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Usage of purchased self-tests for HIV and sexually transmitted infections in Amsterdam, the Netherlands: results of population-based and serial cross-sectional studies among the general population and sexual risk groups

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ABSTRACT

Objectives There are limited data on the usage of commercially bought self-tests for HIV and other sexually transmitted infections (STIs). Therefore, we studied HIV/STI self-test usage and its determinants among the general population and sexual risk groups between 2007 and 2015 in Amsterdam, the Netherlands.

Setting Data were collected in four different studies among the general population (S1–2) and sexual risk groups (S3–4).

Participants S1–Amsterdam residents participating in representative population-based surveys (2008 and 2012; n=6044) drawn from the municipality register; S2–Participants of a population-based study stratified by ethnicity drawn from the municipality register of Amsterdam (2011–2015; n=17 603); S3–Men having sex with men (MSM) participating in an HIV observational cohort study (2008 and 2013; n=597) and S4–STI clinic clients participating in a cross-sectional survey (2007–2012; n=5655).

Primary and secondary outcome measures Prevalence of HIV/STI self-test usage and its determinants.

Results The prevalence of HIV/STI self-test usage in the preceding 6–12 months varied between 1% and 2% across studies. Chlamydia self-tests were most commonly used, except among MSM in S3. Chlamydia and syphilis self-test usage increased over time among the representative sample of Amsterdam residents (S1) and chlamydia self-test usage increased over time among STI clinic clients (S4). Self-test usage was associated with African Surinamese or Ghanaian ethnic origin (S2), being woman or MSM (S1 and 4) and having had a higher number of sexual partners (S1–2). Among those in the general population who tested for HIV/STI in the preceding 12 months, 5–9% used a self-test.

Conclusions Despite low HIV/STI self-test usage, we observed increases over time in chlamydia and syphilis self-test usage. Furthermore, self-test usage was higher among high-risk individuals in the general population. It is important to continue monitoring self-test usage and informing the public about the unknown quality of

Strengths and limitations of this study

► The study included data from four different studies with large sample sizes among both the general population and sexual risk groups in Amsterdam, the Netherlands.
► Data were collected between 2007 and 2015, which enabled us to estimate (temporal) trends in HIV/sexually transmitted infection self-test usage.
► The results are limited to the use of self-tests in Amsterdam, the Netherlands and only to the use of HIV, chlamydia and syphilis self-tests.

available self-tests in the Netherlands and about the pros and cons of self-testing.

INTRODUCTION

Self-tests for HIV and other sexually transmitted infections (STIs) are tests that are collected, performed and interpreted autonomously by individuals wanting to know their HIV/STI status.[1 2] Self-sampling tests differ from self-tests as they involve a laboratory for the analysis of self-collected specimens.

HIV self-tests may be a promising prevention strategy as they can lead to increased testing rates[1 3–5] and safer sex practices.[6 7] Studies report good accuracy of unsupervised HIV self-testing and high user acceptability.[1 3 4 8 9] Despite legislation that prohibits over-the-counter sold HIV tests (including HIV self-tests), HIV self-tests are easily available through the internet in the Netherlands.[10]

Unlike self-sampling, where accuracy is shown to be high,[11] few studies have evaluated the accuracy of STI self-tests other than

HIV and the limited data available report alarmingly poor results.[12][13] Also, there are concerns about the lack of linkage to counselling, treatment and care for HIV/STI self-test users who test positive[2][14] and the lack of clear information and/or instructions for self-tests that are currently available.[10][13][15] Due to these concerns, the National Institute for STI and AIDS Control in the Netherlands (STI AIDS Netherlands) currently recommends against the use of STI self-tests.[10] However, like HIV tests, STI self-tests have already been easily available through the internet, at the pharmacy and drugstore for a number of years.

Due to the anonymous nature of self-testing, the extent to which commercially sold HIV/STI self-tests are used and determinants of usage are not well known. Studies among men having sex with men (MSM) in France in 2009[16] and among attendees of a street-based HIV testing programme in Spain in 2010–2012[17] found that 0.6–0.8% of participants had ever used an HIV self-test. A study among an internet panel in the Netherlands in 2006 found that 0.1%, 0.08% and 0.03% of participants had ever used a self-test for HIV, chlamydia and syphilis, respectively.[18] In a study among online recruited MSM in China in 2013, 20% reported HIV self-test usage.[19] However, these studies were not designed to study the population-based prevalence of HIV/STI self-test usage or study trends over time. Furthermore, analyses of determinants of usage[16–18] were restricted to HIV self-test or overall self-test usage, including non-HIV/STI self-tests, for example, for diabetes or cholesterol.

To gain insight into HIV and STI (ie, chlamydia and syphilis) self-test usage in the Netherlands, we studied (temporal trends in) HIV/STI self-test usage and its determinants among the general population and high-risk groups in Amsterdam, the Netherlands.

METHODS
Study populations
Between 2007 and 2015, data regarding HIV/STI self-test usage were collected in four different studies (S1–4) in Amsterdam, the Netherlands, among the general population (S1–2) and HIV-negative high-risk groups (S3–4) (table 1)

S1: Representative sample of Amsterdam residents participating in a serial cross-sectional Health Monitoring Survey
Every 4 years, a random sample of Amsterdam residents is drawn from the municipality register and asked to participate in a representative population-based cross-sectional Health Monitoring Survey conducted by the Public Health Service of Amsterdam.[20][21] Participants complete questionnaires (paper/online) on physical, mental and sexual health. Participants unable to fill in a questionnaire on paper or online and hard to reach groups are assisted by a trained interviewer. Participation rates in the Health Monitor Survey were 50% in 2008 and 38% in 2012. Questions on HIV/STI self-tests usage were answered in the 2008 and 2012 surveys by participants aged 16–54 years and 19–64 years, respectively. To compare both waves, only participants aged between 19 and 54 years were included.

