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Latent classes of sexual risk and corresponding STI and HIV positivity among MSM attending centres for sexual health in the Netherlands

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ABSTRACT

Objectives Continuing high STI positivity among men who have sex with men (MSM) attending centres for sexual health (CSH) indicates that high-risk behaviour is ongoing. The objective of this study was to gain a better insight into risk behaviours among MSM attending CSH and to explore STI and HIV positivity by subgroups.

Methods We used national data routinely collected during CSH consultations for this study. From September to December 2017, questions on group sex, substance use and sex with HIV-positive partners were asked at each CSH consultation. We analysed latent classes of client-related factors and sexual risk behaviour among MSM attending CSH in this period. We examined STI positivity and prevalence ratios by latent classes.

Results A total of six classes were identified in order of increasing risk: 'overall low-risk behaviour' (n=2974; 22.0%), 'Western origin and multiple sex partners' (MSP) (n=4182; 30.9%), 'Non-Western origin and MSP' (n=2496; 18.5%), 'living with HIV' (n=827; 6.1%), 'group sex and HIV-positive partners' (n=1798; 13.3%) and 'group sex and chemsex' (n=1239; 9.2%). The any STI positivity ranged from 14.0% in the overall low-risk behaviour class to 35.5% in the group sex and chemsex class. HIV positivity did not differ significantly between classes. The Western origin and MSP class was largest and accounted for the majority of STI and HIV infections.

Conclusions Although STI positivity increased with increased risky behaviours, considerable STI positivity was found in all six latent classes. Comparable HIV positivity between classes indicates risk reduction strategies among subgroups engaged in risky behaviours. The differences in risk behaviour and STI positivity require preventive strategies tailored to each subgroup.

Key messages

- We revealed six latent classes of men who have sex with men attending centres for sexual health, each with different patterns of risk and STI prevalence.
- Although high-risk subgroups presented with higher STI positivity, HIV positivity was comparable between subgroups.
- Drug use, group sex and partner number were defining factors in subgroup assessment and should be discussed during an STI consultation to tailor preventive messages.
- Considerable STI prevalence also in lower and intermediate risk behaviour subgroups indicates that tailored intervention strategies are needed.

INTRODUCTION

Men who have sex with men (MSM) are disproportionately at risk for STIs and HIV.[1] Approximately 25 000 new HIV infections were acquired in Europe in 2017, of which 40% was among MSM.[2] In addition, more than half of gonorrhoea and syphilis infections and almost all cases of lymphogranuloma venereum (LGV) were attributable to MSM.[3] In the Netherlands, STI/HIV surveillance data showed contradicting STI and HIV trends.[4] The number of new HIV infections has declined over the years, yet continuing high STI positivity among MSM attending centres for sexual health (CSH) indicates that high-risk behaviour is ongoing.

Although condom use and number of sexual partners are defining risk factors for STI/HIV transmission and acquirement,[1] risk severity is related to particular combinations of sexual behaviours.[5] HIV risk reduction strategies, such as 'serosorting' (sex with partners of the same HIV status) and 'strategic positioning' (no receptive intercourse with HIV-positive partners), are commonly reported by MSM.[6] Many professionals in the field of STI/HIV prevention and care increasingly recommend pre-exposure prophylaxis (PrEP) for high-risk MSM, since it has been shown to be highly effective in preventing HIV infection.[7] However, these strategies do not protect against other STI.[8] Behaviours that are associated with increased risk taking practices include 'chemsex' (the use of drugs in the context of sex) and group sex.[8 9] The extensive duration of chemsex encounters may result in significant mucosal trauma, facilitating STI transmission. Studies in the UK have shown that chemsex is associated with condomless anal intercourse with multiple partners of unknown or discordant HIV status.[9 10] Associations between combinations of risk behaviours and STI/HIV positivity have not been explored in the Netherlands to date.

