 (2.62 to 5.27)***	2.60 (1.80 to 3.76)***
>5	567	462 (81.5)	58 (10.2)	1	1	47 (8.3)	1	1
Condomless anal intercourse								
No	901	384 (42.6)	205 (22.8)	1.98 (1.57 to 2.49)***	1.23 (0.95 to 1.60)	312 (34.6)	2.81 (2.27 to 3.47)***	1.70 (1.34 to 2.17)***
Yes	1196	767 (64.1)	207 (17.3)	1	1	222 (18.6)	1	1
Notified for HIV								
Yes	992	484 (48.8)	219 (22.1)	1.56 (1.25 to 1.96)***	1.44 (1.12 to 1.85)**	289 (29.1)	1.63 (1.32 to 2.00)***	1.69 (1.34 to 2.14)***
No	1105	667 (60.4)	193 (17.5)	1	1	245 (22.2)	1	1
HIV severity‡								
High	1742	922 (52.9)	365 (21.0)	1.93 (1.38 to 2.70)***	1.72 (1.19 to 2.47)**	455 (26.1)	1.43 (1.08 to 1.89)*	0.94 (0.68 to 1.31)
Moderate–low	355	229 (64.5)	47 (13.2)	1	1	79 (22.3)	1	1
HIV risk perception‡								
Moderate–low	1982	1059 (53.4)	402 (20.3)	3.49 (1.80 to 6.78)***	1.89 (0.95 to 3.79)	521 (26.3)	3.48 (1.93 to 6.28)***	2.08 (1.08 to 4.00)*
High	115	92 (80.0)	10 (8.7)	1	1	13 (11.3)	1	1
Amount of gay friends‡								
Moderate–low	1521	748 (49.2)	314 (20.6)	1.73 (1.34 to 2.23)***	1.61 (1.21 to 2.15)**	459 (30.2)	3.30 (2.51 to 4.33)***	2.03 (1.50 to 2.74)***

Continued

Table 3 Continued

	Total	Recent tested (reference group)			Not recently tested			Never tested		
	N	n (%)	OR univariate	OR adjusted	n (%)	OR univariate	OR adjusted	n (%)	OR univariate	OR adjusted
High	576	403 (70.0)	1		98 (17.0)	1	1	75 (13.0)	1	1
Time spent with gay friend†‡										
Moderate-low	1756	905 (51.5)			370 (21.1)	2.40 (1.69 to 3.39)***		481 (27.4)	2.47 (1.80 to 3.39)***	
High	341	146 (72.1)			42 (12.3)	1		53 (15.5)	1	
Sense of belonging to a gay community†‡										
Moderate-low	1532	780 (50.9)			325 (21.2)	1.78 (1.36 to 2.32)***		427 (27.9)	1.90 (1.49 to 2.43)***	
High	565	371 (65.7)			87 (15.4)	1		107 (18.9)	1	

Bold values are statistically significant (P<0.05).
*P<0.05, **P<0.01, ***P<0.001.
†Not included in the final model.
‡Measured on a 5-point Likert scale.
MSM, men who have sex with men.
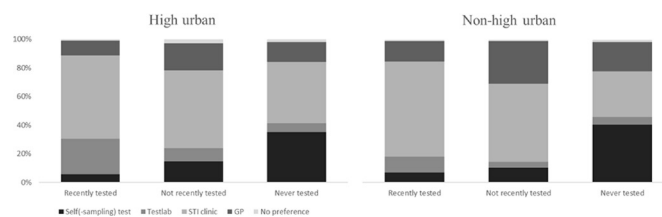
Figure 1 Self-reported preferred method of HIV testing for men who have sex with men living in different urbanised areas with different HIV test frequencies. GP, general practitioner; STI, sexually transmitted infection.