S2: Participants of the multiethnic HELIUS Study
The HEalthy LIfe in an Urban Setting (HELIUS) Study is a multiethnic population-based cohort study investigating mechanisms underlying ethnic differences in communicable and non-communicable diseases.[22] A random sample of individuals aged 18–70 years old was drawn from the municipality register of Amsterdam, stratified by ethnicity, including those of Surinamese (with African Surinamese and South-Asian Surinamese as the

Study	Study design	Study population	Period of data collection	N
S1: The Health Monitoring Survey	Serial cross-sectional	Representative sample of Amsterdam residents	2008 and 2012	Total: 6044 2008: 2547 2012: 3497
S2: The HEalthy Life in an Urban Setting (HELIUS) Study	Cohort study	Random sample of Amsterdam residents from Surinamese, Turkish, Moroccan, Ghanaian and Dutch ethnic origin	2011–2015 (baseline data)	Total: 17 603
S3: The Amsterdam Cohort Studies (ACS)	Cohort study	HIV-negative MSM	2008 and 2013	Total: 597 2008: 447 2013: 469
S4: STI Clinic HIV Survey	Serial cross-sectional	HIV-negative STI clients of the Public Health Service of Amsterdam	2007–2009 and 2012	Total: 5655 Autumn 2007: 949 Spring 2008: 935 Autumn 2008: 924 Spring 2009: 935 Autumn 2009: 911 Spring 2012: 1001

Table 1 Descriptive of the contributing studies for this manuscript

MSM, men having sex with men; STI, sexually transmitted infection

main ethnic groups), Turkish, Moroccan, Ghanaian and Dutch ethnic origin. Response rate (number participated/number invited) in the HELIUS Study was 28%. Baseline data collection took place in 2011–2015. Participants underwent a physical examination and completed a self-administered questionnaire (paper/online), including questions on sexual health and HIV/STI self-test usage. Participants unable to fill in the questionnaire themselves were assisted by an ethnically matched trained interviewer. To compare results with the results of study 1 (representative sample of Amsterdam residents), only participants aged between 19 and 54 years were included in the analyses.

S3: MSM participating in the Amsterdam Cohort Studies (ACS)

The Amsterdam Cohort Studies (ACS) among MSM started in 1984 and is an open, prospective cohort study that investigates the epidemiology, pathogenesis, risk factors and effect of interventions concerning HIV/AIDS and other bloodborne infections and STIs in the Netherlands.[23 24] Biannually, HIV-positive and HIV-negative participants complete questionnaires (paper/online) on sexual behaviour, give blood for HIV testing and storage and, since 2008, are tested for STI. HIV/STI self-test usage was measured in two waves (early 2008 and late 2013). For the present study, HIV-positive MSM were excluded (2008: n=88; 2013: n=61).

S4: STI clinic clients participating in a serial cross-sectional survey

Biannually between 1991 and 2012, approximately 1000 visitors of the Amsterdam STI outpatient clinic of the Public Health Service were asked to participate in a cross-sectional survey, initially started to measure HIV prevalence and later also other (bloodborne) infections.[25 26] Participants were interviewed using standard questionnaires which included questions about risk factors for HIV and other infections and HIV/STI test behaviour. Participants received routine STI testing and were anonymously screened for HIV and from 2007 onwards also for other infections (eg, hepatitis C virus, human papilloma virus, herpes simplex virus). Participation rate varied between 65% and 96% over the years. Data on HIV/STI self-test usage were collected in six waves: Autumn 2007, Spring 2008, Autumn 2008, Spring 2009, Autumn 2009 and Spring 2012. For the present study, HIV-positive STI clinic clients were excluded (n=408).

We included only participants with available HIV/STI self-test data. S2–4 received institutional review board approval by the medical ethics committee of the Academic Medical Center of Amsterdam (S2: project number 10/100; S3: project number 07/182; S4: project number 06/257). For S1, approval by an ethics committee or institutional review board was not necessary according to Dutch legislation on medical research involving human subjects. Detailed information about the studies can be found elsewhere.[20–26]

Variables

Sociodemographics, sexual (risk) behaviour and self-test usage

Age, ethnic origin, education level and sexual behaviour (testing behaviour, condomless intercourse, number of sexual partners, STI diagnosis) were obtained according to the individual study protocols. Non-Dutch ethnic origin was defined as being born outside the Netherlands with at least one parent who was also born outside the Netherlands (first-generation migrant) or being born in the Netherlands but with both parents born outside the Netherlands (second-generation migrant).[27] In the HELIUS Study (S2), participants' ethnicity was based on their and their parents' country of birth. Surinamese subgroups (South-Asian Surinamese, African Surinamese, Javanese Surinamese and Surinamese other/unknown) were classified according to self-reported ethnic origin. Due to small numbers, Javanese Surinamese were included in the Surinamese other/unknown group. Age was grouped into four categories (16–24 years/25–29 years/30–34 years/≥35 years). Number of (lifetime) sexual partners was categorised based on tertiles. Condomless intercourse was defined as not always or never using a condom while practising vaginal and/or anal sex with casual partners. Among STI clinic clients (S4), this variable included both steady and casual partners since partner type was not measured.