The degree of STI risk is often determined based on single categorical variables or by summing the number of risky sexual behaviours in a score.[11–13] These types of methods limit the assessment of complex correlation between variables and therefore may ignore important relationships. Latent class analysis (LCA) is a commonly used method to derive unmeasured data-driven combinations of a set of variables.[14] An important advantage of LCA is that it helps to obtain a closer assessment of risk groups based on correlations of risky behaviours, which may guide the development of targeted preventive strategies.[5 15–17]

The primary objective of the current study is to identify risk behaviour-related subgroups of MSM attending CSH by applying an LCA approach. Second, we examined the association between the subgroups and chlamydia, gonorrhoea, infectious syphilis, LGV and HIV infection.

METHODS

Study population

We used national CSH surveillance data, which contained all consultations performed at CSH or via Testlab, an online service for requesting STI/HIV laboratory testing without seeing a CSH professional. In brief, 24 publicly funded CSH offer low-threshold free-of-charge STI/HIV care for predefined high-risk populations exclusively.[4] MSM are eligible for STI/HIV testing independent of risk behaviour. During consultations, healthcare professionals register information on demographics and STI risk factors or discuss a self-administered questionnaire. Testlab services are offered by eight CSH to MSM without STI/HIV symptoms, notification for STI/HIV exposure or an indication for HIV postexposure prophylaxis. MSM using Testlab services filled out a self-administered web-based questionnaire and attended a laboratory for testing. The CSH report a selection of routinely collected information on demographics, STI risk factors, laboratory testing and test results to the National Institute for Public Health and the Environment (RIVM) for surveillance purposes.

Registration of MSM risk behaviour data in 2017 included optional questions on having had sex with HIV-positive men, group sex and substance use before or during sex in the 6 months prior to consultation. Because of incomplete registration of these behaviours, the RIVM requested CSH to improve registration of these behaviours from September to December 2017. For the current study, we selected MSM consultations during these months. Among men who tested repeatedly, only the first consultation was selected. No ethical approval was needed since we used routinely collected, deidentified surveillance data.

STI/HIV testing procedures

According to Dutch CSH guidelines, MSM should receive rectal, urethral and oral chlamydia and gonorrhoea testing, as well as syphilis and HIV testing, independent of sexual risk behaviour.[18] LGV testing is recommended for all rectal chlamydia-positive MSM. An exception is opting-out for HIV testing. Microbiological diagnostics were carried out at local laboratories according to standard procedures.[18]

Client-related factors and (sexual) risk behaviours

We selected 11 factors and behaviours to be considered as indicators for our latent class model. Client-related factors included age (dichotomised by median), originating from or having had a partner originating from a non-Western country (no, yes), current or highest completed level of education (low/medium or high) and HIV status (positive or negative/unknown). Non-Western countries included all countries in Latin America, Africa, Eastern Europe and Asia. Origin was based on the country of birth of the client and of the client's parents according to Statistics Netherlands.[19] For partners, origin was self-reported by the client. Current HIV status was based on self-reported testing history and if previously tested, the result of the most recent test (no; yes, positive; yes, negative; yes, result unknown; unknown). Responses 'yes, result unknown' and 'unknown' were coded as unknown.

Sexual risk behaviours included having had an STI (chlamydia, gonorrhoea or infectious syphilis) in the past year (no, yes), number of partners (categorised into 0–1, 2–3, 4–9, >10 based on distribution and imprecise registration of high numbers of partners), having had sex with known HIV-positive men (no, yes, I don't know), group sex (no, yes), anal sex (no anal sex, insertive anal sex, receptive anal sex or both) and drug use before or during sex (no, yes) and, if so, the type of drugs used. We defined chemsex as the use of (a combination of) crystal methamphetamine, gamma-hydroxybutyric acid (GHB)/gamma-butyrolactone (GBL) or mephedrone.[8 9 20] A recall period of 6 months was defined for these behaviours.

Available STI risk factors that we excluded were (1) (client of) sex workers (low sample size), (2) condom use and partner type (steady or casual) of last contact (not representative for all sexual encounters in the past 6 months), (3) receptive oral sex (reported by over 90%), (4) being notified and (5) having STI/HIV symptoms (not client or behaviour related).