samples and in the home setting (home sampling) can remove structural barriers of HIV testing, such as being seen at a testing facility clinic or having to disclose sexual preference or behaviour and increase testing frequency.[24] In lower urbanised areas, previously identified barriers are, among others, distance to clinic and long waiting times.[25] Home-sampling tests could also serve healthcare providers by unburdening them. GPs working in smaller areas found it more difficult to discuss patients' sexual relationships than those working in urban areas.[26] However, implementation of home sampling can be challenging. Barriers to implementing self-testing/self-sampling are related to costs, availability of a logistical infrastructure and concerns related to the dislocation of self-testing/self-sampling from sexual healthcare pathways and services.[24 27 28] Self-sampling strategies, in combination with social network testing (where tests are provided by a trusted other), have been proposed to overcome barriers to testing, such as stigma. Self-sampling strategies provide autonomy and privacy and could potentially work especially well to reach MSM living in non-highly urbanised areas.[29] People living in low urbanised areas are more likely to experience higher levels of HIV-related stigma. The expected stigma from the public community might hamper location-based testing.[17] The distribution of self-sampling tests via the social network, for example, by gay friends, has been shown to increase test uptake.[30] In a study among black MSM, receiving social support from peers in their social network was associated with a lower risk of delayed HIV testing. Social network interventions reach the people in the network and individuals who are peer-related to them, which tend to make social network interventions cost-effective.[31] Its use in areas with potentially less strongly connected social networks, possibly non-highly urbanised areas, should be explored. COVID-19 has spread rapidly around the world, making care at home more important than ever due to quarantine obligations and reduced access to routine location-based HIV testing.

Strengths and limitations

This study, with data from many MSM (n=3815) living in the Netherlands, provides insight into HIV testing among Dutch MSM living in different urbanised areas. This information is useful for sexual healthcare providers to optimise care and know which group does not get tested (on a regular basis). The collection of a wide range of sociodemographic, sexual risk behaviour and social environment factors enabled

comprehensive explorative data analyses, with adjustment for confounding factors.

In this study, we were not able to do a response rate analysis as we did not have any data on (the amount of) non-responders. This is a limitation of the study as non-response bias could have occurred. The validity of self-reported HIV-testing behaviour, recall bias or social desirability bias could have occurred. This could possibly lead to an overestimation of actual testing behaviour or an underestimation of sexual risk behaviour. However, as the questionnaire was online and anonymous, we expect this bias to be likely small, and we do not expect this bias to differ between MSM from highly and non-highly urbanised areas. Some bias might also be introduced because of a probable over-representation of MSM with a high educational level, which occurs in most internet surveys. As bisexual MSM were less well represented in our study population, this thus likely means that the proportion never tested in highly urbanised (11%) and non-highly urbanised areas (25%) may be underestimated as a less well testing population of bisexual MSM were represented less. This study provides insight into HIV-testing behaviour among Dutch MSM and might be similar for other countries and could provide insight into testing behaviour in a large portion of the European population. Other parts of the world may have different living addresses per square kilometre values for the classification of highly and non-highly urbanised areas. This could also be a possible explanation why in other studies transportation and logistics (eg, distance to the clinic) were barriers for not HIV testing for MSM living in non-highly urbanised areas[32] but not in our study.

Implications and conclusions

HIV-testing proportions and factors associated with never testing and not recent testing were found to differ between MSM in highly and non-highly urbanised areas of the Netherlands. Therefore, HIV-testing strategies should be targeted to reach MSM in different urbanisation settings. Home sampling might be a promising enhancement of current sexual healthcare for MSM. As implementation (eg, providing a logistical infrastructure) for home sampling and self-testing can be challenging, research is needed to determine the requirements for this process as well as the specific challenges associated with the areas in which implementation will take place.

Author affiliations
[1]Department of Sexual Health Infectious Diseases and Environmental Health, GGD South Limburg, Heerlen, The Netherlands
[2]Department of Medical Microbiology, Care and Public Health Research Institute (CAPHRI), Maastricht Universitair Medisch Centrum+, Maastricht, The Netherlands
[3]Institute of Applied Health Sciences, Health Psychology, University of Aberdeen, Aberdeen, UK
[4]Center for Infectious Disease Control, National Institute for Public Health and the Environment (RIVM), Bilthoven, The Netherlands
[5]Centre for Social Research in Health, University of New South Wales, Sydney, New South Wales, Australia
[6]Department of Interdisciplinary Social Science, Faculty of Social and Behavioral Sciences, Utrecht University, Utrecht, The Netherlands
[7]Department of Social Medicine, Care and Public Health Research Institute (CAPHRI), Maastricht Universitair Medisch Centrum+, Maastricht, The Netherlands
[8]Department of Health Promotion, Care and Public Health Research Institute (CAPHRI), Maastricht Universitair Medisch Centrum+, Maastricht, The Netherlands

ORCID iDs
Jeanine Leenen http://orcid.org/0000-0002-9906-042X
Chantal Den Daas http://orcid.org/0000-0003-0955-3691

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