HIV/STI self-test usage was defined as having used a HIV, chlamydia and/or syphilis self-test in the preceding 6 (S3: MSM participating in the ACS) or 12 months (S1–2: the general population and S4: STI clinic clients). We focussed on HIV, chlamydia and syphilis self-tests as at the start of the study these were the main HIV/STI self-tests available through the internet and/or pharmacies. In each study, self-tests were explained to participants as home tests that they had bought (eg, through the internet, at the pharmacy and/or at a drugstore) for self-use at home.

Additionally, general HIV/STI testing behaviour in the previous 12 and 6 months, including self-testing, was measured among the general population (S1–2), respectively. As our sexual risk groups (S3–4) received HIV/STI testing at the time and location of recruitment, general HIV/STI testing behaviour was not measured in these groups.

Statistical analyses

Within each study, we described study population characteristics and prevalence of self-test usage. Prevalence of self-test usage and 95% CIs among the representative sample of Amsterdam residents (S1) were weighted by sex, age, district and in 2012 also for income, marital status, household size and ethnic origin to calculate the Amsterdam population-based prevalence of self-test usage. Time trend in HIV/STI self-test usage among the representative sample of Amsterdam residents (S1) was assessed by using X^2 tests. In S2–4, Wilson intervals[28] were used to determine 95% CIs as self-test usage prevalence was low. Time trend in HIV/STI self-test usage

among STI clinic clients (S4) was assessed by logistic regression analyses using restricted cubic splines to take the non-linear time trend into account. For all analyses among MSM participating in the ACS (S3), we performed logistic regression analyses using generalised estimating equations to correct for repeated measurements. For participants of the multiethnic HELIUS Study (S2), no time trend was assessed. Among the general population (S1–2), we additionally calculated the proportion of self-test usage among participants who reported to have had an HIV/STI test in the previous 12 and 6 months, respectively.

Using univariable and multivariable logistic regression analyses, we assessed determinants of HIV/STI self-test usage. Despite our large sample sizes, we were unable to identify determinants for HIV and STI self-test usage separately because of the small numbers of HIV/STI self-test users. Determinants in the analyses included age, ethnic origin, education level, sexual risk behaviour and calendar year of data collection. For univariable and multivariable analyses, among the representative sample of Amsterdam residents (S1), no weighting was used. Determinants of self-test usage among participants of the multiethnic HELIUS Study (S2) were only assessed among those aged 18–34 years, because questions on sexual risk behaviour were optional for participants aged 35 years or older. Variables with a p value <0.10 in univariable analyses were included in the final multivariable models. We checked for interactions between the independent variables in the final models.

A p value of <0.05 level was considered statistically significant. Analyses were performed using STATA Intercooled 13.1 (STATA Corporation, College Station, Texas, USA) and SPSS V.21 (SPSS, Chicago, USA).

RESULTS
Characteristics
In total, 29 899 individuals were included in this study: 6044 inhabitants of Amsterdam (S1), 17 603 participants of the multiethnic HELIUS Study (S2), 597 MSM participating in the ACS (S3) and 5655 STI clinic clients (S4) (table 1).

Of 6044 inhabitants of Amsterdam participating in the Health Monitoring Survey (S1), 2547 participated in 2008 and 3497 in 2012. Participants had a median age of 35 years (IQR: 28–45), 60% (3621/6044) were women, 77% (4660/6044) had a college degree or higher, 58% (3486/6044) were of Dutch origin and 21% (1288/6044) had been tested for HIV and/or STI in the previous 12 months.

Of 17 603 participants of the multiethnic HELIUS Study (S2), the median age was 40 years (IQR: 30–48), 59% (10 339/17 603) were women, 27% (4822/17 603) had a college degree or higher and 10% (1794/17 603) were tested for HIV and/or STI in the previous 6 months. Seventeen per cent (3051/17 603) were of Dutch origin, 13% (2353/17 603) of South-Asian Surinamese,

16% (2875/17 603) of African Surinamese, 2.0% (352/17 603) of other or unknown Surinamese origin, 20% (3470/17 603) of Turkish, 20% (3566/17 603) of Moroccan and 11% (1905/17 603) of Ghanaian origin.

Of 597 MSM participating in the ACS (S3), 447 participated in early 2008 and 469 participated in late 2013 (319 MSM participated in both waves). Participants had a median age of 38 years (IQR: 33–43), 91% (543/597) had a college degree or higher and 79% (469/597) were of Dutch origin.

Of 5655 STI clinic clients participating in the cross-sectional survey STI Clinic HIV Survey (S4), 949 participated in Autumn 2007, 935 in Spring 2008, 924 in Autumn 2008, 935 in Spring 2009, 911 in Autumn 2009 and 1001 in Spring 2012. Participants had a median age of 26 years (IQR: 22–34), 46% (2571/5655) were women, 50% (2852/5655) had a college degree or higher, 57% (3199/5655) were of Dutch origin and 13% (762/5655) were diagnosed with an STI at their visit.

Prevalence of HIV/STI self-test usage
Among the representative sample of Amsterdam residents (S1; table 2), HIV/STI self-test usage in the preceding 12 months increased from 0.9% (22/2547; 95% CI: 0.6% to 1.4%) in 2008 to 1.3% (57/3497; 95% CI: 1.0% to 1.8%) in 2012, respectively (p<0.001). This increase was primarily due to increases in chlamydia (2008: 0.7%, 2012: 1.2%, p<0.001) and syphilis self-test usage (2008: 0.1%, 2012: 0.4%, p<0.001). Among those who were tested for HIV/STIs in the preceding 12 months, 5.4% (70/1288; 95% CI: 4.3% to 6.8%) used a self-test. This proportion significantly increased over time (2008: 3.7%, 2012: 6.8%, p=0.014) and was higher among those of non-Dutch ethnicity, although borderline significant (Dutch: 4.4%, non-Dutch: 6.9%, p=0.056).