Statistical analysis

We modelled latent classes of MSM according to the indicators using the poLCA software package in R.[21] A series of models specifying 2–10 latent classes was tested, each with 10 random starts and a maximum of 10 000 iterations. Due to the iterative expectation-maximisation algorithm, the latent class models are able to retain records with missing values for indicator variables. This algorithm starts with arbitrary posterior probabilities (the probability that a case in a specific class reports a given response to an indicator), which are updated in the expectation step based on complete cases.[21] Next, the posterior probabilities are updated using as many observed indicators of incomplete cases. In the maximisation step, the log-likelihood function is maximised given these posterior probabilities.

We chose the model with the most optimal number of classes based on interpretability and lowest Bayesian information criterion (BIC) value. We considered the entropy of each model to measure uncertainty in class assignment, which scales from 0.0 to 1.0, with higher values indicating higher certainty of classification.[22] The smallest class was not allowed to be smaller than 5% of the population. We examined the posterior probabilities to assess whether all indicators were necessary in the model to avoid unnecessary complexity.[23] MSM were assigned to the class in which they had the highest probability of membership.

Positivity for chlamydia, gonorrhoea, infectious syphilis (primary, secondary and latent stage), LGV and HIV infection was calculated in those tested for the specific STI only. Prevalence ratios (PR) were obtained using log-binomial regression. PRs were adjusted for being notified for STI/HIV exposure (yes/no/missing) and having STI/HIV symptoms (yes/no/missing).[4] Also, we corrected for indicators that were not included in the final LCA model.

Table 1 Characteristics and sexual risk behaviour of MSM attending CSH in the Netherlands, September to December 2017

	First consultations	
	n	%
Total	13 516	100.0
Age (years)		
Median (IQR)	35 (26–47)	
Range	15–85	
Age group		
<35	6621	49.0
≥35	6895	51.0
Origin from an non-Western country*		
No	10 577	78.3
Yes	2939	21.7
Partner from a non-Western country*		
No	9402	69.6
Yes	3843	28.4
Missing	271	2.0
Educational level†		
Low/medium	3847	28.5
High	8657	64.1
Missing	1012	7.5
Current HIV status		
Negative/unknown‡	11 977	88.6
Known positive	1539	11.4
Partners, n§		
0–1	1112	8.2
2–3	3060	22.6
4–9	4808	35.6
>10	4293	31.8
Missing	243	1.8
Anal sex§		
No	1167	8.6
Yes, insertive	2572	19.0
Yes, receptive	1514	11.2
Yes, both insertive and receptive	7148	52.9
Missing	1115	8.2
CT/NG/Syphilis infection preceding year		
No	9556	70.7
Yes	3223	23.8
Missing	737	5.5
Sex with known HIV-positive men§		
No	4424	32.7
Don't know	5198	38.5
Yes	1982	14.7
Missing	1912	14.1
Group sex§		
No	8151	60.3
Yes	3324	24.6
Missing	2041	15.1
Chemsex§, ¶		
No	7491	55.4
Yes	1141	8.4
Missing	4884	36.1
Type of consultation		
Performed at CSH	11 149	82.5
Testlab services**	2367	17.5

*Non-Western countries include all countries in Latin America, Africa, Eastern Europe and Asia.
†Low/medium: no education or completion of primary school, basic vocational education, high school or secondary vocational education. High: higher vocational education or university.
‡Current HIV status based on previous self-reported question 'previously tested for HIV and corresponding result'. Responses 'yes, result unknown' and 'unknown' were coded as unknown. Current HIV status unknown for n=85.
§In the preceding 6 months.
¶Defined as the use of (a combination of) crystal meth, mephedrone or gamma-hydroxybutyric acid/gamma-butyrolactone (GHB/GBL) before or during sex.[8 9 20]
**Testlab is an online service for requesting STI/HIV laboratory testing without seeing a CSH professional.
CSH, centres for sexual health; CT, *Chlamydia trachomatis*; MSM, men who have sex with men; NG, *Neisseria gonorrhoeae*.

In sensitivity analysis, we repeated all analyses excluding records with missing data to assess if latent class distribution and associations with STIs would differ. R (V.3.5.1) was used for the LCA and proceeding steps, data cleaning was done in SAS (V.94, SAS Institute).

RESULTS

Characteristics of the study population

From September to December 2017, a total of 14 658 consultations among 13 516 unique MSM were registered (table 1), among whom the median age was 35 years (range: 15–85) and 11.4% was known HIV positive. Of all MSM, 36.2% reported four to nine partners and 32.3% reported more than 10 partners. Group sex, chemsex and having had sex with an HIV-positive partner were reported by 24.6%, 8.4% and 14.7% of all MSM, respectively. However, these behaviours, especially chemsex, were missing for a high proportion of MSM (44.7%).

LCA model fitting

Based on the lowest BIC values a model with eight classes was best fitting. Two of these classes were distinguished by age group only and thus had almost identical posterior probabilities for all other indicators. Also, posterior probabilities for age group were comparable in all other classes. Furthermore, all classes had similar posterior probabilities for educational level (ranging from 0.60 to 0.80 for a high educational level). Hence, we reran the model without age group and educational level, which resulted in a seven-class model with the lowest BIC value (BIC=152 287, entropy=0.56, smallest class=5.8%). However, two classes had similar posterior probabilities. Therefore, we considered the six-class model as most optimal based on both BIC values and posterior probabilities (BIC=152 311, entropy=0.51, smallest class=6.1%).

Table 2 shows the latent classes and posterior probabilities of the final model. MSM in class 1 (n=2974; 22.0%), 'overall low risk', had higher probabilities of lower risk behaviour, for example, a low number of partners, no anal sex or only insertive anal sex, and no group sex or chemsex. Class 2 'Western origin and multiple sex partners (MSP; n=4182; 30.9%)' and class 3 'non-Western origin and MSP (n=2496; 18.5%)' can be considered as intermediate risk subgroups, which had comparable probabilities of risk behaviours but differed in origin and having had a partner with a non-Western origin. Both classes had a higher probability of having more partners (4–9) compared with class 1 and slightly higher probabilities of other risk behaviours. Class 4, 5 and 6 can be considered as high-risk subgroups. Class 4 (n=827; 6.1%), 'living with HIV', had the highest probability of being known HIV positive, followed by class 6 (n=1239; 9.2%), 'group sex and chemsex'. Both class 5 (n=1798; 13.3%), 'group sex and HIV-positive partners' and class 6 had high probabilities of having group sex and more than 10 partners in the past 6 months. However, class 5 had a higher probability of having had sex with a known HIV-positive partner compared with class 6. Contrary, class 6 had a higher probability of not knowing the HIV status of their partner and is the only class with a high probability of having had chemsex in the past 6 months.

Association between classes and STI

Chlamydia positivity ranged from 7.1% to 15.6% and gonorrhoea positivity ranged from 6.5% to 21.7% in class 1 and class 6, respectively (table 3). Compared with chlamydia positivity, gonorrhoea positivity was slightly lower or similar in class 1–3, but higher in high-risk subgroups. Infectious syphilis positivity was higher in class 4 (5.7%) and class 6 (5.1%) compared with

Table 2 Latent classes and posterior probabilities of client-related factors and sexual risk behaviour among MSM attending CSH (n=13 516)