Among participants of the multiethnic HELIUS Study (S2), 1.4% (245/17 603; 95% CI: 1.2% to 1.6%) used an HIV/STI self-test in the preceding 12 months. Among those tested for HIV/STIs in the preceding 6 months, 8.8% (158/1794; 95% CI: 7.6% to 10%) used a self-test. The latter was significantly different between ethnic groups (Surinamese other/unknown 13%, South-Asian Surinamese 12%, African Surinamese 12%, Dutch 8.4%, Ghanaian 5.6%, Moroccan 5.0% and Turkish 4.6%, p=0.001).

Among MSM participating in the ACS (S3), HIV/STI self-test usage in the preceding 6 months remained stable over time, 1.1% (5/447; 95% CI: 0.5% to 2.6%) in 2008 and 1.3% (6/469; 95% CI: 0.6% to 2.8%) in 2013 (p=0.824).

Among STI clinic clients (S4), HIV/STI self-test usage in the preceding 12 months increased from 0.8% (8/949; 95% CI: 0.4% to 1.7%) in 2007 to 2.1% (21/1001; 95% CI: 1.4% to 3.2%) in 2012 (p<0.001). This increase was primarily due to an increase in chlamydia self-test usage (2007: 0.1%, 2012: 1.8%, p<0.001).

Table 2 Usage of self-tests for HIV and sexually transmitted infections (STIs) in the preceding 6 (study 3) or 12 months (studies 1, 2 and 4) among the general population and sexual risk groups in Amsterdam, the Netherlands, 2007–2015

Study	Survey period	Overall HIV/STI self-test usage*				Chlamydia self-test usage				Syphilis self-test usage				HIV self-test usage			
		n/N	%	(95% CI)	Change over time	n/N	%	(95% CI)	Change over time	n/N	%	(95% CI)	Change over time	n/N	%	(95% CI)	Change over time
General population																	
Study 1: Representative sample of Amsterdam residents (n=6044)†																	
	2008	22/2547	0.90	(0.57 to 1.41)		17/2547	0.69	(0.42 to 1.15)		4/2547	0.14	(0.05 to 0.38)		7/2547	0.28	(0.12 to 0.64)	
	2012	57/3497	1.30	(0.95 to 1.77)		55/3497	1.20	(0.88 to 1.65)		14/3497	0.35	(0.18 to 0.65)		13/3497	0.27	(0.14 to 0.52)	
					p<0.001				p<0.001				p<0.001				p=0.522
Study 2: Participants of the multiethnic HEalthy LIfe in an Urban Setting (HELIUS) Study (n=17 603)																	
	2011–2015	245/17 603	1.39	(1.22 to 1.58)		219/17 603	1.24	(1.09 to 1.42)		48/17 603	0.27	(0.21 to 0.36)		66/17 603	0.37	(0.29% to 0.48)	
					NA				NA				NA				NA
Sexual risk groups																	
Study 3: MSM participating in the Amsterdam Cohort Studies (n=447 in 2008/n=469 in 2013)																	
	2008	5/447	1.12	(0.48 to 2.59)		1/447	0.22	(0.04 to 1.26)		3/447	0.67	(0.23 to 1.95)		2/447	0.45	(0.12 to 1.62)	
	2013	6/469	1.28	(0.59 to 2.76)		1/469	0.21	(0.04 to 1.20)		1/469	0.21	(0.04 to 1.20)		4/469	0.85	(0.33 to 2.17)	
					p=0.824				p=0.971				p=0.319				p=0.455
Study 4: STI clinic clients (n=5655)																	
	2007 Autumn	8/949	0.84	(0.43 to 1.65)		1/949	0.11	(0.02 to 0.60)		2/949	0.21	(0.06 to 0.77)		7/949	0.74	(0.36 to 1.51)	
	2008 Spring	10/935	1.07	(0.58 to 1.96)		3/935	0.32	(0.11 to 0.94)		1/935	0.11	(0.02 to 0.60)		6/935	0.64	(0.29 to 1.39)	
	Autumn	15/924	1.62	(0.99 to 2.66)		9/924	0.97	(0.51 to 1.84)		1/924	0.11	(0.02 to 0.61)		6/924	0.65	(0.30 to 1.41)	
	2009 Spring	17/935	1.82	(1.14 to 2.89)		13/935	1.39	(0.81 to 2.36)		0/935	0.00	(0.00 to 0.41)		4/935	0.43	(0.17 to 1.09)	
	Autumn	34/911	3.73	(2.68 to 5.17)		29/911	3.18	(2.23 to 4.53)		2/911	0.22	(0.06 to 0.80)		6/911	0.66	(0.30 to 1.43)	
	2012 Spring	21/1001	2.10	(1.38 to 3.19)		18/1001	1.80	(1.14 to 2.82)		0/1001	0.00	(0.00 to 0.38)		3/1001	0.30	(0.10 to 0.88)	
					p<0.001				p<0.001				p=0.802				p=0.723

*Total numbers of individual tests can exceed total number of overall HIV/STI self-test usage because some individuals used more than one self-test.
†Prevalence of self-test usage and 95% CIs among inhabitants of Amsterdam (study 1) were weighted by sex, age, district and in 2012 also for income, marital status, household size and country of origin to calculate the Amsterdam population-based prevalence of self-test usage in 2008 and 2012.
MSM, men having sex with men; NA, not applicable.