	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6
	Lower risk	Intermediate risk		High risk		
	Overall low risk	Western origin and MSP	Non-Western origin and MSP	Living with HIV	Group sex and HIV-positive partners	Group sex and chemsex
n	2974	4182	2496	827	1798	1239
%	22.0	30.9	18.5	6.1	13.3	9.2
Partners, n*						
0–1	0.30	0.01	0.05	0.09	0.00	0.00
2–3	0.51	0.18	0.24	0.29	0.00	0.02
4–9	0.19	0.53	0.52	0.34	0.16	0.23
>10	0.00	0.28	0.19	0.27	**0.84**	**0.75**
Anal sex						
No	0.19	0.11	0.08	0.01	0.03	0.00
Yes, insertive	0.20	0.22	0.30	0.10	0.25	0.04
Yes, receptive	0.17	0.10	0.13	0.15	0.10	0.05
Yes, both insertive and receptive	0.44	0.57	0.49	**0.73**	**0.62**	**0.91**
Origin from an non-Western country†						
No	**0.81**	**0.94**	**0.61**	0.60	**0.77**	**0.83**
Yes	0.19	0.06	0.39	0.40	0.23	0.17
Partner from a non-Western country†						
No	**0.93**	**0.96**	0.39	**0.69**	0.39	**0.69**
Yes	0.07	0.04	**0.61**	0.31	**0.61**	0.31
Current HIV status						
Negative/unknown‡	**0.97**	**0.97**	**0.99**	0.28	**0.97**	0.56
Known positive	0.03	0.03	0.01	**0.72**	0.03	0.44
CT/NG/Syphilis infection preceding year						
No	0.88	**0.83**	**0.80**	0.52	**0.69**	0.36
Yes	0.12	0.17	0.20	0.48	0.31	**0.64**
Sex with known HIV-positive men*						
No	**0.64**	0.47	0.36	0.13	0.18	0.05
Don't know	0.04	0.07	0.06	0.45	0.19	**0.76**
Yes	0.31	0.47	0.58	0.42	**0.63**	0.19
Group sex*						
No	**1.00**	**0.72**	**0.92**	**0.80**	0.31	0.10
Yes	0.00	0.28	0.08	0.20	**0.69**	**0.90**
Chemsex*§						
No	**0.99**	**0.91**	**0.96**	**0.90**	**0.82**	0.30
Yes	0.01	0.09	0.04	0.10	0.18	**0.70**

Bold values indicate posterior probabilities higher than 0.60 in each class. Posterior probabilities for an indicator variable within a class sum to 1.
*In the preceding 6 months.
†Non-Western countries include all countries in Latin America, Africa, Eastern Europe and Asia.
‡Current HIV status based on previous self-reported question 'previously tested for HIV and corresponding result'. Responses 'yes, result unknown' and 'unknown' were coded as unknown. Current HIV status unknown for n=85.
§Defined as the use of (a combination of) crystal meth, mephedrone or gamma-hydroxybutyric acid/gamma-butyrolactone (GHB/GBL) before or during sex.[8 9 20]
CSH, centres for sexual health; CT, *Chlamydia trachomatis*; MSM, men who have sex with men; MSP, multiple sex partners; NG, *Neisseria gonorrhoeae*.

other classes (range 1.5%–2.5%). Although STI positivity was highest in the high-risk subgroups, the total number of infections was highest in the intermediate risk subgroups due to group size. LGV, however, occurred mainly in class 4 (30.8%) and in class 6 (19.3%), both in positivity and in absolute number. HIV positivity was similar across classes with most infections occurring in the intermediate risk subgroups.

All classes had a significant higher adjusted PR (aPR) of chlamydia, gonorrhoea or coinfection compared with class 1 with the highest aPR in class 6 of 1.97 for chlamydia (95% CI 1.63 to 2.38, p<0.0001), 2.98 for gonorrhoea (95% CI 2.52 to 3.55, p<0.0001) and 3.64 for coinfection (95% CI 2.57 to 5.23, p<0.0001) (figure 1). The aPR of infectious syphilis was significantly higher for class 4 (2.66, 95% CI 1.7 to 3.99, p<0.0001) and class 6 (2.47, 95% CI 1.69 to 3.63, p<0.0001), but not for the other classes. Adjustment for confounding mostly affected PR of class 4 and class 6 as MSM in these classes had received partner notification or presented with STI/HIV symptoms more often compared with the other classes (online supplement table 1). We did not calculate aPRs and CIs for HIV and LGV because of low numbers.

Sensitivity analysis

In sensitivity analysis, we repeated the LCA in MSM with complete data only (n=7477). We obtained a six-class model according to similar procedures as the analysis including incomplete records. Only minor differences in posterior probabilities were observed, resulting in a slight difference in class assignment (online supplement table 2). Small differences in positivity presented, but between-class differences remained similar (results not shown).

DISCUSSION

We revealed six latent classes of MSM attending CSH in the Netherlands, each with different patterns of risk and STI

Table 3 Number of STI cases, number of MSM tested and positivity by the six latent classes of MSM attending CSH (n=13 516)*

		Class 1	Class 2	Class 3	Class 4	Class 5	Class 6
		Lower risk	Intermediate risk		High risk		
		Overall low risk	Western origin and MSP	Non-Western origin and MSP	Living with HIV	Group sex and HIV-positive partners	Group sex and chemsex
n		2974	4182	2496	827	1798	1239
%		22.0	30.9	18.5	6.1	13.3	9.2
Any STI	n/N	416/2972	816/4182	414/2495	239/826	406/1798	440/1239
	Positivity	14.0	19.5	16.6	28.9	22.6	35.5
	95% CI	(12.8 to 15.3)	(18.3 to 20.7)	(15.2 to 18.1)	(25.9 to 32.1)	(20.7 to 24.6)	(32.9 to 38.2)
Coinfection	n/N	47/2972	90/4182	57/2495	35/826	56/1798	88/1239
	Positivity	1.6	2.2	2.3	4.2	3.1	7.1
	95% CI	(1.2 to 2.1)	(1.8 to 2.6)	(1.8 to 2.9)	(3.1 to 5.8)	(2.4 to 4.0)	(5.8 to 8.7)
Chlamydia†	n/N	212/2970	392/4181	224/2489	105/825	192/1798	193/1239
	Positivity	7.1	9.4	9.0	12.7	10.7	15.6
	95% CI	(6.3 to 8.1)	(8.5 to 10.3)	(7.9 to 10.2)	(10.6 to 15.2)	(9.3 to 12.2)	(13.7 to 17.7)
Urogenital	n/N	92/2959	149/4178	88/2484	28/824	58/1792	64/1238
	Positivity	3.1	3.6	3.5	3.4	3.2	5.2
	95% CI	(2.5 to 3.8)	(3.0 to 4.2)	(2.9 to 4.3)	(2.4 to 4.9)	(2.5 to 4.2)	(4.1 to 6.5)
Anal	n/N	150/2781	275/4011	149/2407	83/819	139/1787	144/1234
	Positivity	4.3	6.5	6.2	12.0	7.8	11.7
	95% CI	(3.6 to 5.1)	(5.8 to 7.3)	(5.3 to 7.2)	(9.9 to 14.4)	(6.6 to 9.1)	(10.0 to 13.6)
Oral	n/N	17/2618	44/3678	23/2250	9/758	35/1685	22/1195
	Positivity	0.6	1.2	1.0	1.2	2.1	1.8
	95% CI	(0.4 to 1.0)	(0.9 to 1.6)	(0.7 to 1.5)	(0.6 to 2.2)	(1.5 to 2.9)	(1.2 to 2.8)
Gonorrhoea†	n/N	194/2970	405/4180	194/2489	125/826	211/1798	269/1239
	Positivity	6.5	9.7	7.8	15.1	11.7	21.7
	95% CI	(5.7 to 7.5)	(8.8 to 10.6)	(6.8 to 8.9)	(12.9 to 17.7)	(10.3 to 13.3)	(19.5 to 24.1)
Urogenital	n/N	53/2961	103/4178	66/2484	39/825	49/1795	57/1237
	Positivity	1.8	2.5	2.7	4.7	2.7	4.6
	95% CI	(1.4 to 2.3)	(2.0 to 3.0)	(2.1 to 3.4)	(3.5 to 6.4)	(2.1 to 3.6)	(3.6 to 5.9)
Anal	n/N	118/2775	262/4009	124/2407	98/820	129/1786	203/1236
	Positivity	4.3	6.5	5.2	12.0	7.2	16.4
	95% CI	(3.6 to 5.1)	(5.8 to 7.3)	(4.3 to 6.1)	(9.9 to 14.4)	(6.1 to 8.5)	(14.5 to 18.6)
Oral	n/N	104/2870	224/4122	99/2450	42/822	108/1793	126/1237
	Positivity	3.6	5.4	4.0	5.1	6.0	10.2
	95% CI	(3.0 to 4.4)	(4.8 to 6.2)	(3.3 to 4.9)	(3.8 to 6.8)	(5.0 to 7.2)	(8.6 to 12.0)
Syphilis	n/N	45/2952	87/4166	33/2488	47/821	45/1798	63/1228
	Positivity	1.5	2.1	1.3	5.7	2.5	5.1
	95% CI	(1.1 to 2.0)	(1.7 to 2.6)	(0.9 to 1.9)	(4.3 to 7.5)	(1.9 to 3.3)	(4.0 to 6.5)
HIV	n/N	15/2877	30/4068	28/2466	0/51	15/1760	6/625
	Positivity	0.5	0.7	1.1	0.0	0.9	1.0
	95% CI	(0.3 to 0.9)	(0.5 to 1.1)	(0.8 to 1.6)	(0.0 to 7.0)	(0.5 to 1.4)	(0.4 to 2.1)
LGV‡	n/N	3/130	10/253	5/140	24/78	8/135	26/135
	Positivity	2.3	4.0	3.6	30.8	5.9	19.3
	95% CI	(0.8 to 6.6)	(2.2 to 7.1)	(1.5 to 8.1)	(21.6 to 41.7)	(3.0 to 11.3)	(13.5 to 26.7)