Table 3 Determinants associated with the usage of self-tests for HIV and sexually transmitted infections (STIs) in the previous 12 months among a representative sample of Amsterdam residents, 2008 and 2012, the Netherlands

	HIV/STI self-test usage			Univariable analyses		Multivariable analyses	
	n	N	%	OR (95% CI)	p Value	aOR (95% CI)	p Value
Age (years)							
19–24	11	802	1.37	1	0.001	1	0.013
25–29	21	950	2.21	1.63 (0.78 to 3.39)		1.81 (0.85 to 3.89)	
30–34	23	1101	2.09	1.53 (0.74 to 3.17)		2.14 (1.01 to 4.55)	
≥35	24	3191	0.75	0.55 (0.27 to 1.12)		0.84 (0.39 to 1.84)	
Sexual orientation							
Heterosexual men	15	2115	0.71	1	0.004	1	0.001
MSM	7	249	2.81	4.05 (1.64 to 10.03)		3.43 (1.24 to 9.48)	
Women	57	3621	1.57	2.24 (1.27 to 3.96)		3.63 (1.83 to 7.21)	
Missing	0	59	0.00				
Education level							
No college degree	16	1290	1.24	1	0.801		
At least college degree	62	4660	1.33	1.07 (0.62 to 1.87)			
Missing	1	94	1.06				
Ethnic origin							
Dutch	40	3486	1.15	1	0.204		
Non-Dutch	39	2558	1.52	1.33 (0.86 to 2.08)			
Condomless intercourse with casual partner in the previous 12 months							
No	49	5273	0.93	1	<0.001	1	0.934
Yes	24	546	4.40	4.90 (2.98 to 8.05)		1.03 (0.50 to 2.13)	
Missing	6	225	2.67				
Number of partners in the previous 12 months							
0	7	967	0.72	1	<0.001	1	<0.001
1	30	4090	0.73	1.01 (0.44 to 2.31)		0.86 (0.37 to 1.97)	
≥2	35	747	4.69	6.74 (2.98 to 15.27)		5.77 (2.15 to 15.46)	
Missing	7	240	2.92				
Survey period*							
2008	22	2547	0.86	1	0.011	1	0.031
2012	57	3497	1.63	1.17 (1.04 to 1.33)		1.16 (1.01 to 1.32)	

*The calculated prevalence and 95% CI were calculated based on unweighted numbers and therefore differ from the estimated presented in table 2.
(a)OR, (adjusted) OR; MSM, men having sex with men

Overall, chlamydia self-tests were most used, except among MSM participating in the ACS where HIV self-tests were most used.

Determinants of HIV/STI self-test usage

In multivariable analyses among the representative sample of Amsterdam residents (S1; table 3), only participants aged between 30 and 34 years (adjusted OR (aOR) 2.14 (95% CI: 1.01 to 4.55)) were significantly more likely to have used self-tests compared with those aged between 19 and 24 years, whereas the aOR was 1.81 (95% CI: 0.85 to 3.89) and 0.84 (95% CI: 0.39 to 1.84) for those aged between 25–29 years and ≥35 years, respectively (overall p value 0.013). Also, MSM (aOR 3.43 (95% CI: 1.24 to

9.48)) and women (aOR 3.63 (95% CI: 1.83 to 7.21)) were more likely to have used self-tests compared with heterosexual men. Those reporting one or more sexual partners in the preceding 12 months (one partner: aOR 0.86 (95% CI: 0.37 to 1.97); >2 partners: aOR 5.77 (95% CI: 2.15 to 15.46)) were more likely to have used self-tests compared with participants reporting no partners. As described above, self-test usage was higher in 2012 compared with 2008 (aOR 1.16 (95% CI: 1.01 to 1.32)).

Among participants of the multiethnic HELIUS Study (S2; table 4), participants aged between 30 and 34 years (aOR 0.59 (95% CI: 0.39 to 0.90)) were less likely to have used self-tests compared with participants aged 19–24

Table 4 Determinants associated with the usage of self-tests for HIV and sexually transmitted infections (STIs) in the previous 12 months among participants of the multiethnic HEalthy LIfe in an Urban Setting (HELIUS) Study between 2011 and 2015, Amsterdam, the Netherlands