*Positivity calculated by number of MSM with a positive test divided by the total number of MSM tested.
†Positive at any location (urogenital, anal and/or oral).
‡LGV was tested only in rectal chlamydia-positive MSM.
CSH, centres for sexual health; LGV, lymphogranuloma venereum; MSM, men who have sex with men; MSP, multiple sex partners.

occurrence. Generally, we found that STI positivity was higher and that coinfection more frequently occurred in subgroups at highest risk, ranging from a two to three times higher prevalence in the highest risk group compared with the lowest risk group. Strikingly, we did not find major differences in HIV positivity between subgroups and the majority (61.7%) of new HIV infections were attributed to two intermediate risk groups. By contrast, LGV was predominantly found in MSM living with HIV and MSM engaged in chemsex and group sex.

The strengths of our study include the large sample size and the availability of an extensive set of self-reported client-related factors and sexual risk factors complemented with microbiological outcomes. Another major strength of our study is that we could retain all records with missing data by applying LCA using the poLCA package in R, which calculates class membership based on posterior probabilities corrected for patterns among the missing data.[21] Some limitations must be noted. First, the interpretation of our results is limited to MSM attending CSH as our surveillance lacks data on STI consultations at other healthcare settings, for example, general practitioners.[4] Second, LCA is not inferential statistics, limiting the generalisability of the identified classes. Third, latent class assignment depends on the available set of indicator variables. No long-term information on risk reduction strategies such as consistent condom use was available, and we might not have assessed all risk behaviours. Last, we had insufficient power to calculate PRs for HIV and LGV.