	HIV/STI self-test usage			Univariable analyses		Multivariable analyses	
	n	N	%	OR (95% CI)	p Value	aOR (95% CI)	p Value
Age (years)							
19–24	65	2259	2.88	1	0.064	1	0.032
25–29	71	2028	3.50	1.22 (0.87 to 1.72)		0.91 (0.63 to 1.32)	
30–34	47	2072	2.27	0.78 (0.54 to 1.15)		0.59 (0.39 to 0.90)	
Gender							
Men	70	2602	2.69	1	0.457		
Women	113	3757	3.01	1.12 (0.83 to 1.52)			
Education level							
No college degree	123	4119	2.99	1	0.462		
At least college degree	59	2216	2.66	0.89 (0.65 to 1.22)			
Missing	1	26	4.17				
Ethnic origin							
Dutch	42	1184	3.55	1	<0.001	1	<0.001
South-Asian Surinamese	25	832	3.00	0.84 (0.51 to 1.39)		1.29 (0.77 to 2.17)	
African Surinamese	69	822	8.39	2.49 (1.68 to 3.70)		2.54 (1.69 to 3.82)	
Other/unknown Surinamese	5	100	5.00	1.43 (0.55 to 3.70)		1.77 (0.68 to 4.64)	
Ghanaian	19	438	4.34	1.23 (0.71 to 2.14)		1.89 (1.04 to 3.44)	
Turkish	11	1375	0.80	0.22 (0.11 to 0.43)		0.52 (0.26 to 1.03)	
Moroccan	12	1592	0.75	0.21 (0.11 to 0.39)		0.44 (0.22 to 0.89)	
Missing	0	16	0.00				
Migration status							
NA (Dutch)	42	1184	3.55	1	0.313		
First-generation migrant	46	1671	2.75	0.77 (0.50 to 1.18)			
Second-generation migrant	95	3504	2.71	0.76 (0.52 to 1.10)			
Number of lifetime sexual partners							
0–1	18	2887	0.62	1	<0.001	1	<0.001
2–5	57	1433	3.98	6.60 (3.87 to 11.26)		4.11 (2.33 to 7.23)	
>5	105	1842	5.70	9.63 (5.82 to 15.94)		5.65 (3.22 to 9.93)	
Missing	3	197	1.52				
Condomless intercourse with casual partners in the preceding 6 months							
No	140	5617	2.50	1	<0.001	1	0.073
Yes	37	513	7.20	2.99 (2.05 to 4.37)		1.45 (0.97 to 2.18)	
Missing	10	409	2.40				

(a)OR, (adjusted) OR; NA, not applicable

years, whereas the aOR was 0.91 (95% CI: 0.63 to 1.32) for those aged between 25 and 29 years (overall p value 0.032). African Surinamese (aOR 2.54 (95% CI: 1.69 to 3.82)) and Ghanaian participants (aOR 1.89 (95% CI: 1.04 to 3.44)) were more likely to have used self-tests compared with Dutch participants, whereas Moroccan participants (aOR 0.44 (95% CI: 0.22 to 0.89)) were less likely to have used self-tests (overall p value <0.001). Also, those reporting ≥2 lifetime sexual partners (2–5 partners: aOR 4.11 (95% CI: 2.33 to 7.23); >5 partners: aOR 5.65

(95% CI: 3.22 to 9.93)) were more likely to have used self-tests compared with participants reporting <2 sexual partners.

Among MSM participating in the ACS (S3; table 5), those reporting 3–8 casual partners in the preceding 6 months (unadjusted OR 9.86 (95% CI: 1.21 to 80.55)) were more likely to have used self-tests compared with participants reporting <3 casual partners, whereas the OR 1.32 (95% CI: 0.08 to 21.18) was for those reporting >8 casual partners (overall p value 0.028).

Table 5 Determinants associated with the usage of self-tests for HIV and sexually transmitted infections (STIs) in the previous 6 months among HIV-negative men having sex with men participating in the Amsterdam Cohort Studies in 2008 and 2013, Amsterdam, the Netherlands

	HIV/STI self-test usage			Univariable analyses	
	n	N	%	OR (95% CI)	p Value
Age (years)					
18–29	3	124	2.42	1	0.334
30–34	3	198	1.52	0.62 (0.12 to 3.14)	
≥35	5	194	2.58	0.34 (0.08 to 1.45)	
Education level					
No college degree	2	93	2.15	1	0.384
At least college degree	9	823	1.09	0.5 (0.11 to 2.36)	
Ethnic origin					
Dutch	9	731	1.23	1	0.821
Non-Dutch	2	136	1.47	1.20 (0.26 to 5.59)	
Missing	0	49	0.00		
Number of sexual partners in the previous 6 months					
0–2	1	672	0.15	1	<0.001
3–8	7	206	3.40	6.60 (3.87 to 11.26)	
>8	1	38	2.63	9.63 (5.82 to 15.94)	
Missing	2	916	0.22		
Condomless intercourse with casual partners in the preceding 6 months					
No	6	672	0.89	1	0.028
Yes	4	206	1.94	9.86 (1.21 to 80.55)	
Missing	1	38	2.63	1.32 (0.08 to 21.18)	
Survey period					
2008	5	447	1.12	1	0.824
2013	6	469	1.28	1.03 (0.81 to 1.31)	

Among STI clinic clients (S4; table 6), MSM (unadjusted OR 2.37 (95% CI: 1.31 to 4.29)) and women (unadjusted OR 2.32 (95% CI: 1.39 to 3.86)) were more likely to have used self-tests compared with heterosexual men. In multivariable analyses among STI clinic clients, a statistically significant interaction between sexual orientation and calendar period was found (p=0.032). Self-test usage significantly increased over time among women (2007: 0.4%, 2012: 3.1%, p<0.001), whereas the increase among heterosexual men and decrease among MSM were not statistically significant.

DISCUSSION

This study shows that the prevalence of HIV/STI self-test usage in the preceding 6–12 months among both the general population and high-risk groups in Amsterdam, the Netherlands, is relatively low (1–2%). However, chlamydia and syphilis self-test usage increased over time among a representative sample of Amsterdam residents (S1) and chlamydia self-test usage increased over time among STI clinic clients (S4).

The overall low HIV/STI self-test usage among the general population and sexual risk groups is in line with findings from other European studies on HIV self-testing (France; Spain)[16 17] and on HIV/STI self-testing (the Netherlands).[18] However, in a study from China, 20% of MSM reported prior HIV self-testing.[19] The difference between Europe and China on HIV self-test usage can be explained by legal restrictions on selling HIV self-tests. In China, HIV self-test can be legally sold, whereas in France, Spain and the Netherlands, there were legal restrictions on HIV self-tests at the time the studies were conducted. In France, HIV self-tests became legally available in 2015, after the study on HIV self-test usage was conducted.[1]

Although we found an overall low HIV/STI self-test usage in the general population, 5–9% of the individuals who tested for HIV/STI in the preceding 6 or 12 months used a self-test. This finding indicates that although self-testing is currently not recommended by the National Institute for STI and AIDS control in the Netherlands (STI AIDS Netherlands),[10] a substantial proportion opt for self-testing as their method of testing. Furthermore, our study shows HIV/STI self-test usage was higher among

Table 6 Determinants associated with the usage of self-tests for HIV and sexually transmitted infections (STIs) in the previous 12 months among clients of the STIs clinic of the Public Health Service Amsterdam, the Netherlands (2007–2012)

HIV/STI self-test usage — Univariable analyses

	n	N	%	OR (95% CI)	p Value
Age (years)					
16–24	41	2192	1.87	1	0.527
25–29	30	1331	2.25	1.21 (0.75 to 1.95)	
30–34	10	727	1.38	0.73 (0.37 to 1.47)	
≥35	24	1405	1.71	0.91 (0.55 to 1.52)	
Sexual orientation					
Heterosexual men	20	1994	1.00	1	0.003
MSM	25	1065	2.35	2.37 (1.31 to 4.29)	
Women	59	2571	2.29	2.32 (1.39 to 3.86)	
Missing	1	25	4.00		
Survey period					
2007	8	949	0.84	1	0.001
2008	25	1859	1.34	1.60 (0.72 to 3.57)	
2009	51	1846	2.76	3.34 (1.58 to 7.07)	
2012	21	1001	2.10	2.52 (1.11 to 5.72)	
Education level					
No college degree	26	1786	1.46	1	0.177
At least college degree	57	2852	2.00	1.38 (0.87 to 2.20)	
Missing	22	1017	2.16		
Ethnic origin					
Dutch	67	3199	2.09	1	0.255
First-generation migrant	15	1106	1.36	0.64 (0.37 to 1.13)	
Second-generation migrant	21	1259	1.67	0.79 (0.48 to 1.30)	
Missing	2	91	2.20		
Condomless intercourse in the preceding 6months (vaginal or anal)					
No condomless intercourse	13	974	1.33	1	0.215
Condomless intercourse	71	3671	1.93	1.46 (0.80 to 2.65)	
Missing	21	1010	2.08		
Number of lifetime sexual partners					
0–8	35	1944	1.80	1	0.297

HIV/STI self-test usage — Multivariable analyses

Sexual orientation * Survey period

	n	N	%	OR (95% CI)	p Value
Heterosexual men					
2007	2	358	0.56	1	0.536
2008	5	664	0.75	1.35 (0.26 to 7.00)	
2009	9	648	1.39	2.51 (0.54 to 11.67)	
2012	4	324	1.23	2.23 (0.41 to 12.23)	
MSM					
2007	4	140	2.86	1	0.553
2008	10	337	2.97	1.04 (0.32 to 3.37)	
2009	9	391	2.30	0.80 (0.24 to 2.64)	
2012	2	197	1.02	0.35 (0.06 to 1.93)	
Women					
2007	2	451	0.44	1	<0.001
2008	10	858	1.17	2.65 (0.58 to 12.14)	
2009	33	807	4.09	9.57 (2.29 to 40.08)	
2012	14	455	3.08	7.13 (1.61 to 31.54)	

Continued

Table 6 Continued

	HIV/STI self-test usage Univariable analyses					HIV/STI self-test usage Multivariable analyses				
	n	N	%	OR (95% CI)	p Value	n	N	%	OR (95% CI)	p Value
9–20	29	1873	1.55	0.86 (0.52 to 1.41)						
≥21	41	1835	2.23	1.25 (0.79 to 1.97)						
Missing	0	3	0.00							
STI diagnosis at visit (chlamydia/syphilis/gonorrhoea/HIV)										
No STI	91	4840	1.8	1	0.741					
STI	13	762	1.71	0.91 (0.50 to 1.63)						
Missing	1	53	1.89							

MSM, men having sex with men

women and MSM compared with heterosexual men in the representative sample of Amsterdam residents and among STI clinic clients. These results are consistent with results that women and MSM are in general more likely to test for HIV and STI compared with heterosexual men.[20] Heterosexual men might perceive themselves at lower risk for HIV/STI than women and MSM and therefore less often test for HIV/STI. It might also be that heterosexual men experience greater barriers to test for HIV/STI. Among the general population and MSM participating in the ACS, also a higher number of sexual partners were associated with higher self-test usage, suggesting self-tests might be used by individuals at higher risk of HIV/STI and therefore may be reaching the relevant populations.[29] Among participants of the multiethnic HELIUS Study, we found that individuals of African Surinamese or Ghanaian origin were more likely to use self-tests. In addition, among HELIUS Study participants who have tested for HIV/STI in the preceding 12 months, individuals of Surinamese origin (all subgroups: South-Asian, African and other/unknown Suriname origin) more often opted for the use of a self-test compared with other ethnic groups. It might be that individuals of Surinamese or Ghanaian origin more often experience barriers to test at regular facilities than the other groups and therefore more often opt for self-testing. This might suggest that self-testing could increase HIV/STI test uptake among these groups, but this should be further explored in future studies. Also, it might be that individuals of Surinamese or Ghanaian origin are more aware of the availability of HIV/STI self-tests. This association between self-testing and ethnic origin was not found among the representative sample of Amsterdam residents (S1) and our sexual risk groups (S3–4). This is most likely because in these studies we grouped all non-Dutch origin ethnicities together because of small numbers.