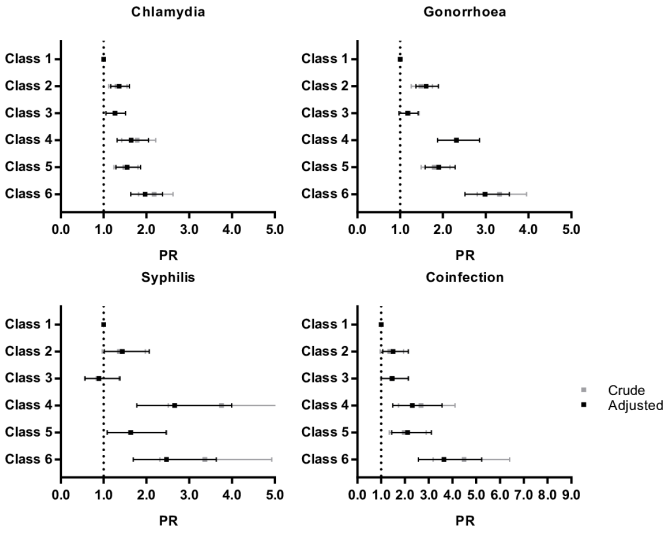

Figure 1 Prevalence ratios (PR) for chlamydia, gonorrhoea, syphilis and coinfection (having >1 STI) for each latent class, crude and adjusted for age (continuous), educational level (low/medium, high), notified for STI/HIV exposure (yes/no/missing), STI/HIV symptoms (yes/no/missing). Class 1: overall low risk, class 2: Western origin and multiple sex partners (MSP), class 3: non-Western origin and MSP, class 4: living with HIV, class 5: group sex and with HIV-positive partners, class 6: group sex and chemsex. Chlamydia and gonorrhoea; positive at any location (urogenital, anal and/or oral).

A study in the USA comparable to ours found four latent classes.[15] The low-risk group was similar to our low-risk class, with high proportions of MSM with 0 or 1 partner, no prior STIs and only HIV-negative MSM. Their largest class (48.8% of the population), with high proportions of MSM with 5–10 partners, was similar to our largest 'Western origin and MSP' subgroup. Substance use also strongly distinguished the highest risk class, as well as a high number of partners (>10). They did report differences in HIV positivity between groups, advocating focusing PrEP interventions to especially those in the highest risk group, which is not supported by our study. However, their sample size was considerably lower (n=449) which may have limited the assessment of more extensive classes.

Few other previous studies described latent classes of sexual risk among MSM, yet comparison of latent classes is limited due to the variability in settings, methods and indicator variables used.[5 16 17] However, across studies, the number of partners is consistently important in the definition of classes and correlates with inconsistent condom use and increased risk behaviour. High rates of partner change may facilitate transmission of STI, including those with a relatively shorter infectious period. For example, the symptomatic nature of urethral gonorrhoea leads to limited transmission due to timely diagnosis and treatment.[24] Our results showed increased prevalence of gonorrhoea in subgroups with high number of partners, even higher than chlamydia, which may indicate that urethral gonorrhoea infections play a larger role in transmission among these MSM.

HIV positivity has declined over the past years in the Netherlands due to rapid detection, treatment and viral supression.[4] HIV positivity was not significantly higher in high-risk subgroups, indicating that these MSM may effectively apply HIV risk reduction strategies, such as viral load sorting or PrEP usage. Another explanation may be that HIV infections in high-risk groups were more recently acquired compared with low and moderate risk groups, among whom infections might be the result of exposure and risk behaviour from more than 6 months previously. Furthermore, the majority of new HIV infections were found in the intermediate risk groups (62%), implying that HIV prevention interventions should not be limited to populations at highest risk only. Although we observed similar risk behaviour in the two intermediate risk groups, stigma and cultural beliefs among MSM with a non-Western origin could lead to increased vulnerability to HIV and less healthcare-seeking behaviour compared with MSM with a Western origin.[25] As it will be difficult to identify and reach those with HIV infection in these large intermediate risk groups, intensified partner notification for HIV is needed. In addition, new testing strategies such as community-based testing are needed to reach hard-to-reach groups such as individuals of non-Western origin.[26]

STI positivity was higher among MSM with both chemsex and group sex than among MSM with group sex and HIV-positive partners. Group sex on itself is not inherently riskier than one-on-one sex, as long as the right preventive measures are taken.[8] In addition to increased STI and HIV transmission due to use of chemsex drugs, substance misuse could severely affect general health and could result in dependency and overdose.[27 28] High-risk behaviours are difficult to change as they may also inter-relate with mental health issues, which would require more complex interventions than safe sex or risk reduction education only.[29] Continuing the collection of these behaviours during STI consultations will enable us to study behavioural changes over time in different subgroups and relate this to, for example, PrEP implementation. Also, more research is needed on the role of and differences in psychosocial determinants between subgroups and needs for care.

In conclusion, collection of information on drug use, group sex and sex with HIV-positive partners enabled us to identify six latent classes in this overall high-risk group of MSM attending CSH. The differences in risk behaviour and STI positivity between classes require preventive strategies tailored to each subgroup. Our results contribute to a better understanding of correlations of characteristics and behaviours of MSM and may be used to guide interventions.

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