Although we found an association between age and self-test usage in the two studies among the general population, this association was not found among the sexual risk groups. However, the results with regard to age and self-testing among the representative sample of Amsterdam residents and among the participants of the multiethnic HELIUS Study were inconsistent.

The low HIV/STI self-test usage among our high-risk groups can be explained by our data sources, since we included individuals who attended the Public Health Service's HIV/STI testing facilities and MSM participating in the ACS who were offered structural biannual HIV/STI testing. These individuals may have overcome testing barriers related to these facilities and therefore be less likely to opt for self-testing.

Our study shows that in recent years chlamydia self-tests are most commonly used in all study groups except for MSM participating in the ACS. This could be due to higher self-perceived risk of chlamydia; one of the most prevalent and well-known STIs among heterosexuals.[29] Furthermore, we found that increases in chlamydia self-test usage are primarily responsible for the observed

overall increases of HIV/STI self-test usage among Amsterdam inhabitants and STI clinic clients. Our data cannot ascertain whether increased availability of chlamydia self-tests led to their increased usage. However, an increase in awareness of chlamydia self-testing is another plausible explanation, especially considering a chlamydia screening implementation programme that was conducted between 2008 and 2010, in which all 16-year-old to 29-year-old residents in Amsterdam and other cities were informed about chlamydia and invited to apply for a free self-sampling test kit.[30 31] Although the participation rate in this screening programme was low (16%)[30 31] and self-sampling tests differ from self-tests, this may have increased general awareness about availability of self-tests and therefore explain the peak of self-test usage seen in 2009 among STI clinic clients.

HIV self-testing may be a valuable (additional) strategy to reach risk groups for testing, as highly accurate self-tests are available and acceptability is high among key groups.[1 9 32] Some countries, for example, France, UK and USA have already approved an HIV self-test for sale.[1 33 34] The Netherlands has not authorised HIV self-tests for sale, but from 2014 to 2015 HIV self-tests were offered in combination with online counselling in a pilot study targeting MSM and migrants from HIV endemic countries.[35] Preliminary results of this pilot study and other studies show that a large proportion of HIV self-test users have never or not recently been tested for HIV.[3 16 35] This suggests HIV self-testing programmes can be of additional value to increase testing rates among individuals not reached at regular testing facilities. However, this might only be true for individuals who are aware of their HIV risk. Additional interventions are needed to promote HIV testing among those individuals at risk for an HIV infection who are unaware of their risk.[36] Also, it is important when implementing HIV self-testing programmes that highly accurate HIV self-tests and counselling and linkage to care are offered.[1 37]

For STIs other than HIV, the accuracy of currently available self-tests is less clear. Previous studies have shown that the accuracy of chlamydia self-tests is low and tests have been sold without proper instructions and information.[10 12 13] The observed increase in chlamydia self-test usage is concerning. Therefore, it is important to gain insight into the accuracy of currently available STI self-tests. Furthermore, it is important to continue monitoring self-test usage and informing the public about the unknown accuracy and the pros and cons of self-testing.

The strengths of this study are the large sample size and that we were able to assess HIV/STI self-test usage in both the general population and sexual risk groups. However, some limitations need to be addressed. First, the results are limited to the population of Amsterdam, an urban population with nearby access to a free-of-cost HIV/STI testing service for HIV/STI risk groups at the Public Health Service, and therefore less generalisable to other, for example, more rural settings. Second, individuals participating in health-related research might not be representative of the general population. However, we were able to calculate population-based estimates by applying weighting among the sample of Amsterdam inhabitants (S1) and were able to estimate self-test usage among a multiethnic population in Amsterdam (S2), a group that is often under-represented in health-related research. Third, we were unable to identify determinants for HIV, chlamydia and syphilis self-test usage separately due to small numbers. Determinants may differ across different STIs, for example, MSM might be more likely to use HIV self-tests, whereas women might be more likely to use chlamydia self-tests. Fourth, we only focussed on HIV, chlamydia and syphilis self-tests. Currently, other STI self-tests are available (eg, gonorrhoea self-test). Although this study gives an indication of the overall self-test usage, future studies should include other self-tests available.

In conclusion, overall HIV/STI self-test usage in Amsterdam, the Netherlands, is relatively low. However, chlamydia and syphilis self-test usage increased over time among the representative sample of Amsterdam residents and chlamydia self-test usage increased over time among STI clinic clients. Furthermore, a substantial proportion of persons in the general population who had been tested for HIV/STI reported the use of a self-test and we found higher self-test usage among participants of Surinamese or Ghanaian origin. It is important to continue monitoring self-test usage and informing the public about the unknown quality of current self-tests available and regarding pros and cons of self-testing. Also, motives for self-test usage among different ethnic groups should be further explored in future studies. Self-testing programmes can be a valuable additional strategy for public health professionals to address the needs of certain risk groups and increase testing rates, and the higher HIV/STI self-test usage among those at higher risk for HIV/STI in the general population suggests that self-test programmes might have an appeal to these groups. When implementing such programmes, it is however imperative that high-quality tests are used and alternative counselling (eg, online) and linkage to care are offered.

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